Possum Management Using Aerial 1080 – Not New, Definitely Improved

Researchers in the Pest Control Technologies Team at Landcare Research – ***Penny Fisher, Graham Nugent***, ***David Morgan***, ***Bruce Warburton***, ***Phil Cowan*** and ***Janine Duckworth*** – bring us up to date on using 1080 for managing possums.

Possum poisons in New Zealand

A number of poisons are currently registered in New Zealand for management of brushtail possums, a major introduced pest. Use of some 'old' pesticides such as strychnine, arsenic and warfarin has been discontinued, while others of similar vintage including sodium fluoroacetate (1080), cyanide and phosphorus are still used for ground-based possum control. Since the early 1990s two additional compounds, the anticoagulant brodifacoum and the Vitamin D analogue cholecalciferol, have been registered for ground-based possum control (Eason et al. 1994).

In contrast, there is only one pesticide, 1080, that is currently registered for aerial application in mainland possum control. As such it has become a crucial tool in large-scale management of possum as vectors of bovine TB and as conservation pests. The first NZ applications of 1080 were in the 1950s for rabbit control, when it was noted "..its properties..commend it for the control of all mammalian pests and as it is likely to be used more widely in this country... it is desirable that farmers, hunters, and others should be informed about its nature and properties" (McIntosh 1958). In 2011 an independent review concluded that 1080 was the most cost effective of the vertebrate pesticides currently used in New Zealand for broad-scale possum management (Parliamentary Commissioner for the Environment 2011). It is also the best-described in a toxicological and environmental risk assessment context (Eason et al. 2011), subject to the most stringent regulatory controls and reporting requirements (Environmental Risk Management Authority 2007), and yet attracts the most pronounced spectrum of positive and negative perceptions regarding the risks of its use (Green & Rohan 2011). However, any discussion of risk alone is unbalanced without considering the benefits, and rationale for the selection of 1080 from a range of alternative possum control methods.

Refinement of aerial 1080 baiting practices for possum management

Manufactured cereal pellets or (less commonly nowadays) chopped carrot are used as bait in aerial applications. Pellets are uniformly manufactured, pre-packaged, can be stored, and incorporate a possum-preferred flavour such as cinnamon or orange to mask the presence of 1080 (Morgan 1990). Carrot bait is prepared on site just before aerial application as pieces weighing about 6 g, surface-coated with a solution of 1080, green dye and for possums a flavour lure is added. Preparing fresh carrot bait is less convenient than pellets but in comparison to pellets, carrot baits are considerably more resistant to rainfall (Bowen et al. 1995), slightly more palatable to possums (Henderson et al. 1999a), and cheaper to produce. While the bait and concentration of 1080 used in it have not changed much in the last few decades, major refinements and improvements have transformed the way aerial baiting is conducted.

During the 1970s, aerial 1080 operations killed an average of 70% of possums (Batcheler 1978), increasing to 88% by the 1990s (Henderson et al. 1999b). Historically, high application rates (up to 32 kg of bait per hectare) and fixed-wing aircraft (Morgan et al. 1997) were used. A focus on ensuring that all possums could encounter bait led to the introduction of navigational guidance (GPS) systems and helicopter-borne buckets fitted with a spinner to spread bait laterally to achieve complete bait coverage (Morgan 1994). Factors that influence bait quality (Morgan 2004) or affect bait uptake by possums such as rainfall (Bowen et al. 1995), temperature (Veltman & Pinder 2001) or availability of natural food were also indentified. Now, many operations are so effective that the standard trap–catch monitoring technique detects few or no surviving possums (Morgan et al. 2006).

Increased understanding of possum feeding behaviour, movement patterns and home range utilisation (often now using GPS telemetry) has been part of an integrative and adaptive approach to improve the use of aerial 1080. For example, prefeeding possums with non-toxic bait was known to increase percent kills. Recent field studies using electronic monitoring confirmed that pre-feeding stimulates possums to search for bait (Warburton et al. 2009), and increases the probability that possums will eat a lethal dose of bait (Nugent et al 2009). Pre-feeding in aerial operations is now routine, especially where both possums and rats are targeted, but pre-feeding increases cost. Current research is addressing ways to reduce these costs. Bait quality and size have emerged as key criteria driving bait cost - emphasis is

now on avoiding the production of fragments during bait manufacture, handling, and distribution. Bait fragments contain sub-lethal amounts of 1080 and can induce bait shyness and pose increased risk to non-target birds.

