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Manaaki Whenua

Options for controlling peafowl (*Pavo cristatus*) in New Zealand

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A. David M. Latham

Landcare Research

Prepared for:

Horizons Regional Council

Private Bag 11025, Manawatu Mail Centre,

Palmerston North, 4442

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Landcare Research, Gerald Street, PO Box 40, Lincoln 7640, New Zealand,
Ph +64 3 321 9999, Fax +64 3 321 9998, www.landcareresearch.co.nz

Reviewed by:	*Approved for release by:*
Bruce Warburton Research Leader Landcare Research	Phil Cowan Science Team Leader Pest Control Technologies

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Contents

Summary

Project and client

- Peafowl (*Pavo cristatus*) can be agricultural and urban pests. This report summarises methods that can be used to mitigate the impacts of peafowl in New Zealand and was completed by Landcare Research for Horizons Regional Council during March 2011. It was funded by the Ministry of Science and Innovation, Envirolink fund (Project HZLC81).

Objectives

- To provide information to council pest managers and landowners with feral peafowl problems in New Zealand so that they can consider which options for controlling peafowl may be suitable in their particular region.

Main findings

- Peafowl damage crops and foul pasture in rural areas and may create noise disturbance, damage to gardens, and fouling in urban areas.
- Peafowl are carriers of zoonotic diseases but evidence of peafowl-to-human transmission is scarce.
- Peafowl damage may be mitigated by:
    - Shooting with shotguns and centrefire rifles in rural areas
    - Poisoning using alpha-chloralose or DRC 1339
    - Trapping using multi-capture traps
    - Fertility control

Conclusions

- Feral peafowl can cause problems in rural and urban areas and the need for a viable control method has become apparent.
- Landowners currently shoot peafowl; however, because peafowl become very wary and elusive when hunted, shooting is not considered a viable, long-term method for reducing population densities.
- Pest managers need to determine the extent of damage caused by peafowl, as well as the likelihood that the problem will intensify and spread to other areas. Managers need to determine if a regional-scale control programme is warranted, and if it is, determine and define clear measurable outcomes and ensure that ongoing funding is available.
- Trapping has been used successfully to control peafowl in urban areas, but it is not considered a viable option in rural areas.
- Poisoning peafowl with the pesticides alpha-chloralose or DRC 1339 is considered a viable control option, as is reducing peahen fertility using OvoControl-G®. However,

these substances cannot legally be used in New Zealand until they have been formally registered for use on peafowl with the Environmental Risk Management Authority and approvals from the Standards branch of the Ministry of Agriculture and Forestry.

- Because the public's view is likely to be polarised, with some people considering peafowl to be pests and others viewing them as an attractive addition to the countryside, conflict may arise over the use of lethal versus non-lethal control methods. Where such conflict arises, OvoControl-G® may be a useful control option.
- The cost (including registration) of using alpha-chloralose, DRC 1339 or OvoControl-G® is likely to be expensive but they may be the most viable, long-term options to control feral peafowl populations. Currently, shooting and trapping are the only legal methods available to landowners and pest managers.

Recommendations

Horizons Regional Council should:

- Assess the extent of peafowl damage and peafowl distribution and abundance in the region. Such information will quantify the magnitude of the problem caused by peafowl and consequently the level of management needed to control peafowl populations, and what justification there might be for further research to support registration of new products.
- Consider, as part of a future Envirolink project, modelling the potential for peafowl range expansion under New Zealand habitat and climatic conditions and peafowl population dynamics under various harvest strategies.
- Consider jointly with other regional councils with peafowl problems getting alpha-chloralose or DRC 1339 registered for use as pesticides on peafowl in New Zealand.
- Consider getting OvoControl-G® registered in New Zealand to control peahen fertility, because lethal control of peafowl may be deemed unacceptable by the public in some areas.
- Continue to use trapping and shooting until such time as pesticides or fertility control options are legally available for use on peafowl.

