

Weed management in shore plover aviaries at Mt Bruce Wildlife Centre

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1. Background

The National Wildlife Centre at Mt Bruce has been experiencing weed management problems in some of their aviaries. The ones causing the most concern are a set of large aviaries in which they breed the endangered New Zealand shore plover.

The habitat consists of a pebble/stone terraced base with a narrow stream of water flowing through the centre of the aviary. Most of the stone area has an underlay of weed matting but this does not seem to help to control the weed growth. The breeding season for the shore plover is September to February and this coincides with the main flush of weed growth. The weed species consist of aquatic varieties in the waterways and various dicot weeds and grasses on the stone area.

The problem time for the shore plover is, however, November to February when the birds have small chicks that may die due to entanglement in the weeds. The Species Manager, Glen Holland, is looking for a weed control management programme that is entirely safe with the birds remaining in the aviary, without any major disturbance that may reduce the effectiveness of the breeding programme.

This report outlines current weed management control options and gives an overview of future design modifications for the aviaries and an integrated pest management programme using agrichemical and non-chemical methods of weed control.

2. Weed control requirements

2.1 CURRENT SITUATION AT MOUNT BRUCE

Mount Bruce staff use Roundup® herbicide for perimeter weed control so that security checks of the netting can be made more easily at ground level. In other situations it is used for interior weed control of the aviaries. In the aviaries open to public viewing, the weeds need to be controlled so that it is easier for the visitors to see the birds. To control the extensive weed growth that can occur in the three New Zealand shore plover aviaries at present, staff move the birds out of the aviaries before and after the breeding season, spray with Roundup, manually pull the weeds and return the birds to the aviaries.

The main causes for concern about this method are:

- Weed growth is uncontrolled during the breeding season
- Young chicks die due to weed entanglement

- Moving the birds is unsettling
- The work is labour-intensive

A better procedure would be to control the weeds with the birds remaining in the aviaries and to be able to use the control method during the high weed growth periods that also coincide with the breeding season.

A solution to the weed control problem for all three situations: perimeter weed control, weed control for public viewing, weed control to prevent weed entanglement of shore plover chicks, would be the use of an agrichemical that could be sprayed on to the weeds in the habitat which the birds occupy, and that was risk-free for these endangered birds.

Roundup is an agrichemical that will control a wide range of weed species and is promoted as a very environmentally safe agrichemical by its manufacturers Monsanto. It may be suitable in many situations at Mount Bruce, but caution is recommended on the basis of evidence reported by independent groups. These groups have studied the made-up product, Roundup (active ingredient and formulation), as opposed to the registered ingredient, for which toxicity data are presented only on the active ingredient glyphosate. Meriel Watts and Ronald Macfarlane of the Pesticide Action Network (PO Box 1170, 10850 Penang, Malaysia) have prepared a summary on glyphosate that expresses some concerns and includes references to scientific papers reviewed in its preparation.

2.2 SUITABILITY OF ROUNDUP HERBICIDE

Roundup is one of the world's most widely used herbicides and is very successful at controlling a wide range of aquatic and terrestrial weed species including many of those most difficult to kill. Its popularity comes from this ability to control so many weeds and its low level of toxicity, especially in comparison to paraquat, a desiccant chemical widely used in the same way.

Roundup has glyphosate - N-(phosphonomethyl) glycine - as its active ingredient. This is considered by the World Health Organisation (WHO) as low in toxicity and has a class IV hazard classification: Unlikely to present an acute hazard in normal use. However, it becomes more complicated than just looking at the active ingredient, as the commonly used component of glyphosate products is POEA, which is reported as being two to three times more toxic than glyphosate, so the combination of the two may be even more toxic.

The toxicity of agrichemicals is measured by an LD_{50} or LC_{50} (the dose or concentration of the product required to kill 50% of the test population).

The following are examples of toxicity measurements for glyphosate:

Species	LD/LC_{50} (mg/kg, ppm)
Quail	>4640 mg/kg
Duck	>4640 ppm

Rats	>4320 mg/kg oral
Rabbits	>2000 mg/kg dermal

The acute toxicity of other components in formulations combined with glyphosate include:

- POEA:Oral **LD₅₀** (Rats) +/- 1860 mg/kg
- Isopropylamine:Oral **LD₅₀** (Rats) 820 mg/kg

Independent studies referenced by Watts & MacFarlane raise concerns about the reproductive effects of these chemicals and the environmental fate of the product. Literature suggests that, depending on the extent of soil binding and microbial breakdown, the half-life of glyphosate may vary from 7 to 174 days. In one study, glyphosate was calculated to have a half-life of 120 days in pond water sediment. Glyphosate is slightly toxic to aquatic micro-organisms but some formulations can be slightly to highly toxic. It is reported that it can affect growth and photosynthesis in blue-green algae, destroy habitat food supply, and have adverse effects on non-target aquatic plants.

Scientific information on the product's low toxicity suggests that, although the product is very safe, caution may be necessary where we are dealing with a critical outcome like the survival of a bird species. If there was an excessive accumulation of chemical toxins in the habitat of the shore plover and this interfered with the reproductive outcomes of the species it could be disastrous for the programme.

Caution in the use of Roundup directly on to the weeds during the breeding season of the New Zealand shore plover is therefore recommended. Alternative methods of weed control using non-chemical control should be considered for the shore plover aviaries, with Roundup being used for weed control management only where any potential effects would be minimised (see recommendations).

