



Devil Ark

Giving hope to the Tasmanian devil

John Weigel AM

When I first heard about the devil facial tumour disease (DFTD) in 2002, I had no idea how serious the epidemic would prove to be, and how it would threaten the very existence of the iconic Tasmanian devil. How could the marsupial world's number one tough-guy succumb to some punk newcomer disease? Devil numbers were estimated to be as high as 150,000 – and the fighting character of the world's largest (and most charismatic) carnivorous marsupial was legendary – providing inspiration for the popular Warner Brothers cartoon character.

But within a few short years the survival of the Tasmanian devil was far from certain. As the horrible truth about DFTD emerged, predictions of extinction were increasingly being made, while researchers frantically scrambled in search of hope. The inevitable association between the decline of Tasmanian devils with the earlier loss of the Thylacine seized the attention of the

Australian public and a range of relevant government and conservation agencies. Wildlife biologists worried about a broader and potentially catastrophic flow-on effect to come in the wake of the DFTD juggernaut. The success of feral predators in Tasmania has been hitherto suppressed by the devils through competition and perhaps predation. The predicted readjustment in numbers of feral dogs, cats and possibly foxes in the rush to fill the ecological void left by the devils could place perilous pressure upon a handful of additional marsupial species such as eastern barred bandicoot and eastern quoll, for which Tasmania has up until now provided a last-stand stronghold.

For many in the Australian zoo industry, the gloomy forecast for the wild population, combined with the simultaneous extirpation of the cause of the extinction, made the establishment of a representative insurance population a once-in-a-career priority. In 2005

my organisation – the Australian Reptile Park (ARP) – along with other members of the Zoo & Aquarium Association began working with the overarching Tasmania-based Save the Tasmanian Devil Program with the aim of providing a mainland 'insurance population' of healthy Tasmanian devils – away from the disease front. This vision of a genetically robust population of captive or semi-captive devils that could be post-apocalyptically returned to the wild was by and large accepted by all relevant government agencies and stakeholders by the end of that year. In 2006 the Reptile Park received the first insurance population devils for this combined effort following an onerous quarantine process in Tasmania to guard against the risk of shipping DFTD-infected devils. A year later we imported additional founder animals, while an equal number were received by a combination of other mainland zoos.

Above: John Weigel with rough-scale python.

A big idea

Because of the dangerous aggressiveness of Tasmanian devils towards one another when maintained in confined enclosures, traditional husbandry methods involve keeping mature individuals in separate pens for extended periods, bringing small groups together for periods of socialisation or brief periods of mating. This level of keeper interaction raises the costs. In addition to poor cost efficiency, we felt that natural behaviour was very much suppressed, suggesting the long-term risk of genetically based 'captive adaptation' – the bane of small population breeding programs that excessively interrupt natural ecology and social behaviour of a species. Although breeding success within our 'intensively' managed complex of 40 pens was highly successful, the apparent deficiencies made it unsuitable for a much-expanded project involving hundreds of devils maintained for a period of up to 50 years.

Instead, my team and I began contemplating a 'big systems' approach – one that would be as cost-effective as it would be inductive to the preservation of wild-type behaviour. By early 2007 we were talking to our zoo partners about clusters of 'free-range environmental enclosures' that would be spacious enough, and contain sufficient environmental variation – including potential den sites – to support a mixed social grouping of say, six to ten relatively unrelated devils each. In 2008 we presented the 'Devil Ark' concept at a four-day IUCN workshop in Hobart dedicated to finding a coordinated approach to saving the Tasmanian devil, where enthusiastic support was received from the participants, including most if not all relevant stakeholders such as researchers, wildlife managers, zoos and government representatives. But as often occurs with breaks from traditional thinking, the idea itself can be the relatively easy part, while effective implementation of the idea requires a whole lot more work! It took another two very busy years to overcome a seemingly endless range of practical and bureaucratic impediments before construction of Devil Ark could be reasonably contemplated.