1 Introduction

Peafowl (*Pavo cristatus*) can be agricultural and urban pests. The following report summarises methods that can be used to mitigate the impacts of peafowl in New Zealand and provides information to pest managers and landowners that are concerned about the impacts of peafowl so that they can consider which control options may be suitable for use in their particular region. It was completed by Landcare Research for Horizons Regional Council during March 2011 and funded by the Ministry of Science and Innovation, Envirolink fund (Project HZLC81).

2 Biology, status and damage caused by peafowl

2.1 Description and biology

The peafowl (also known as the Indian or common peafowl) is native to India and Sri Lanka. Peafowl were first introduced into New Zealand in the 1840s as ornamental birds, but have since escaped and established feral populations (Heather & Robertson 2005). They are widely distributed in areas in the North Island and northern South Island that have a Mediterranean climate (Robertson et al. 2007). Preferred habitat is rough hill-country and river valleys with good cover, particularly near farmland (Marchant & Higgins 1993). Peafowl are omnivorous and their diet includes seeds, fruits, flowerbuds, shoots, invertebrates, and small vertebrates.

Male peafowl (peacocks) are large birds (4.5 kg) with unmistakable metallic blue and green plumage and a long train of tail feathers. Females (peahens) are smaller (3.5 kg) and are less colourful than males (Heather & Robertson 2005). Peafowl are usually found in groups of 5–10 individuals; however, considerably larger flocks are not uncommon (Marchant & Higgins 1993). Peafowl roost at night, usually in tall trees, and they call frequently before taking their position in roost trees. Nesting usually occurs in a shallow scrape in the ground that may be lined with leaves, sticks or other debris. Little is known about breeding in New Zealand, although females have been observed incubating eggs in late-November (Marchant & Higgins 1993). Clutch size ranges from 4 to 8 eggs that are incubated for about 28 days by the female (Heather & Robertson 2005). Chicks leave the nest shortly after hatching and follow their mother. Peafowl are normally capable of breeding at 2 years. Social organisation, social behaviour, and population structure have not been assessed in New Zealand.

2.2 Legal status of peafowl

Under the Wildlife Act 1953, Schedule 5, peafowl are listed as an unprotected species in New Zealand, and therefore it is lawful for anyone to hunt, kill, or have in their possession this bird if it is not domesticated (http://www.legislation.govt.nz/act/public/1953/0031/latest/DLM278571.html, accessed 3 March 2011). This status means that landowners may carry out lethal control of feral peafowl on their property. The Manawatu-Wanganui Regional Pest Animal Management Strategy states that the management objective for peafowl within this region is suppression, and that the main means of achieving suppression should be by voluntary self-help groups (Lambie 2009).

2.3 Damage caused by peafowl

Peafowl may cause crop losses in rural areas, and can be a nuisance in urban areas.

Rural impacts

The effects of peafowl on pasture and crops in rural areas have not been quantified in New Zealand. However, in parts of India peafowl have been reported as a nuisance to agriculture and horticulture because they damage crops and consume cultivated fruit (Ali & Ripley 1980). Because peafowl feed on seeds, fruits, flowerbuds, and shoots in New Zealand, they may similarly cause damage to pastures, crops, and orchards in New Zealand (Marchant & Higgins 1993). Invertebrates make up a large component of peafowl diet; crops may be damaged and seeds and seedlings dug up as peafowl scratch through soil and litter to find invertebrates. Fouling of pastures may also result from peafowl foraging on farmland. In the eastern Bay of Plenty, peafowl reportedly damaged winter clover crops and broke polythene covers of silage pits (Hall & Mill 1998; Greg Corbett, Environment Bay of Plenty, pers. comm.).

It is important to note that the feral goose (*Anser anser*), paradise shelduck (*Tadorna variegata*), ring-necked pheasant (*Phasianus colchicus*), and feral turkey (*Meleagris gallopavo*) are also widely distributed throughout the Horizons Region (Robertson et al. 2007). The diet of these species can include fruit, grass, and various crops, and consequently overlaps the diet of peafowl. Thus attributing pasture and crop damage to peafowl may be difficult, particularly where damage done by peafowl is additive to that done by other species.

