

Environmental Management in Tasmania: Better off Dead?

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Tasmania is Australia's island state. It has been isolated from the Australian mainland for millennia, and its biota exhibit a high degree of endemism. Tasmania was the final refuge for the world's largest marsupial carnivore, the thylacine. After tens of millennia of co-existence with the Tasmanian aborigines, the thylacine was successfully exterminated. This was the culmination of a century-long bounty program starting in 1830. The last thylacine died in captivity in 1936. From 1952 Tasmania has pioneered the widespread use of the poison sodium fluoroacetate (1080), a contaminant of which is a tumorigen, against its native marsupials. With the thylacine exterminated, the Tasmanian devil is currently the world's largest marsupial carnivore. Like the thylacine before it, Tasmania is the last refuge of the devil. The future of this endemic species is now uncertain due to the outbreak amongst many of these animals of serious tumours, dubbed Devil Facial Tumour Disease (DFTD). The European fox could theoretically step into the biological niche of top-level predator vacated by the thylacine. The Tasmanian Government has embarked on an expensive and extensive poison-baiting of the island targeting a claimed fox infestation, an infestation lacking hard evidence and one that is treated with great skepticism by many. Are these 'better-off-dead' environmental management approaches an unfortunate relic of the past, or do they really point the path to the future?

Keywords: Thylacine, Tasmanian tiger, *Thylacinus cynocephalus*, Tasmanian devil, *Sarcophilus harrisii*, Tasmania, Van Diemen's Land, fox, sodium fluoroacetate, sodium monofluoroacetate, 1080, predator.

INTRODUCTION

"My only love sprung from my only hate!
Too early seen unknown, and known too late!
Prodigious birth it is to me
That I must love a loathed enemy" (Shakespeare, 1597:34).

To be loathed too early and loved too late is a tragedy. For the thylacine, in modern-day Tasmania, it has come to this, you cannot walk out of your front door without being confronted by the thylacine. Any trip to the CBD of Tasmania's capital city, Hobart, is witness to a procession of thylacines. This endemic carnivorous marsupial, persecuted in life, once at the top of the Tasmanian food chain, has made the successful transition from loathed and living, to loved and iconic.

The thylacine has trodden the path from millennia of co-existence with humans, to European 'discovery', to colonial and state government-sponsored persecution and ultimately extermination, to the ubiquitous graphic icon that it is today, emblazoned on the forward and rear number-plates of Tasmanian-registered vehicles, and on a plethora of government, private and tourist artifacts.

In 1968, the then Premier of Tasmania, Eric Reece, proposed, that "Tasmania would probably benefit more" according to Beresford and Bailey (1981: 6) from the thylacine:

"... if it was extinct and joins such departed species as dinosaurs, moa birds, and kiwis. The now almost legendary Tasmanian Tiger has done much to create an awareness about Tasmania abroad. In recent years this elusive animal has had the same effect on anthropologists as flying saucers have had upon those who scan the skies" (Reece quoted in Beresford & Bailey, 1981: 6).

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Tasmanian environmental management practices have witnessed the thylacine despatched to the grave. Now, an image of a thylacine is the state government's symbol, presenting and projecting the quintessential Tasmania to local and visitors. Is this imagery a statement of triumphalism or tragedy?

ISLAND

The island of Tasmania first appeared on a European map of 1644 as "Anthonio Van Diemens Landt" (Jones, 1948:24). Dutchman Abel Janszoon Tasman was the first to circumnavigate Australia, and "The Tasman Map of 1644" was a tangible fruit of his achievement. The southern half of Tasmania was mapped in detail but separation from the Australian mainland remained unreported on Tasman's Map.

Tasman was more than a century ahead of subsequent visitors. Tasmania was visited at the end of the eighteenth century by French and English expeditions; the former largely with a view to scholarship, or at least that was the outcome, and the latter with a view to conquest and the expansion of empire.

Unlike the generally happy interchanges between the French and the indigenous Tasmanians (e.g. Labillardière's account in Duyker, 2003; *Le Jar du Clesmeur*, 1772), the English settlement-cum-invasion of Tasmania out of Sydney beginning in 1803 was an unhappy clash of cultures (Ryan, 2004).

The name 'Tasmania' was adopted in 1856. The island is Australia's most southerly state and is the only non-mainland state. Tasmania sits at a latitude is 42° South, a longitude of 146° East. It is 360 km from north to south and 310 km from east to west. The population is 500,000. The capital city of Hobart has a population of 210,000. Tasmania is comparable in size to Sri Lanka, and is slightly smaller than Ireland (UN, 2008). Contemporary industries are tourism, mining, agriculture and manufacturing - the world's largest catamarans are designed and manufactured in Hobart and exported to the world (Incat, 2010).

