Feral Chicken Management Plan

GOVERNMENT OF BERMUDA
Ministry of Environment and Planning
Department of Conservation Services

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Executive Summary

The feral chicken *(Gallus gallus domesticus)* is a major source of noise nuisance, destruction of habitat, damage to crops and gardens, competition to native and endemic species and potential disease vectors impacting human health.

In 2011 it was estimated that there were at least 30,000 feral chickens roaming throughout the island. Chickens have a very high reproductive rate and with no natural predators their population will continue to grow exponentially.

A latent issue throughout the 20th century it is hypothesized that a major milestone was reached when many commercial and residential chicken coops were destroyed in Hurricane Emily (1987). Since then the feral chicken population has grown significantly and can be found in all major open spaces, golf courses, agricultural fields, residential areas, hotel and commercial properties.

Until such time as the private sector finds a suitable use, that meets the need of removing the problem of feral chickens, the priority for pest management must be euthanasia.

While the private sector can provide assistance to specific incidents of pest control, the strategic management of feral chickens is the responsibility of the government, due to their abundance, life cycle and wide ranging circulation patterns.

The aim of the management plan is to provide a framework for government led action to minimize the economic, environmental and human harm caused by feral chickens, through coordination, prevention, rapid response, research and education.

The plan will seek to eradicate chicken infestations within priority areas, to limit their spread and reduce impacts in all other areas, until such time as eradication is possible.

Key components of the plan include:

- the creation of a government led working group coordinated by the Department of Conservation Services.
- improved legislation to stop the release and feeding of invasive species into the wild.
- implementation of an integrated pest management strategy, customized to suit the conditions of each individual site and designed to be efficient and humane.
- The use of effective means of control including traps, nets, licensed shooting, baiting using the pest control product alpha-chloralose, Snatching and any other methods approved by the Minister responsible for the Environment.
- development of a public relation and awareness campaign.

The plan will be implemented using existing government personnel, as well as registered volunteers and contractors. The expected operating cost per annum, excluding costs associated with government staff is $30,000. This is accommodated for in the existing budget of the Department of Conservation Services (2014).

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1.0. Introduction and purpose of the plan

1.1. Purpose of the plan

The purpose of the Feral Chicken Management plan is to provide a framework for government led action to minimize the economic, environmental and human harm caused by the feral chicken (*Gallus gallus domesticus*) through activities that include coordination of resources, prevention of infestations, rapid response to public control requests, control strategies, research and education.

The plan is an evolving document which will be revised annually. Ongoing accomplishments and new information will guide the refinement and revisions of goals and strategies in future versions of the plan.

1.2. The need for control

For centuries humans have introduced plants and animals around the world, both intentionally and unintentionally. Most western food crops and domesticated animals are non-native species that help sustain our way of life. For example, managed livestock are examples of non-native species which are not invasive.

Only a small percentage of introduced species cause serious problems in their new environments and these are collectively known as "invasive species".

An "invasive species" can be defined as a species that is *1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health*[1]*.*

Figure 1: Coney Island Park infestation, 2012

Invasive species typically have high reproductive rates, disperse easily, and can tolerate a wide range of environmental conditions. Often, they lack predators in their new environments. As a result, invasive species may out-compete native species for prey or other resource needs (e.g. breeding sites). They may also prey upon native species, spread pathogens and parasites, or alter the genetic makeup of closely related species.

Feral animals are domesticated animals that have, for one reason or another, found their way into an un-managed state and become self-sustaining in the wild. Feral goats are considered invasive in various regions throughout the world, and feral chickens are considered to be invasive in Bermuda.

[1] International Union for Conservation of Nature

While uncommon, Bermuda is not alone in that feral chickens have become major nuisances in places such as Hawaii, New Orleans (after Hurricane Katrina), Key West, Los Angeles, downtown Miami and Pitcairn Island[2].

1.3. Why do we care?

The problems caused by feral chickens in Bermuda were highlighted during a stake holder driven Invasive Species workshop held by the Department of Conservation Services in 2003. These included:

1. crop losses- representing loss of quality food and income to the agriculture sector.
2. destruction of private and community gardens.
3. crowing roosters causing significant noise nuisance in residential and guest property areas.
4. potential human health risk as a reservoir for avian and zoonotic diseases (most notably Avian Influenza, Salmonella and Toxoplasmosis).
5. Rooster attacks on park users, hotel guests and members of the public in their residences.
6. protection of native and endemic species from predation and competition.
7. reservoir of fowl mite which can have a damaging effect on protected bird species such as the Eastern Bluebird.
8. scavenging on domestic refuse, contributing to the island's trash problem.
9. risk to road users and aircraft.