High on the list of challenges was the daunting task of finding a suitable property. Physically, the property needed to be big enough – at least 300 ha, and of such a nature that digging many

kilometres of 600 mm deep trenching in association with escape-proof fencing was possible. Ideally, the environment would be 'Tasmania-like' in climate and character. But the overriding consideration that trumped all others was that it had to be available at a miraculously low cost. This overriding requirement certainly narrowed the range of choices! In fact, in the end there was only one choice – a heavily timbered property positioned high in the Barrington Tops of New South Wales. The 500-hectare site was generously provided by the James Packer family at the kingly rental rate of \$1 per year for a starting period of 30 years. A lucky break for an unlucky marsupial species.

Construction of 'Stage 1' of Devil Ark commenced mid-year in 2010 and was completed by the end of the year. An initial 30-hectare complex was defined by three kilometres of high-security perimeter fencing, and included within it a dozen escape-proof enclosures of varying sizes, including six breeding enclosures of approximately four hectares each. A bank of ten small (100 m²) holding pens was built to accommodate single devils on an as-needed basis. The works were conducted using contracted machine operators and fencing contractors, with all planning, direction and support labour provided by ARP.

Devils back on the ground in New South Wales – a half-millennium later

In January 2011 the completion of the first stage of the Devil Ark project was signalled by the arrival of the first 47 'founders' – a mix of wild-caught devils

post-quarantine, and strategically chosen progeny from the Australian Reptile Park's in-house breeding program – where numbers had swollen to 65 devils. The first group of founders took to their spacious Devil Ark pens with apparent zeal, and for the first time for many, began behaving like wild Tasmanian devils. This marked the first time in hundreds of years that the species had a taste of at least semi-wild existence on the Australian mainland, where it had previously been widespread and abundant. The popular belief is that mainland 'Tasmanian' devils and Thylacines were out-competed, and perhaps preyed upon by the introduced dingoes.

Initially, three breeding enclosures were stocked in configurations of six or eight mature devils in equal sex ratios. The social dynamics that unfolded in the pens were monitored nightly by infrared cameras and electronic sensing devices. By the end of the first breeding season it was apparent that properly functioning social groups had taken shape in each of the enclosures. Eight of the ten mature females produced young that first year, and all 20 resulting joeys survived through the weaning process unscathed. In fact there were no significant injuries to any devils in any of the established social groups – a very encouraging start!

In 2012 two additional breeding pens were deployed, increasing the number of reproductive-aged females in social groups to 18. Of these, 14 produced litters, yielding a total of 36 joeys. The influx of joeys and additional founders contributed to a population of 140 Tasmanian devils prior to the



Around 25 joeys are born after a 19-21 day gestation period, but only the first four that attach to the mother's teat will live, so it's survival of the fittest right from the start.



John Weigel and daughter Blanca with Prime Minister John Howard on occasion of John receiving his AM in 2008.

2013 breeding season. By August 2013, 19 of 24 mature female Tasmanian devils within the social groups were carrying 'jelly-bean' stage pouch young. It is a frustrating reality that ongoing expansion of Devil Ark can only keep pace with fundraising success.

The numbers game

Despite the best efforts of a range of researchers and wildlife managers – and a peppering of encouraging news releases of 'breakthrough' discoveries over the past decade, the spread of DFTD continues unabated. Predictions of disease resistant devils to the west were dashed when the disease demonstrated an ability to rapidly adapt to overcome all challengers. At least a dozen strains of DFTD were identifiable by 2009.

With up to 90 percent of the pre-disease population already gone, and no feasible 'silver bullet' on the horizon, increasing hope is extended to the STTDP Insurance Population Strategy. STTDP consultant research geneticist Professor Kathy Belov wrote in ABC *Science* in August 2012:

"Vaccine development takes time, and time is something the devils don't have.

The best thing we can do now is to support the captive insurance program. This program holds and breeds devils free from the disease in zoos and fauna parks - both in Tasmania and on the mainland - with the long-term goal of returning disease-free devils back into Tasmania."