Urban impacts

Feral peafowl have been reported to cause significant noise disturbance and fouling in urban areas such as Townsville, Australia (Townsville City Council 2010), and California, USA (e.g. Oliande 1999; Bradley 2002). Peafowl are also known to cause damage to gardens and other property, harass people and pets, and increase the occurrence of vehicle collisions as motorists attempt to avoid birds (Bradley 2000). Because feral peafowl populations in New Zealand are located primarily in rural areas, noise disturbance, fouling, and other impacts in urban areas are of limited concern. Nuisance peafowl in urban areas in New Zealand are likely to be primarily caged birds. However, Hall and Mill (1998) reported that feral peafowl caused problems in suburban areas in the western Bay of Plenty. Noise disturbance by feral peafowl may also impact residents of rural areas and lifestyle blocks.

Peafowl are susceptible to approximately 80 infectious diseases and parasites, including fowl pox, haemorrhagic enteritis, avian tuberculosis, fowl typhoid, fowl cholera, coccidiosus, pigeon malaria, salmonella, tapeworms, mites, and lice (Schwartz 1994). Although there is the possibility of risk to public health from zoonotic diseases, the extent to which these diseases are present in peafowl in New Zealand, particularly feral populations, is not known. However, Hall and Mill (1998) suggest that peafowl in the Bay of Plenty have the potential to spread diseases, such as salmonella, to livestock and humans.

3 Control options

3.1 Shooting

Because peafowl are listed under Schedule 5 of the Wildlife Act, it is lawful for anyone to hunt, kill, or have in their possession this bird if it is not domesticated. Accordingly, peafowl hunters employ a wide variety of rifles and shotguns, including air rifles, rimfire rifles, centrefire rifles, and shotguns of various gauges. Hunters generally recommend head or neck shooting of peafowl when using air rifles or small calibre/gauge rifles and shotguns because projectiles are unlikely to penetrate the feathers of the peafowl, particularly at longer distances. The 'Code of Practice for the Humane Destruction of Birds by Shooting in South Australia' (http://www.environment.sa.gov.au/Plants_and_Animals/Animal_welfare/Animal_welfare_legislation/Codes_of_practice_for_the_humane_destruction_of_wildlife, accessed 4 March 2011) states that 12-gauge shotguns with number 1 or 2 shot (36 g per cartridge) or a centrefire rifle with telescopic sights should be used to shoot Cape Barren geese (*Cereopsis novaehollandiae*) and emu (*Dromaius novaehollandiae*). A similar code of practice is not available in New Zealand; however, because peafowl are a relatively large species, following the South Australian code of practice is recommended.

Targeting peafowl in trees used for roosting may prove effective (see caution below regarding the need to follow the Arms Code) and roost trees may be easily identified by listening for peafowl calling in evenings prior to roosting. Shooting at night is dangerous and shots should only be fired if you are certain it is safe to do so; shooting during the hours of darkness is forbidden in any state forest, forest park or national park. If shooting during the day, it is recommended that shooters wear camouflage because peafowl are very wary, particularly after populations have experienced hunting pressure.

Shooting is not a viable option in urban areas, and may be problematic in semi-urban (lifestyle block) areas. Discharging shotguns or non-silenced or suppressed centrefire rifles would create noise disturbance. Firearm safety issues are also of greater concern in urban and semi-urban areas than in the less populated rural areas. However, regardless of where firearms are used to control peafowl populations, safe use of firearms must be the number one priority and the seven basic rules of the Arms Code must be obeyed (http://www.police.govt.nz/service/firearms/armscode.pdf, accessed 4 March 2011). Rule 5 (check your firing zone) is particulary relevant if shooting at peafowl when they are roosting in trees.