As a toxin, 1080 is relatively fast-acting so possums must find and eat a lethal quantity of bait within 30-60 minutes after first eating bait. Otherwise they lose appetite, may survive, and then be bait and/or poison shy (Ogilvie et al. 2000). Recent research (Nugent et al. 2011) has linked the concepts that (*i*) fragmentation of bait producing sublethal doses can result in the survival of some possums and that (*ii*) high aerial application rates (i.e. high bait densities) were addressing this risk by ensuring multiple bait encounters by possums in a short enough time to overcome sublethal exposure. Current field-based research is directed at effective bait delivery in clusters or strips compared to the current practice of uniform coverage. New techniques have been developed to deliver the requisite density of bait in clusters or strips based on knowledge of possum nightly movement distances. In the most successful trial to date, near total reductions in possum (and rodent) activity were achieved using just 167 g of pellet bait per hectare (Landcare Research, unpubl. data). This rate approximates one quarter of a gram of 1080 spread over 10,000 square meters.

Over the last 20 years research and operational trial and error have driven aerial application rates of 1080 bait down by about 80%, to about 2 kg of bait per hectare (see Veltman & Westbrooke 2011). Research into prefeeding and cluster/strip sowing highlights further potential to reduce sowing rates and toxin use by as much again simply through innovation in how baiting is conducted. In future it may be feasible to apply aerial baiting for as little as $10/ha (bait and flying costs only, including a single pre-feed) per operation, which on a typical 5-year cycle equates to just a few dollars per hectare per year.

Biological control for possums

The concept of non-lethal, target-specific biological control of possums is attractive, as it could overcome some of the major concerns around broad-scale use of vertebrate pesticides for possum management. Concerted research effort in this area over the last two decades has made significant progress but the technical challenge of field delivery means that operational use of biological control for possums remains a long term goal.

Most recently research of biological control has been in two areas, fertility control and a potentially possum-specific toxin. Fertility control research focused on development of an orally deliverable vaccine that targeted possum zona pellucida proteins (ZP), where immunisation against these proteins resulted in infertility (Mate et al. 2003; Duckworth et al. 2007, 2008). Another approach was to inhibit gonadotrophin-releasing hormone (GnRH) to shut down behavioural and physiological aspects of reproduction and renders possums infertile (Eckery et al. 1998; Cross et al. 2011). Laboratory trials with injected vaccines demonstrated significant potential for ZP- and GnRH-based vaccines to reduce possum fertility sufficiently to contribute to possum management (Cross et al. 2011). The major challenge was then to develop vaccines that could be bait-delivered. Various approaches were tried (Walcher et al. 2008; Cross et al. 2011) and some success was achieved in laboratory trials; for example with oro-nasal delivery (Walcher et al. 2008). But further research was unable to either increase the proportion of vaccinated females that became infertile or the duration of the infertility beyond one breeding season (Cross et al. 2011). Funding for research in this area was stopped in September 2010, reflecting the slower than hoped for progress towards a practical fertility control product and changes in end-user priorities.

Incremental improvement versus new tools for possum control

Conventional wisdom suggests a range of toxins with differing characteristics are needed to allow managers to choose a control method that is tailored to their specific control situations. Research is therefore supporting the development of new toxins and improved use of existing ones. Zinc phosphide, an 'old' poison with a long international history of use in rodent control, was recently registered in New Zealand for ground application against possums (EPA 2011). A combination of cholecalciferol and the anticoagulant coumatetralyl is also being evaluated for possums (Eason et al. 2010) as is sodium nitrite. For any newly registered possum poison, operational comparisons with 1080 (as the *de facto* current standard) will be necessary in aspects such as animal welfare impacts, primary and secondary risk to non-target birds and, of course, efficacy against possums. The cost of these new bait formulations is currently uncertain, but their future use in ground-based possum control will provide a basis for comparing efficacy with that of aerial 1080. A cholecalciferol bait formulation is currently being field-tested towards registration for aerial application against possums (Pest Control Research 2011), and would eventually be subject to cost-efficacy comparisons if successful.

In a recent overview, the Parliamentary Commissioner for the Environment (2011) stated "… there is no alternative poison available now or in the near future that could be used aerially and would be

preferable to 1080". Aerial baiting is likely to remain the most cost effective possum control tool for forested areas, and while the low cost of 1080 (<$0.04 per lethal dose, using 12-g cereal baits) makes it unlikely that any alternative that is as economical and effective against possums could be developed, refinements in sowing practice may make it feasible to consider far more expensive alternative toxins.

While new control tools are an important facet of future pest management in New Zealand, we note that the 'product pipeline' for development, registration and industry adoption of new active ingredients or control devices is costly, long-term and sometimes risky. The complementary strategy of incremental improvement of existing control tools and smarter ways to use them can deliver on-ground benefits to pest managers in a shorter time frame and with less research investment. This approach is exemplified by the substantially "improved" knowledge, return on research investment and operational changes that have accompanied ongoing use of 1080. For example, development of an effective deer repellent for possum bait (Morriss 2007), has provided an operationally-available solution to pest managers faced with opposition to aerial 1080 use by hunters. Clearly, it is important to balance 'speculative' investment in the development of new tools and toxins against the pressing need for continuous improvement toward making the best possible use of what we already have to manage possums. This is especially important if we truly want to halt the decline in New Zealand's biodiversity and stop further extinction of our endemic fauna.

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