Now, four years later, the insurance population now comprises of over 500 Tasmanian devils, with more than a third of these held at Devil Ark. At first blush this sounds quite positive, given that the program population geneticists are prescribing an 'effective population' of 500 devils to adequately retain the targeted level of genetic diversity over a period of up to 50 years. Unfortunately, there is a big difference between 'census population' – the actual number of Tasmanian devils held in captivity and on Tasmanian islands and (proposed) peninsulas, and the corresponding 'effective population' that they represent. Wikipedia provides a definition of effective population as "the number of individuals in an idealised population that has a value of any given population genetic quantity

that is equal to the value of that quantity in the population of interest". In principle, population geneticists assign a given small population a coefficient of effectiveness value based on the extent of influence extended to the planning and coordination of pairings to best preserve genetic variation within that population. Within the varied husbandry models currently in practice or under consideration within the Tasmanian devil insurance population, a relatively high effectiveness score is afforded to the most intensively coordinated pairings of devils (i.e. within the intensive holdings in zoos where the devil-per-pen methodology provides ultimate control over the composition of pairings). In this instance a genetic effectiveness value of 0.5 has been estimated. This means that zoo holdings of say, 200 devils would be equivalent to an effective population of 100. If not for the relatively high costs of maintaining devils in this manner, coupled with the likely drain of natural behaviours over time, this husbandry model might be an insurance population panacea.

On the other end of current and proposed small population management systems for devils, islands such as Maria Island east of Tasmania, where a high-profile release of captive-bred devils was recently undertaken, as well as 'virtual islands' such as large free-range enclosures or the proposed fenced-off peninsulas in Tasmania provide little or no scope for strategic pairings and are accordingly assigned an effectiveness value of only 0.1 – wherein the proposed sustainable population on Maria Island of 150 devils represents an effective population of only 15.

The Devil Ark model, wherein an intermediate degree of genetic coordination is provided, is regarded as having an effectiveness coefficient of 0.25, so that in effect, the current population of 180 devils presents an effective population of 45 – three times greater than the eventual potential of Maria Island at the tiniest fraction of the cost of implementation. In its three short years of operation Devil Ark has proven to be far and away the most cost-effective element of the insurance population with regards to both census population and effective population size. This cost efficiency and underlying practicality of the modular Devil Ark model – where the number of spacious pens containing eight mature devils can be adjusted upwards as needed – is a fundamentally important consideration when weighing the prospective long-term roles of the various husbandry models that are shaping up within the broader insurance population.

What price the devil?

The goal for the first stage of the Devil Ark project was to establish a cost-effective working model comprising a complex of functional social groups of devils that breed readily while retaining wild-type behaviour. This has been accomplished with resounding success, and the existing facility can accommodate an ongoing population of 180 devils at a cost of approximately \$1,300 per devil per year. This level of operational costing stands in stark contrast to the experience of other existing husbandry models, including the 'intensive' mainland facilities, which can exceed \$10,000 per devil per year.

The envisioned second stage of development for Devil Ark is to expand the complex to accommodate 360 devils by 2017. There is sufficient land at the spectacular Barrington Tops site to

expand as needed to accommodate a population of well over 1,000 Tasmanian devils (an effective population of 250) for as long a period as required. Improved operational efficiencies at this population would see the annual cost per devil reduced to an estimated \$900.