The use of shooting to control peafowl populations will require a long-term, sustained operation because hunted peafowl quickly become wary of humans and shooting success declines (Greg Corbett, Environment Bay of Plenty, pers. comm.). Similarly, shooting may interfere with other control options, such as trapping and poisoning, because birds quickly become wary of humans. In addition, many members of the public value introduced ornamental birds such as peafowl, and may be against the use of lethal control methods and instead advocate live-capture methods (similar situations have occurred with feral pigeons, *Columba livia* (Morriss 2009) and Kaimanawa wild horses (e.g. http://kaimanawa.homestead.com/history.html, accessed 4 March 2011)).

3.2 Poisoning

There are currently no registered pesticides for peafowl control in New Zealand (Bill Simmons, Animal Control Products, pers. comm.). However, there are two possible pesticide options for controlling peafowl, alpha-chloralose and DRC 1339 (3-chloro-4-methyl benzamine HCl, also known as Starlicide). To register these pesticides for peafowl control in New Zealand an approval from the Environmental Risk Management Authority (ERMA) would be required. In addition, approval is required under the Agricultural Chemicals and Veterinary Medicine (ACVM) Act from the Standards branch of the Ministry of Agriculture and Forestry (MAF). Such approval will be based on assessments of efficacy, toxicology, animal welfare, residues, public and operator safety, and non-target risks.

Alpha-chloralose is a stupefying agent – affecting the nervous system and retarding metabolism – that works best under colder conditions. Alpha-chloralose powder is available to approved handlers for mixing into baits for black-backed gull (*Larus dominicanus*) control and has proven to be effective for this species (e.g. Nelson 1994). Depending on the amount of powder used, alpha-chloralose can be used to kill or incapacitate gulls. Where management aims to kill gulls, a lethal dose must be eaten or incapacitated birds will need to be captured and euthanased. The main advantage of using this pesticide is that if valued non-target birds accidentally eat bait, they may be revived if kept in a warm, dark place. However, because peafowl are a relatively large bird and would require a high concentration of pesticide to be effective, smaller non-target species may be killed in peafowl poisoning operations that use alpha-chloralose. Other disadvantages may include birds ingesting sub-lethal doses and consequently behaving abnormally and deterring other peafowl from ingesting bait, and peafowl flying off after they have eaten bait to die elsewhere. The latter outcome may be upsetting to the public. The effectiveness of a single application may be short-term and localised.

DRC 1339 is currently only registered for use on rooks (*Corvus frugilegus*) and starlings (*Sturnus vulgaris*) in New Zealand. It is registered and has been used successfully on other species elsewhere, e.g. feral pigeons in the USA (Blanton et al. 1991). It has also proven to be an effective pesticide for pheasants and bobwhite quail (*Colinus virginianus*) in laboratory experiments (Schafer et al. 1977; Nikodémusz & Imre 1982). DRC 1339 appears to have low to moderate toxicity to most mammals (DeCino et al. 1966), small granivorous birds (Shefte et al. 1982), and most avian predator and scavenger species (Schafer 1972). The effectiveness of this pesticide on peafowl is not known. Alpha-chloralose and/or DRC 1339 may prove to be effective pesticides for peafowl control if they can be registered for use. Toxicity trials would need to be conducted to determine which of these pesticides would be most appropriate for use on peafowl in New Zealand.

Because peafowl become wary if they have been persecuted by humans, a period of approximately one year without hunting or other molesting of peafowl should be implemented before poisoning is attempted, to allow the birds time to settle down (Greg Corbett, Environment Bay of Plenty, pers. comm.). Extensive prefeeding of targeted flocks would likely also be required. Ways to avoid or minimise non-target species being killed would also need to be considered. Further information on alpha-chloralose and DRC 1339 is available from Animal Control Products (http://www.pestoff.co.nz/start.htm, accessed 4 March 2011) and Cowan et al. (2010) provide a review of DRC 1339 in a report prepared for Horizons Regional Council.