Tasmania is marketed as 'Pure Tasmania' (www.puretasmania.com) promoting the green credentials of the state, its natural beauty, its wilderness, its wildness, and its distinctive marsupial and monotreme fauna. One fifth of the state, 1.38 million hectares in the south west, is designated as the Wilderness World Heritage Area (PWS, 2008). Tasmania spawned the world's first green political party, the United Tasmania Group, in 1972 (UTG, 1972), and one of the world's earliest associations to promote organic agriculture, the Living Soil Association of Tasmania, which was founded in 1946 (Paull, 2009).

ENDEMISM

Tasmania was once connected to the Australian mainland by a 'land bridge', but rising sea level created a 200 kilometre stretch of rough water, Bass Strait, that marooned the flora, fauna, and people of Tasmania, for a period of isolation of perhaps 10,000 years. When he encountered it, Abel Tasman retreated in fear from this living museum. Montanus relates that: "From the forest he [Tasman] heard a shrill sound from singing people. He took fright and went back on board" (Montanus, 1671:18). In contrast, the French expeditions, particularly those of Marion Dufresne of 1792, Bruni d'Entrecasteaux of 1792-93, and Nicholas Baudin of 1802, recorded important early contact observations of the island and the islanders.

The first encounter was described: "One of the old Diemenlanders advanced towards them, and presented them with a torch - which is really a sign of peace for these people. Our people accepted it and presented a mirror to the old man ... after staring hard at them [the French sailors] they threw away their hatchets and began to dance. This reception made M. Marion very optimistic and he ordered a landing at once" (*Le Jar du Clesmeur*, 1771:20). This encounter was not however without cost to the Tasmanians: "one of the natives who had just expired ... had been pierced with three bullets" (*Le Jar du Clesmeur*, 1771:21). This expedition was also unaware of Bass Strait: "New Holland ... there is hardly any doubt that what is known as [Van] Diemen's Land is part of it" (*Le Jar du Clesmeur*, 1771:22).

Jacques-Julien Houtou de Labillardière was the principal naturalist on board Bruni d'Entrecasteaux's expedition. Labillardière's interest was especially in novelty, and in new species.

Endemism is the difference of place. Newcomers could not, and indeed did not, fail to recognize that here was difference. The value and significance of that difference was interpreted differently. For

Labillardière, and naturalists that followed, here was a treasure trove of novelties. Montanus (1671:22) however commented that: “Greenery would abound more if the natives did not burn the areas where they wander”, without at all appreciating the pyroculture that had been practiced by the Tasmanians for millennia as an innovative and successful environmental management strategy (Bird, Bird, Coddington, Parker, & Jones, 2008).

Félix Delahaye, a member of the d’Entrecasteaux expedition, brought a distinctive perspective - the eye and skills of a gardener. His attitude was to collect and contribute. He had embarked with “gardener’s clothes”, four cases of vegetable seeds, one case of nuts of fruit trees, and one case of gardening tools (Duyker, 2005:5). Instructions for the voyage included: “It will be good to leave in this place the seeds of all our species of vegetables that the gardener takes with him, as well as the nuts and seedlings of our fruit trees” (cited by Duyker, 2005:8).

It was with goodwill that saw Delahaye equipped for the dual tasks of contributing and collecting. Delahaye diarized that: “I sowed plants suitable for the season, which are celery, chervil, chicory, cabbages, grey romaine lettuce, different kinds of turnips, white onion, radishes, sorrel, peas, black salsify and potatoes” in a tilled plot “28 feet square” (1792:36). This was at Geographe Bay, south-eastern Tasmania. Delahaye’s account continues: “I had large quantities sown everywhere in the woods, in the more open spaces and where the soil was more friable ... I sowed mixed seeds everywhere, thrown at random, where I believed they would succeed” (1792:36).

The following year, Delahaye wrote that he: “... discovered a small garden which had been started by the English. There was an inscription on a tree stating that Captain Bligh had been there, and that he had planted 7 fruit trees in the region. We looked around and recognized all the species, and one that had died. There were two pomegranate trees, a quince tree and 3 fig trees that had started to grow. They were very small and I pruned them and tilled the ground” (1793:42). This was at Adventure Bay, Bruny Island, off the south-east coast of Tasmania; the ‘Captain Bligh’ was William Bligh of *Mutiny on the Bounty* renown.

These earliest European responses to the endemism of Van Diemen’s Land were non-destructive, to harvest and sow, to collect and contribute. With a view to utility and imagined futures, Delahaye identified a salad vegetable, a black fruit that, when cooked, produced “something like ink; it could be used as a dye” (1792:35), and observed “plains that could be cultivated and which I believe could produce very good wheat” (1792:36).

This benign approach to the endemism of Van Diemen’s Land was superseded by the settlement/invasion of the English from 1803.