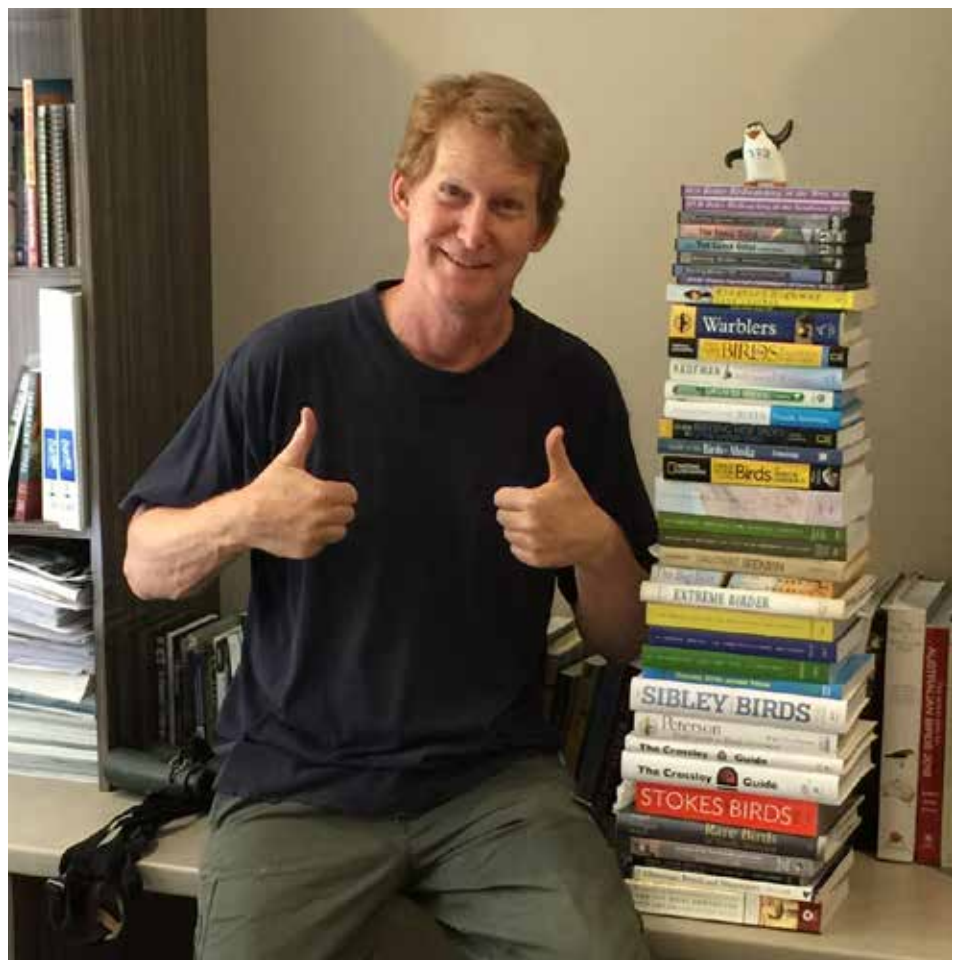
The Devil Ark team remains positive about its potential role in securing a future for the Tasmanian devil with an eventual reintroduction program after DFTD literally consumes itself to death. The new and effective system for maintaining large numbers of the cranky marsupials in modular environmental pens is working well, perhaps with scope for further improvement. The Devil Ark model is identified in the Save the Tasmanian Devil Program Meta-population Strategy review as the most appropriate format for large-scale expansion of the insurance population when required. The critical 'when required' refers to the point in time when the disease has spread to the west coast of Tasmania – an event predicted to occur within the next three to five years.

Having demonstrated scope to maintain half of the insurance population into the future in naturalistic conditions for

less than \$1 million per year, it remains an urgent imperative to find the funding required to continue building and populating Devil Ark.

I remain personally confident that the establishment of a successful insurance population is achievable, and that Devil Ark can play a linchpin role to this end. This means that even if the on-the-ground efforts to curtail the spread of DFTD fail, the overarching conservation mission to save the Tasmanian devil is refreshingly 'winnable' in comparison to the plights of many mainland species for which either habitat loss or predation by feral pests are critical factors.

Devil Ark Inc is an independent charitable organisation with tax deductible gift recipient status. Professional fundraising staff has been retained to more aptly pursue the essential resources required. A managing Board of Directors conducts the business of Devil Ark, while the Devil Ark Advisory Committee – comprised of industry representatives and experts from both the mainland and Tasmania – meets two to three times a year to steer the on-the-ground development and management of Devil Ark.



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