3.3 Trapping

Multi-capture cage traps can be used to remove peafowl from specific sites where they are creating problems. The City of Rancho Palos Verdes, California, USA, has had success with this method, removing 19 birds from a property over a number of days (Bradley 2000). Traps that aim to capture multiple birds are preferable to those that target individuals, because the latter would likely increase bird vigilance and wariness of traps and be unlikely to reduce peafowl numbers effectively at a district or regional scale. Corral traps of various designs may be appropriate for the capture of large numbers of birds within a flock. The City of Rancho Palos Verdes provides information on peafowl trapping methods (http://www.palosverdes.com/rpv/additional_information_resources/animal_reg/Peafowl/peafowl_population_management.cfm, accessed 4 March 2011). Where nuisance birds are few, e.g. where one or a few individuals have dispersed to an area where peafowl were previously absent, traps that target individuals may be appropriate (e.g. the urban quick-release net trap; http://www.ecotrap.com.au/products.html, accessed 4 March 2011). Extensive prefeeding would likely be needed to attract birds into traps; prefeed time would likely differ between trap types and the number of birds being targeted. Call birds have been used successfully to trap some species; however, the efficacy of using this method with peafowl is unknown.

3.4 Rendering eggs unhatchable

Locating peafowl nests and rendering eggs unhatchable may help control peafowl numbers, particularly where the birds are a problem in urban areas. Eggs should not be removed from nests and destroyed because this will only encourage the peahen to lay another clutch of eggs. Rather, the embyro should be prevented from developing, by coating the eggs in liquid paraffin or corn oil, or by inserting a nail into the eggs and addling the contents (Bradley 2000; Morriss 2009). The peahen will continue to brood the addled eggs for the normal incubation period before eventually deserting the nest. Although considered effective for some species, it is unlikely that sufficient peafowl nests could be located within a district for this method to have any impact on a population.

3.5 Non-harmful deterrents

Where peafowl are creating a specific problem by feeding in certain crop fields or roosting in problem areas, non-harmful deterrents may be useful but their effectiveness (particularly long-term) is unclear and they are unlikely to be a viable long-term option for peafowl control. Examples of non-harmful deterrents include ‘scare windmills’ and ‘flying eagle kites’ (JWB Marketing, Nuisance Wildlife Consultant, http://www.birddamage.com/turkeys.htm, accessed 4 March 2011; numerous similar products are available). These products provide novel stimuli to birds and are most effective as short-term deterrents. Sonic repellers are also available in the USA. These products emit sounds that confuse, disorient, and intimidate pest birds to scare them away from target areas (e.g. the ‘Goosebuster®’ is designed to scare geese from an effective area of up to 2.8 ha; http://www.bird-x.com/goosebuster-p-25.html, accessed 4 March 2011). Sonic repellers tend to be species specific and designed for North American species. Non-harmful deterrents are particularly useful for the management of nuisance birds in North America because many ‘nuisance’ species are native and subject to various protective legislation. For example,

turkeys may be killed by legal methods during carefully monitored and regulated hunting seasons; however, outside of those seasons, non-harmful control options must be used.

Propane gas cannons that produce periodic loud explosions have long been a popular type of bird scarer. However, the audible bang can reach volumes in excess of 150 decibels near the gun, meaning that the control method will create a potential noise disturbance for neighbours. This problem may preclude their use, particularly where neighbours are in close proximity to one another, such as in life-style blocks. Various other non-harmful deterrents, such as laser emitters, are available, but their effectiveness (particularly long-term) is unclear. See Tracey et al. (2007) for a comprehensive review of non-harmful bird control techniques.

3.6 Removing or reducing availability of food sources

Removing food sources for peafowl as a potential control method may be most applicable in urban areas. For example, in California the public are warned that leaving pet food outside at night could attract peafowl into residential areas (Bradley 2000). Because problems with feral peafowl in New Zealand are primarily rural, removing or reducing the availability of food sources may not be feasible or effective. However, peafowl have been observed feeding on calf meal in feeding troughs in the Bay of Plenty (Greg Corbett, Environment Bay of Plenty, pers. comm.), and farmers may be able to refine feeding methods to reduce the availability of these types of resources to peafowl.