TIGER

Abel Tasman (1642:13) reported that: “the footprints of certain animals observed on the ground were not unlike the paws of a tiger; they also brought on board some excrement”. An officer with Marion Dufresne’s 1772 expedition, Jean Roux (1772:42), appears to be the first European to report a tiger sighting: “We have not seen any quadrupeds other than a little tiger [*qu’un petit Tigre*] which ran away when we pursued the savages in the woods”. Another expeditioner reported that: “our people ...noticed the traces of quadrupeds in different places, some of which resembled deer and others dogs” (Le Jar du Clesmeur, 1772:21).

The thylacine, (*Thylacinus cynocephalus*), popularly known as the Tasmanian or ‘Tassie’ tiger is a marsupial and the last surviving member of the genus *Thylacinus*. Its range once extended through Tasmania, mainland Australia, and New Guinea. On all but the island of Tasmania it became extinct some thousands of years ago, perhaps due to competition from the dingo which was introduced to the Australian mainland 3,500-4000 years ago (Corbett, 2001). Tasmania had been isolated from the Australian mainland, due to rising sea level, some thousands of years prior.

Irish zoologist Eric Guiler (c.1923-2008) spent much of his professional life at the University of Tasmania. He was devoted to investigating the thylacine. He interviewed the aging cohort of thylacine trappers, and published papers (e.g. 1986) and several books on the subject (1985; 1991; 1998), but despite his strenuous efforts, all without ever sighting a living thylacine.

The dust jacket of *Thylacine: The Tragedy of the Tasmanian Tiger* (Guiler, 1985:dj) declares that: “The tragedy of the Tasmanian tiger is that no one bothered to study it properly when it was plentiful, or to investigate whether it was in fact a menace to pastoralists, and nowadays we know so little about the animal and its ecology that there is little we can do to help rehabilitate the species”. Guiler’s tone reveals that he was not convinced that the thylacine was, at that time, extinct. Driven by reported sightings and the hope that it was merely elusive, rather than extinct, Guiler mounted several search expeditions, to flush out the thylacine, but without success.

What can be said, is that the thylacine was the largest marsupial predator, the apex-predator in the Tasmanian landscape, a predator at the ‘top’ of the food-chain and without threat other than from humans. Guiler (1985) described the thylacine as a marsupial with a backward opening pouch, an average total length of 1.62 m [5ft 4in] (head and body length of 1.09 m [5ft 7 in] plus a tail length of 0.53 m [1ft 9 in]), a weight of 25 kg [55lbs], a stiff kangaroo-like tail, and 13 to 19 stripes across the back of the body, extending from the thorax onto the tail. The thylacine was nocturnal. The female, with four nipples, bore between one and four young per litter. Thylacines exhibited “an extraordinarily wide gape which could be used to seize the neck or chest of a wallaby and so crush it” (Guiler, 1985:81). According to trapper accounts: “Thylacines were very persistent runners and could lope after their prey until the animal finally collapsed with exhaustion” (Guiler, 1985:80). Guiler reported that: “I never heard the old-timers refer to the animal as anything but ‘tiger’ or ‘hyaena’, or more rarely ‘wolf’” (1985:36).

The native Tasmanians co-existed with thylacines for 50,000 years (Guiler, 1985). Plomley states that: “The thylacine, commonly known as the Tasmanian Tiger and sometimes as the Hyaena, was formerly common in Tasmania, but is now extinct. The wide distribution of the thylacine in Tasmania is shown by the spread of names for it through the tribes” (1976:312). From a variety of early sources, Plomley reported, along with multiple variations, nine distinct indigenous Tasmanian words for ‘thylacine’: cabberronenener; kannenner; kulener; larnter; longerniner; marmener; poidrerwunne; roun; and warternounnener. Guiler & Goddard (1998) reported ‘corinna’ as another Tasmanian Aboriginal name for the thylacine. None of these names appear to have gained any currency amongst the white newcomers.

Whether the Tasmanian management of thylacines over past millennia was active, passive or non-existent, the result was that Tasmania served as a safe refuge for this curiously odd and distinctive animal, until the white settlement of 1803. It was not only the thylacine that fared poorly under the new regime. The Tasmanian aboriginal population and along with it, the languages, culture and knowledge of place, were decimated by misguided or malignant government action, and, in some cases, inaction (Plomley, 1966, 1987).

What of the thylacine under the new Anglo-regime? It is reported that: “1908 was the last year of real thylacine abundance” (Guiler & Goddard, 1998:143). The Tasmanian state coat of arms appeared in 1917, the dominant graphic elements of which are two thylacines standing on their rear legs supporting a shield decorated with elements including a wheat sheaf and a sheep (Long, 1917). In 1930 the last thylacine killed in the wild was a large male shot at Mawbanna, in the north west of Tasmania by Wilf Batty. On 7 September 1936 the last known living thylacine died in Beaumaris Zoo in Hobart (Guiler, 1985). There have been numerous reported sightings since that 1936 day, but none authenticated.