3. Alternative non-chemical weed control methods

There are a number of non-chemical control options that may be used for the different types of weed management undertaken by staff at Mount Bruce. These methods include: a thermal air system (WEEDTEK), mulching, solarisation, water level control, water-way design, hand weeding (selective chemical and non-chemical).

Each of these non-chemical control methods has advantages and disadvantages, as discussed below.

3.1 THERMAL AIR SYSTEM

A thermal air system allows a high humidity and high temperature to be directed from a treatment head towards the weed vegetation, causing plant cells and their cell wall to rupture. This process then causes the plant to dehydrate and dry up in 24-72 hours. It has a distinct advantage over flame weeding in that it capitalises on the intense internal energy source as heat, without the burnoff effect that causes the plant to go into shock for a period and then regrow.

A system under the trade name WEEDTEK has been developed and is now in operation and marketed by a company called Green Management Limited in Lower Hutt.

The main advantages for Mount Bruce are: non-chemical, no residue, relatively quiet in operation, operated under a wide range of conditions (e.g. calm or windy), quick brown-off of weeds, used over breeding season (timely and enables regular application over short intervals to minimise disruption).

The disadvantage may be: cost of capital purchase.

Contact details for John Fahey and Brian Sutcliffe, Directors of Green Management Ltd, who have developed this system, are:

Green Management Ltd, PO Box 31200, Hutt City. Phone 04 568 5577. Fax 04 568 5437

3.2 MULCHING

Mulching has already been put to good use at the Centre. The most important aspect of good weed management from mulches is the maintenance of the thickness of the mulch. For mulch to work effectively it must maintain a barrier to the germination of the weeds. This thickness must be at least 50 mm to stop the germinating seedling reaching the surface. The stone mulch in the shore plover aviaries will work better if a barrier such as plastic or even newspaper is laid on the surface first and then covered evenly with the stones to the recommended depth. The need for further weed control will then be reduced because weed seeds blowing into the aviaries will also be prevented from establishing.

The main advantages for Mount Bruce are: permanent weed management, can be recycled (washed and reused), low labour input after establishment.

3.3 SOLARISATION

Solarisation is using the heat of the sun magnified through a plastic cover to create a humid intense heat under the cover that kills the weeds in a similar way to the thermal air system. The method uses a sheet of clear plastic that is a comfortable size to move (say 3 X 2 metres of plastic with a light wooden frame). The plastic is laid over the weeds during the heat of the day. The heat

accumulates under the cover, killing the weeds, and can then be moved. This can take as little as 30 minutes or as long as several hours, but it is at no cost other than the operator time. The main point that is critical to the success of this method is using it on the weeds when they are small. It may be as simple as including the moving of this sheet with the staff checks that occur each day.

The main advantages for Mount Bruce are: it is cheap to run.

The disadvantages are: only works during the hot summer months.

3.4 WATER LEVEL CONTROL

Plants, even aquatic plants, require oxygen to survive. If the water level in the streams could be raised to cover the weeds on either side up to the permanent mulch line, this would starve the plants of oxygen and kill them. It would require some experimentation to work out how long the weeds need to be covered to give effective control of the species present.

Conversely, the water could be drained and the area allowed to dry off. This would help mainly with the control of aquatic weeds, which require the water flow for support.

The main advantages for Mount Bruce are: it is cheap to run.

The disadvantages are: cost of initial set-up, may not be able to dry out due to springs.

3.5 WATERWAY DESIGN

The design of the waterway is also a critical component as a method of reducing any dependence on agrichemical control. At present the waterways vary in width from 3 metres to 1 metre and are the mud or silt floor of the aviary. If the waterway was lined with a permanent material like butinol or a thick plastic and restricted to no more than a metre wide, this would prevent any problems of weeds germinating and growing in the area where the mulch or other methods of control described are unable to work effectively.

The ideal arrangement would be to have a 200 mm channel the length of the aviary with sloping sides covered in a suitable material that interfaces with the stone mulch. The channel would provide a permanent water supply, with the water level being reduced from time to time to enable the streamside to be cleaned with a water blaster. The side would have a slight incline to accommodate the varying wading requirements of the shore plover. Aviary design has the potential to minimise the need for weed control, chemical or non-chemical, by applying the knowledge of the needs of the shore plover with simple ideas that can make the maintenance of the aviary more effective.

The main advantages for Mount Bruce are: cheap to run, uses knowledge of staff.

The disadvantages are: cost of initial set-up.

3.6 HAND WEEDING (SELECTIVE CHEMICAL AND NON-CHEMICAL)

Hand weeding, using manual methods or targeted applications of agrichemical, e.g. weedball, will always be required as short-term measures to solve problems where other methods of control have failed for one reason or another. Hand weeding should always be used in circumstances where a single weed control method is not coping with the range of species that need to be controlled. If the labour available to hand weed is not sufficient, an alternative method of control needs to be considered.

4. Recommendations

To achieve the most effective weed management for aquatic and terrestrial plant species in the shore plover and other aviaries at Mount Bruce:

- Use Roundup at label rates on the perimeter of all aviaries and extending up to 30 cm inside their boundary to maintain visual observation of the security of the cage. (This represents less than 10% surface area of most aviaries.)
- Use Roundup in the aviaries where the birds in residence do not feed from the natural habitat.
- Use Roundup in any of the vacant aviaries for any suitable weed control situation, but maintain a 21-day withholding period, i.e. 21 days before the birds are reintroduced.
- For all other situations, especially in the shore plover aviaries, use non-chemical control methods, as described in this report.