3.7 Exclusion from nesting and roosting sites

A number of exclusion devices (e.g. electric wires and monofilament lines) have been used to prevent nuisance birds from nesting or roosting in urban areas. This method is unlikely to prove effective for feral peafowl in rural areas because peahens are not a communal nesting species and their nests are carefully hidden on the ground and difficult to locate, and because peafowl will have access to a number of tall trees for roosting within their home range. See Tracey et al. (2007) and Morriss (2009) for further discussion on bird exclusion methods.

3.8 Fertility control

A bait containing nicarbazin (OvoControl®) has been developed in the USA as a fertility control agent for pigeons, Canada geese (*Branta canadensis*), and ducks (http://ovocontrol.com/, accessed 7 March 2011). Recommended use for registered species in the USA includes daily treatment using an automatic feeder that distributes bait at a certain time every day (usually dawn). Birds quickly become accustomed to this feeding regime. OvoControl® is considered very effective and is purported to interfere with hatchability in approximately 95% of eggs from treated birds (Bynum et al. 2007). Ovocontrol® is non-hazardous and supported by all of the leading animal welfare organisations in North America; however, Ovocontrol® has not been registered for use in New Zealand (although nicarbazin is registered as an anticoccidial agent in poultry in New Zealand; https://eatsafe.nzfsa.govt.nz/web/public/acvm-register, accessed 9 March 2011).

There has been discussion in the USA about using OvoControl-G® (registered product for geese and ducks) as a fertility control agent for peafowl; however, peafowl are not formally

listed on the Ovocontrol website (see above) as a target species. Before OvoControl-G® could be used for fertility control of peafowl in New Zealand it would need to be assessed as a hazardous substance by ERMA, with approval sought for either its experimental use in containment or its full-release. In addition, approval would be required from the Standards branch of MAF for its use as a pest control agent, in terms of its efficacy, toxicology, animal welfare, residues, public and operator safety, and non-target risks.

In the USA, pre-baiting is recommended before applying OvoControl-G® at a rate of one ounce (0.028 kg) per bird per day. The retail cost of Ovocontrol® is US$6.25 per lb (0.45 kg). Thus it would cost US$6.25 (NZ$8.50) per day to treat a flock of 16 peafowl (assuming that the treatment for peafowl is the same as it is for geese and ducks). Because the Ovocontrol website recommends that treatment is continuous throughout the year, the initial costs of fertility control using OvoControl-G® will be high. For example, the cost of controlling 30 flocks (average flock size 16 birds) would be approximately NZ$92,000 for the first year. However, due to declining bird numbers, assuming no immigration from untreated flocks, the cost of bait will decline by approximately 50% during the second year of treatment (http://ovocontrol.com/ovocontrol-p/ovocontrol-g/solution-2/, accessed 7 March 2011). Similarly, costs might be further reduced if OvoControl-G® was found to successfully reduce peahen fertility if applied only during the breeding season (as was suggested by Bynum et al. (2007) for Canada geese). This method, although potentially expensive, could prove effective if all peafowl in a treated area were exposed to treated bait and there was no significant source of external recruitment.