The Tasmanian government, under advice from the Fauna Board, declared on 10 July 1936 the thylacine to be ‘wholly protected’; this was less than two months before the last known thylacine died. On 4 April 1937 the Fauna Board declared that no further permits were to be granted to the Zoo for the capture of thylacines (Guiler, 1985; Guiler & Goddard, 1988; Paddle, 2000). It was a triumph of the post-cautionary principle, of ‘closing the gate after the horse has bolted’; administratively the thylacine paperwork was in order, but ecologically the thylacine was stuffed, in both senses of the word. How did it come to this?

BOUNTY

Sheep were introduced to Tasmania with the 1803 white settlers. Twenty three sheep arrived at Risdon Cove (a present-day suburb of Hobart and across the Derwent River from the Hobart CBD). The population of sheep reached one million in the 1830s, and 1.9 million by 1854 (Kirkpatrick, 2007).

Despite this wonder of colonial economic growth, carried on the back of sheep, Tasmania was not then, and is not now, some agrarian or ovine utopia. Land that had been managed by the indigenous

population was appropriated as grazing land for this introduced species by an invasive class of 'land owner'. The Tasmanian aboriginal occupation, dating through tens of millennia was, it seems, invisible to this new class: "This country for the short time it has been inhabited far surpasses Sydney and in the course of a few years will be a place of consequence" (Robert Dixon, 1821, cited in Abbott & Nairn, 1969:327).

Extensive land clearance and management had been undertaken by the indigenous people, over millennia; what remained for the appropriation of these labours, and the lands themselves, was the clearance of these people from their lands. "Martial law was proclaimed, as far as regarded the Aborigines, and those engaged against them. But in conformity with the humane intentions evinced all along by Sir George Arthur towards the Blacks, certain lines of demarcation were marked out, beyond which it was not permitted to molest or injure the Aborigines" (Jorgen Jorgensen, 1830s edited writings: Plomley, 1991:96). The native Tasmanians who survived these early encounters with settlers and government were systematically removed to Flinders Island (off the north east tip of Tasmania) in 1835 where efforts to clothe, Christianize, and devalue their culture, proved mostly fatal (Plomley, 1966, 1987).

The Van Diemen's Land Company, based in London, owned extensive land holdings in the north west of Tasmania, including Woolnorth, 100,000 acres (40,500 hectares) of the north west tip of the island. The Van Diemen's Land Company introduced a bounty on the thylacine in 1830, apparently the first of such bounties. The terms were generous: "five shillings for every male hyaena, seven shillings for every female hyaena (with or without young) ... When 20 hyaenas have been destroyed the reward for the next 20 will be six shillings and eight shillings respectively and afterwards an additional shilling per head will be made after every seven killed until the reward makes 10 shillings for every male and 12 shillings for every female" (Curr, 1830, in Guiler, 1985:16).

The thylacine bounty of the Van Diemen's Land Company's persisted into the twentieth century. Although the Woolnorth data set is incomplete, the number killed peaked at 19 in 1900, declined to one in 1906, and then none until a final three thylacines were killed in 1914 (Guiler, 1985).

Other bounty schemes were instated. The name of the Buckland and Spring Bay Tiger Exterminating Association (in eastern Tasmania) left no doubt as to its mission. The Hamilton Council (central Tasmania) operated a bounty scheme. The Glamorgan Stock Protection Association (eastern Tasmania) negotiated a bounty scheme in association with the government (Guiler, 1985).

Eric Guiler sought out 'old-timer' trappers and concluded that the claims of stock predation were exaggerated. He reported that one trapper "was emphatic that many thylacines ignored sheep and would pass through a flock without paying any attention to them" (1985:18). Guiler was assured that "losses by sheep stealing were much greater than those sustained from thylacine killings" (Guiler, 1985:19). Of farmer claims of predation, Guiler (1985:20) concluded, that: "There is no doubt that sheep were killed by thylacines but these claims were grossly exaggerated and losses from other causes were inclined to be attributed to the thylacine". Freeman (2005) argues that a 1921 photograph of a thylacine bearing a chicken in its jaws, the sole photograph purporting to be of a thylacine with prey, was fabricated using a stuffed thylacine, and it thus served not to inform, but rather to demonize the thylacine.

Nevertheless, "As a direct result of the sheep losses, real or imaginary ... a petition signed by twenty-six residents of the east coast was presented to state parliament on 28 October 1884 requesting that a bounty be paid on thylacine carcasses ... the matter appeared before parliament again on 4 November 1886 when the claim of 50,000 sheep lost per annum was made. At the time the rural group was very powerful and the Lyne motion to pay £1 bounty ... was carried by twelve votes to eleven" (1985:20-21).

Putting moral, ethical and ecological considerations aside, in achieving its objective, the government's thylacine bounty scheme was an undoubted success story of island environmental management. The outcome was that an endemic species was totally and permanently exterminated, and at a modest cost of thereabouts of £2112 (2040 adults at £1, plus 144 juveniles at 10/- each). Whether the 'final straw that broke the camel's back' was, in the case of the thylacine, the size of the residual breeding population, loss of habitat, wild dog predation, human predation, or distemper (Guiler, 1985: Paddle, 2000), the government's thylacine bounty scheme had run out of customers by 1909 (Fig. 1). There are no known living thylacines in Tasmania, and there may have been none since 1936, the year that it was declared a protected species.

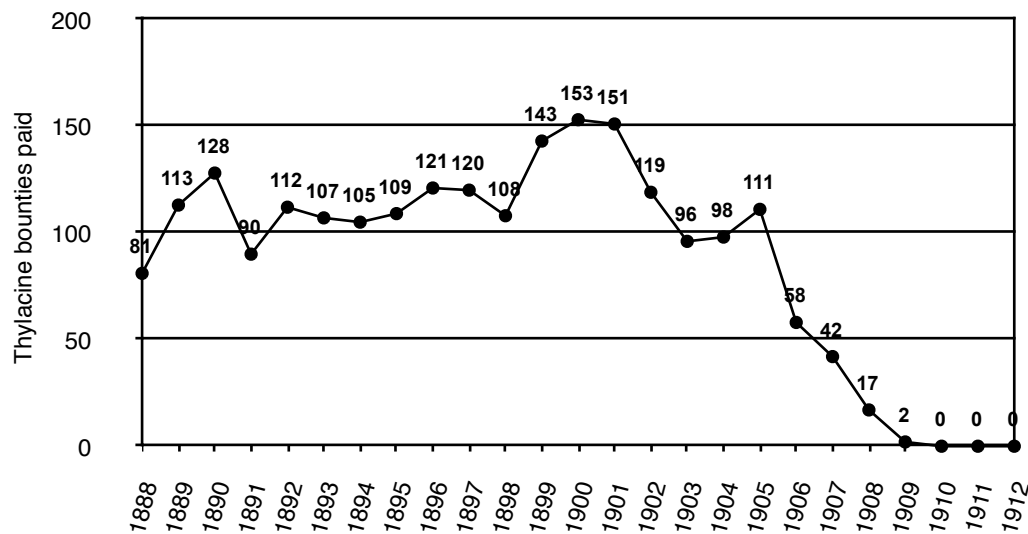


Fig. 1. The number of thylacine bounties paid by the Tasmanian Government (Data source: Guiler, 1985).

ICON

In 1913 Mary Grant Roberts' husband presented her with a solid gold brooch of a thylacine to mark their golden wedding anniversary (Guiler, 1986). This love-trinket was an early adoption of the image of the thylacine for an ornamental purpose. In this case, it was perhaps a trophy celebrating Roberts' successes in exporting live thylacines to zoos including the London Zoo and Sydney's Taronga Park Zoo. The last such thylacine transaction was valued at £25, sold to Taronga Park, 12 October 1918 (Guiler, 1986).

The thylacine may now be dead but it is not forgotten. It is now the iconic emblem of many things Tasmanian - from civic sculptures, to restaurants to beer. Thylacine images adorn a plethora of tourist ephemera, including t-shirts, caps, badges, mugs, stickers, and key-rings. There is a good selection of soft and cuddly stuffed-toy thylacines.

The image of a contented thylacine stares out from every Tasmanian vehicle number plate, and most recently has been coupled with the invitation to readers to: 'Explore the Possibilities'. Official Tasmanian Government letterhead, brochures and publications bear a thylacine image. Even government roadside billboards demonizing foxes and promoting poison-baiting of the island for fox extermination, are emblazoned with this happy thylacine image, apparently without any sense of incongruity.

The thylacine has by now made a successful transition from being a living part of the fabric of the island's biota, to iconic branding marker for things genuinely Tasmanian. Once exterminated, the thylacine went on to become a ubiquitous and celebrated icon of Tasmania. The irony is apparently lost in the ether that the tourist trinkets are made in China, and that the thylacine was decried before it was deified.

Unlike the scatter-gun native wildlife poison-baiting programs that were to follow, the thylacine bounties, in place from 1830, were precisely targeted environmental management practices with measurable outcomes.

1080

In 1951, the year prior to the introduction of the poison '1080' in Tasmania, the Tasmanian Forestry Commission, offered the following advice in their *Tree Planters Guide*: "The planting area should be fenced and netted and cleared of rabbits before planting starts. If netting is not procurable, the rabbits must be, as nearly as possible exterminated before planting, and war must be waged against them

for the first 3 or 4 years after planting” (TFC, 1951).