Table 1 Options for control of feral peafowl in New Zealand

Control option	Pros	Cons
Do nothing	Peafowl remain part of the New Zealand landscape and satisfy the demands of those who value peafowl.	Peafowl damage will continue and likely worsen. Risks of peafowl range extension and population increase.
Shooting	Currently a legal lethal control option available to pest managers and landowners. May cause a short-term reduction in peafowl impacts.	Peafowl are cunning and become wary when hunted. Shooting is unlikely to have an impact in reducing peafowl densities at larger spatial scales or over the long term. Public opposition to lethal control of peafowl.
Poisoning	Can have immediate benefits if sufficient peafowl eat lethal doses. May be a viable option for widespread, long-term control of peafowl in rural areas.	Suitable pesticides are not currently registered for use on peafowl in New Zealand. Non-target species may be killed. Public opposition to poisoning operations. Probably not an acceptable option for the control of nuisance birds in urban areas.
Trapping	Currently a legal option for pest managers and landowners. May be the best option for nuisance birds in urban areas. Live-capture is acceptable to the majority of the public.	Peafowl are cunning and difficult to trap. Start-up costs may be high and checking traps is labour-intensive. Losses may be quickly replaced by immigration or juvenile recruitment. Unlikely to have an impact on peafowl densities at larger spatial scales or over the long term.
Rendering eggs unhatchable	Does not involve lethal control of birds. May be useful in urban areas where there is a greater chance of locating nests. May be more acceptable to the public.	Locating peafowl nests is likely opportunistic and rare. Will not have any measurable, long-term effect on peafowl densities.
Non-harmful deterrents	Acceptable to the majority of the public. May be an effective short-term technique locally.	Cost of buying and installing devices may be high. Some products can create noise disturbance. May be effective locally, but likely to shift the problem elsewhere. Not a long-term option.
Removing availability of food sources	Acceptable to the majority of the public. May be effective locally.	Impossible to implement on a broad scale. Not a long-term option.
Exclusion from nesting and roosting sites	May be effective in preventing peafowl from nesting or roosting on or near undesirable structures.	Not a viable option for large-scale peafowl control in New Zealand.
Fertility control	May considerably reduce juvenile peafowl recruitment. May be a viable option for widespread, long-term control of peafowl in rural areas. Because it does not involve lethal control of peafowl, it is likely to be acceptable to the majority of the public.	Expensive. Products (e.g. OvoControl-G®) require registering in New Zealand. If not used at a broad scale, immigration may negate any reductions resulting from reproductive control. Non-target species may be affected.

4 Comparative effectiveness of control options

For a peafowl control programme to be effective, a number of factors need to be considered. For example, are peafowl the key pest species, and if yes, where are the problem populations and approximately how many birds are there in the affected areas; what spatial scale is most appropriate to control peafowl; who will be involved in the management of the control programme; what is the desired outcome and is it clearly defined and measurable; is there a commitment for ongoing funding to ensure that the desired outcome is reached?

Because feral peafowl populations in New Zealand are found primarily in rural areas (Robertson et al. 2007), and the main complaints about them relate to the destruction or fouling of rural property, councils may consider that landowners should be responsible for peafowl control. A control programme by landowners would likely be undertaken at a relatively small spatial scale, i.e. at the level of individual farms or a group of neighbouring farms with a common peafowl problem. The desired outcome of such a control programme would be a reduction in peafowl density to an agreed level or local extirpation of peafowl flocks. Control options are limited for such a scenario, with many landowners already shooting peafowl in an attempt to reduce densities. Because peafowl become very wary of humans when hunted, it is difficult to get close enough to flocks to shoot them (Greg Corbett, Environment Bay of Plenty, pers. comm.; Bill Simmons, Animal Control Products, pers. comm.). Consequently, while farmers may have isolated successes, shooting as a control option would need to be intensive and sustained if it were to have any impact at the population level within the Horizons Region. Shooting is not considered a viable control option for peafowl in the Bay of Plenty (Hall & Mill 1998).

Trapping is another potential control option for landowners. However, this method also faces the problem that peafowl are very cunning and become shy and elusive if molested (Hall & Mill 1998). Horizons Regional Council would need to assist landowners to establish effective trapping protocols and provide relevant expertise and guidance from experienced trappers using proven trap designs (see City of Rancho Palos Verdes, California, website above). Even with professional expertise, trapping may be impractical in rural areas because of high start-up costs and because trap monitoring is labour-intensive (traps, by law, need to be checked every 24 hours), particularly if trapping were to be undertaken at larger spatial scales. Hall and Mill (1998) discount trapping as a viable control option in rural areas in New Zealand, but do state that live-trapping may be the only control method available in urban areas.