World War II brought new weapons into play for environmental management. In 1944 more than one thousand substances were evaluated at the Patuxent Research Refuge in Maryland, USA for their chemical warfare potential. Sodium fluoroacetate was entered as sample 1080-44. It was identified as a chemical of high potential toxicity, including by the US Chemical Warfare Service. The chemical was classified as ‘Secret’ under the US Espionage Act, and when it was announced to the public it was identified only as ‘1080-44’ (Connolly, 2004).

Sodium fluoroacetate is a light and fluffy white powder that is an odourless, tasteless, water-soluble neurotoxin (IRIS, 2004; Rammell & Fleming, 1978). This toxin is known under a variety of names, including sodium monofluoroacetate. The chemical formula is $C_2H_2FNaO_2$ (Worthing, 1991). It is the sodium salt of monofluoroacetic acid ($C_2H_3FO_2$). It is most commonly known as Compound 1080 or simply ‘1080’.

Sodium fluoroacetate was first synthesized in Belgium by Swarts in 1896 (Rammell & Fleming 1978). It was patented in Germany under the Nazi regime in the 1930s as an insecticide (Connolly, 2004) and as a rodenticide (Rammell & Fleming, 1978).

Monsanto Chemical Corporation was invited by the US government to manufacture and supply 1080 exclusively to the government; the product was regarded as being too toxic to be sold on the open market. Monsanto registered the name ‘Compound 1080’ and manufacturing began at Anniston, Alabama in 1945 (Connolly, 2004). Monsanto sold its production facility, the production process, and the trademark ‘Compound 1080’ to Tull Chemical Company in 1955. Monsanto ceased all production of sodium fluoroacetate, and Tull Chemical has been, since that time, the sole source of the 1080 used in Tasmania. It is exported from Tull Chemical to New Zealand, and then on-sold to Tasmania (Wigley, 2004).

The Tasmanian Government’s 1080 was originally targeted at rabbits, an introduced species, but the remit was promptly broadened to the poisoning of native marsupials including Bennetts wallabies, pademelons and possums (Guiler, Bignell, & Stoddart, 1990).

Sodium fluoroacetate is classified as a male reproductive toxin (Orme & Kegley, 2004). In the WHO Acute Hazard schedule it is classified ‘1a, Extremely Hazardous’ (Orme & Kegley, 2004) It is identified as a Chemical Warfare agent that is “lethal or incapacitating when placed in drinking water” (Hickman, 1999).

Sodium fluoroacetate is highly toxic to all species (Clarke, Harvey, & Humphreys, 1981). There are wide variations across species, including Tasmanian species (Guiler, Bignell, & Stoddart, 1990). The poison may be ingested, inhaled, absorbed through an open wound or mucous membrane (e.g. the eye), or through the skin (HAZMAT, 2004). “The lethal dose is essentially the same by all routes of administration” (Gosselin, Smith, & Hodge, 1984).

Spurr & Drew (1999) identified 45 species of invertebrates feeding on 1080 baits. They included ants, beetles, earwigs, mites weevils, millipedes, centipedes and spiders. For Tasmania, the consequences of the biociding of large areas of the state over six decades are quite unknown. In a decision of the Resource Management and Planning Appeals Tribunal, the potential consequences to the rare Giant Velvet Worm (*Tasmanipatus barretti*) were deemed of sufficient concern, and sufficient uncertainty, to halt a proposed forestry application in the north east of Tasmania (Hall, 2001:9).

The US EPA has rejected an application for re-registration of Compound 1080, on the grounds of “no validated analytical method of detection with limits low enough to determine concentrations of compound 1080 at the level of concern” (EPA, 1990:4).

Sodium fluoroacetate is banned in Laos, Thailand, Slovenia, Belize, Cuba (Orme & Kegley, 2004) and China (Xie, Chen, & Li, 2002); it was banned in the USA by President Nixon in 1972 by Executive Order 11643 (Connolly, 2004). In Tasmania however, economics has trumped ecology: “Poisoning is the least desirable but most cost effective method for reducing large populations of most browsing mammals” (Statham, 2001).

For those favoring death as an environmental management tool, 1080 offers the attribute that it is non-selective. It is toxic to all native Tasmanian fauna (Rammell & Fleming, 1978). It has been applied in Tasmania continuously as baits since 1952 (DPIPWE, 2009). The *modus operandi* has been ‘bait-and-switch’. Animals are induced, non selectively, to a site by free feeds, usually carrots for browsing and

grazing animals; once they are habituated to this, the next free feed is laced with 1080 poison (Statham, 2001).

What is killed, and in what numbers is unknown and probably unknowable. Le Mar & McArthur (2000) found that “animal carcasses are extremely difficult to locate following a poisoning operation”. They report that “animals sought shelter after consuming poisoned bait” and that “seventy-five percent of carcasses were found inside shelters (i.e. inside windrows, hollow logs, dens or under fallen vegetation)”. They reported that of 15 killed animals that they studied, “three carcasses were not found but recovered (radio) collars showed carnivores’ teeth marks, suggesting that Tasmanian devils (*Sarcophilus harrisii*) or spotted-tailed quolls (*Dasyurus maculatus*) had moved and/or consumed them”.

Tasmanian devils, an endemic species, are the eco-clean-up scavengers of Tasmania. Devils are carnivores like the thylacine, but their feast is of carrion, the dead and the dying, this includes roadkill and will also include, of necessity, victims of 1080 poisoning.

This diet opens Tasmanian devils to the potential to ingest multiple sublethal doses of 1080 - and such free meals have been an aspect of the Tasmanian landscape continuously for nearly six decades. Just how this second-hand 1080 has impacted the devils is unknown. But there are some disturbing facts.

DEVILS

The Tasmanian devil is the world’s largest surviving carnivorous marsupial. As a top level predator it relies on the integrity of the whole of the food chain. A problem somewhere in that food chain can manifest as a problem in the devil population.

Devils are known to eat 1080 poisoned animals (Le Mar & McArthur, 2000; Statham, 2001). The Tasmanian Government has distributed a quantity of 1080 sufficient to exterminate the devil population many times over, however the application of 1080 in Tasmania has mostly been applied to carrot as bait for browsing animals. It is used to a smaller degree, and more recently, on meat baits as a fox poison. The impact of serial sublethal doses of 1080 on Tasmanian vertebrates and invertebrates is unknown.

The devil has a propensity for eating dead animals and as a consequence is at serious risk of ingesting 1080 from that source, in serial sublethal doses (Statham, 2001). These sublethal doses can be expected to cause cancer, tumours, and developmental disorders, particularly as a consequence of ingesting the product contaminant, sodium fluoride.

Devils that are protected from 1080 exposure, due to, for example, geographical barriers, are free of Devil Facial Tumour Disease (DFTD). The populations that are DFTD-free are those interstate, those in wildlife parks, and those in forestry-inaccessible areas, such as south west, and west Tasmania (Bevilacqua, 2004; DPIWE, 2004)

Consider:

1. Tasmanian devils eat the carcasses of animals poisoned by 1080 (Le Mar & McArthur, 2000; Statham, 2001).
2. The bodies of 1080-poisoned animals store the poison in their tissues (Okuno, Connolly, Savarie, & Breidenstein, 1984; Tietjen, Deines, & Stephensen, 1988).
3. The supply specification for Tasmania’s 1080 is 90% purity (Wigley, 2004).
4. The usual contaminant of 1080 is Sodium Fluoride (NaF) (Wigley, 2004; Worthing, 1991).
5. Sodium Fluoride is a known tumorigen (Armato et al., 1992; Tsutsui, Suzuki, & Ohmori, 1984).
6. Devils have tumours from a source unknown (McCallum et al., 2009).
7. The affliction Devil Facial Tumour Disease (DFTD) is threatening the species (McCallum et al., 2009).

Sodium fluoride is a known tumorigen that is used experimentally to produce tumors, on demand, in laboratory conditions. So when we see tumors in devils that have access to 1080-poisoned areas of Tasmania, the alarm bells should be ringing, and the precautionary principle ought to be invoked.

Even if the evidence linking 1080 and DFTD is circumstantial, it would be a true wonder if a diet of toxic carcasses had no health ramifications for devils, both individually and collectively. Despite Premier Reece's better-off-dead proposition, in the light of the thylacine's extinction, Tasmania has a reputation to live down, and in the light of its tourism puffery, of, for example, 'Pure Tasmania', there is a narrative to live up to. Islands are special places, they have offered sanctuary and refuge, and some extra care and precaution may be called for, and may serve better than hindsight.

FOX

Leo Schofield (2010:2) writes: "On the wall in the parlour of the pub at Melton Mowbray [central Tasmania] there is a faded picture of the local hunt, styled no doubt on the eponymous English prototype, about to cry 'Tallyho!' and set off. But there were no foxes to hunt in Tasmania at that time and there still are none, despite extensive scat-scattering, shaky science and attempts to persuade the public that we are about to be overrun by 'Renard'. So far \$40 million has been squandered on this program, and still they spend". The scat reference is to Tasmania's Fox Eradication Task Force having recently been caught out by the damaging revelation that it had been importing fox scats (droppings) into Tasmania since 2007 (Kempton, 2010b).