Poisoning was considered the most viable control option for peafowl in the Bay of Plenty (Hall & Mill 1998). Alpha-chloralose and DRC 1339 have proven to be effective pesticides on those species for which they are registered. Similarly, OvoControl® has proven to be effective on nuisance bird species for which it is registered in the USA. Currently none of these substances is registered for use on peafowl in New Zealand and although they are anticipated to be a viable control option, using them to poison peafowl would be illegal (Bill Simmons, Animal Control Products, pers. comm.). However, because they may be the best long-term option for controlling or eradicating feral peafowl populations in New Zealand, consideration should be given to registering alpha-chloralose powder, DRC 1339, and/or OvoControl-G®. OvoControl-G® may be particularly useful if there was public opposition to lethal control methods. Care to minimise or eliminate risks to non-target species would be required if these substances became registered for use on peafowl.

Control options such as rendering eggs unhatchable, non-harmful deterrents, removing or reducing availability of food sources, and exclusion from nesting and roosting sites may be useful short-term solutions in some areas but are unlikely to provide long-term solutions to assist landowners with peafowl problems.

Modelling peafowl population dynamics under varying levels of harvest (i.e. shooting and trapping), nest predation (i.e. locating nests and rendering eggs unhatchable), and fertility control may help to clarify the level of effort required for these control methods to be considered viable options.

5 Conclusions

- Feral peafowl can cause problems in rural and urban areas and the need for a viable control method has become apparent.
- Landowners currently shoot peafowl; however, because peafowl become very wary and elusive when hunted, shooting is not considered a viable, long-term method for reducing population densities.
- Pest managers need to determine the extent of damage caused by peafowl, as well as the likelihood that the problem will intensify and spread to other areas. Managers need to determine if a regional-scale control programme is warranted, and if it is, determine and define clear measurable outcomes and ensure that ongoing funding is available.
- Trapping has been used successfully to control peafowl in urban areas, but it is not considered a viable option in rural areas.
- Poisoning peafowl with the pesticides alpha-chloralose or DRC 1339 is considered a viable control option, as is reducing peahen fertility using OvoControl-G®. However, these substances cannot legally be used in New Zealand until they have been formally registered for use on peafowl with ERMA and approvals from the Standards branch of MAF.
- Because the public's view is likely to be polarised, with some people considering peafowl to be pests and others viewing them as an attractive addition to the countryside, conflict may arise over the use of lethal versus non-lethal control methods. Where such conflict arises, OvoControl-G® may be a useful control option.
- The cost (including registration) of using alpha-chloralose, DRC 1339 or OvoControl-G® is likely to be expensive but they may be the most viable, long-term options to control feral peafowl populations. Currently, shooting and trapping are the only legal methods available to landowners and pest managers.

6 Recommendations

Horizons Regional Council should:

- Assess the extent of peafowl damage and peafowl distribution and abundance in the region. Such information will quantify the magnitude of the problem caused by peafowl and consequently the level of management needed to control peafowl populations, and what justification there might be for further research to support registration of new products.
- Consider, as part of a future Envirolink project, modelling the potential for peafowl range expansion under New Zealand habitat and climatic conditions and peafowl population dynamics under various harvest strategies.
- Consider jointly with other regional councils with peafowl problems getting alpha-chloralose or DRC 1339 registered for use as pesticides on peafowl in New Zealand.
- Consider getting OvoControl-G® registered in New Zealand to control peahen fertility, because lethal control of peafowl may be deemed unacceptable by the public in some areas.
- Continue to use trapping and shooting until such time as pesticides or fertility control options are legally available for use on peafowl.

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horizons
regional council

11-15 Victoria Avenue
Private Bag 11 025
Manawatu Mail Centre
Palmerston North 4442

T 0508 800 800
F 06 952 2929
help@horizons.govt.nz
www.horizons.govt.nz