The program of Tasmania's Fox Eradication Task Force has been widely ridiculed by the public and mercilessly pilloried by cartoonists (e.g. Kudelka, 2010). What can be said in the Force's favour, based on their own values, is that there are no foxes established in Tasmania, none photographed nor road-killed, and is that not evidence of how effectively the Force has spent their \$40 million or so on intensive and extensive poison-baiting across the island? The baits have been meat laced with Tasmania's poison of choice, 1080 (DPIPWE, 2010).

The fox is an apex-predator that theoretically could occupy the biological niche heretofore occupied by the thylacine. Foxes are not an established species in Tasmania. This is despite, what Guiler (1986:158) describes as: "several attempts by persons of more enthusiasm than sense to introduce foxes into Tasmania, mainly for hunting purposes". These efforts, it appears, did not meet with success.

The "Fox Eradication Program leader Matt Marrison ... reinforced the very real threat that foxes posed to not only this region [Kingston to Huonville, south east Tasmania] but Tasmania as a whole" (Naidoo, 2010:39). The program "will spread meat baits laced with 1080 poison across 3,000,000 ha of farms, woodlands and grasslands over five years" (Naidoo, 2010:39). Kempton (2010a:22) reported that 50 out of 180 property owners in the first tranche of this baiting exercise "refused baiters access to their land. Most refusals were driven by fears baits would kill dogs and wildlife". This toxic adventurism, with government funding assured for a decade, may finally extinguish the faint hope for any cryptic thylacine/s that may yet have survived the previous onslaughts against the species.

The Fox Eradication Branch of the Tasmanian Government's Department of Primary Industries, Parks, Water and Environment asserts that one of their aims is to "protect ... the Tasmanian brand" (DPIPWE, 2010:1). While that may be a laudable goal, is Brand Tasmania - think 'Pure Tasmania'- really enhanced by entrenching the dissemination of poison baits across the island as an ongoing mode of environmental management? Where is the mythical cashed-up tourist or backpacker who is seeking the experience of a toxin-baited landscape? If these 1080 baiting programs really are enhancing Brand Tasmania then let them appear on all the tourist promotions and brochures.

FUTURABILITY

"In the human heart there is a perpetual generation of passions, such that the ruin of one is almost always the foundation of another" (La Rochefoucauld, 1678:Maxim 10).

The ultimate tragedy of the thylacine is that it was loathed too early and loved too late. Replica thylacine pelts made from sheep skin by Hobart artists David Hurst and Rebecca Kissling (Killick, 2010) perhaps express the yearning of many Tasmanians and others for what has been lost.

Environmental management rarely achieves unequivocal results, and even more rarely achieves a success which is permanent. The management of the thylacine in Tasmania is a standout example of an

environmental management strategy that was pursued with vigour and persistence over an extended period of time to achieve a final successful outcome that endures to this day. That very success is the great regret of many but it reflects the fact that the care and management of an island can exhibit a finality of outcome just because the opportunity for fight or flight may be truncated owing to the absence of any further safe refuge to which to flee. And that endemism is the essence of the successful yet tragic extermination of the thylacine.

Better-off-dead is an environmental management policy that has been pursued in Tasmania in various guises and under pretexts that have been, and remain, compelling to some. But for all those who yearn for the sight, or just the knowledge, of a thylacine loping across a Tasmanian 'marsupial lawn' - Tasmanian browsing marsupials graze some grasslands to a park-like lawn - better-off-dead is by now a rancid, morally bankrupt, environmental management policy which is quite past its use-by date. Agriculture and silviculture operations may be better off fenced, better off netted, or even better off reverted to bush.

Between 1803 and 1936 thylacines were exported, both dead and alive, around the world (Guiler, 1985; Paddle, 2000). The consequence is that there are thylacine skins, skeletons, pickled foetuses, and other remains, scattered globally (Sleigholme & Ayliffe, 2009). Can the jigsaw of scattered remnants of thylacine DNA ever again be reassembled? There has been one serious unsuccessful attempt at recovery of the thylacine genome (Greer, 2009). Whether this science fiction scenario becomes science fact at some future time is an open question. In the meantime the death-day, 7 September, of the last thylacine to die in captivity has been commemorated in Australia as National Threatened Species Day since 1996 (Environment Australia, 2002).

The Dalek mantra of 'Exterminate, exterminate, exterminate' will surely retain some appeal, as a simple, direct, call to action, but 'Look Ma, we shrank the endemism' is nothing to brag about. Environmental management can be grounded in science, but will it be driven by love or fear? It was Lord Northbourne's 1940 book *Look to the Land* that presented the foundational manifesto of organic agriculture (Paull, 2006). In that book, Northbourne proffered this gentle message: "It now remains for us to try the way of love" (1940, p.192). For managing a farm, an island, or a planet, Northbourne's advice remains worthy of consideration.

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