Figure 2: Crop damage, Wadson's Farm, 2013

[2] Google internet search 2012

1.4. Management goal.

The aim of the plan is to eradicate chicken infestations within priority areas by using various population suppression methods to limit their spread and reduce impacts in all other areas, until such time as eradication is possible.

1.5. Management objectives

The plan seeks to achieve this through:

1. **Coordination** - strengthen the coordination between government and non-government agencies;
2. **Early detection** - strengthen and support early detection mechanisms capable of identifying and reporting the appearance of a pest species in Bermuda and then specific areas before it can become established and control becomes less feasible.
3. **Rapid response** - develop a rapid response capability to implement eradication or containment procedures for the target species before the species can become permanently established.

4. **Control & management** - provide control of an established population through containment, abatement and other management strategies to minimize environmental, economic and human health issues.
5. **Research and risk assessment** - support or conduct research and risk assessment necessary to assess, prioritize and control the target species.
6. **Education and outreach** - provide current information on the target species, their negative impacts, methods of prevention and control to the general public and special interest groups.

2.0 Background

2.1. Historical context

Chickens along with cattle, goats, sheep and rabbits were introduced early in Bermuda's settlement for food and were kept by large segments of the population (c.1620)[3]. Historically a common sight on every homestead was a flock of half-wild chickens scratching around the house and fields hunting insects, seeds and berries, plus whatever feed grain they could scavenge. Many artists' depictions of Bermuda in the 19th century show chickens running through the scenes.

However the advent of refrigeration, modern shipping and increased U.S. competition led to the decline in local agriculture during the 20th century; which in turn led to a significant reduction in the reliance of chicken as a locally produced staple.

In today's society, purchasing processed chicken at the grocery store is now the norm. As such the half-wild chickens that were accepted in the past, as part of everyday life, are now subsisting and reproducing without a use to modern residents causing much damage and nuisance.

It is believed that the recent infestation came to prominence after Hurricane Emily (1987) and subsequent hurricanes, which destroyed many residential and commercial coops, thereby releasing chickens into the wild. Recently, birds have also been deliberately released from captivity by their owners who no longer wish to keep them. Feral chickens are also supported by sympathetic members of the public who view these birds as natural wildlife.

There is much anecdotal evidence suggesting there has been a significant increase in population over the last 20+ years. Based on island wide observations and site assessments it is estimated that there are over 30,000 feral chickens loose in Bermuda (2011[4]).

Today the problem is island wide with large populations of chickens seeming to concentrate in areas where supporting conditions are particularly good. These fowl now occupy open spaces, wooded areas, golf courses, farm lands, parks, nature reserves, restaurants, residential areas, hotel and commercial properties.

[3] R.E. Verrill,1902

[4] Pettit, 2012

2.2. Target species biology

The chicken (*Gallus gallus domesticus*) is a subspecies of the Red Jungle Fowl. Domesticated by man as early as the 7th century, the chicken has become one of our most important food staples. Today more than 50 billion chickens are reared annually as a source of food for both their meat and their eggs[5]. Most are raised using intensive farming techniques. Alternatively, chickens are raised using various free range techniques which allow chickens to roam freely on a farm. Other similar practices include *Yarding* or the use of floorless portable chicken pens. More commonly in the case of Bermuda, micro flocks (involving relatively small numbers of chickens) are kept in suburban or urban residential areas to control insects, utilize chicken waste as fertilizer, for eggs and meat and/or as pets.

Male chickens over the age of 12 months are known as roosters, whereas males under 12 months are referred to as cockerels. Castrated roosters are called capons. Correspondingly, female chickens under 12 months of age are known as pullets and those over this age are called hens. A pullet becomes a hen when she begins to lay eggs between 15-20 weeks. Roosters are not needed for hens to lay eggs, but are needed for egg fertilization to produce chicks.

Chickens tend to live 5-10 years, depending on the breed. Chickens are gregarious birds and live together in flocks; they have a communal approach to the incubation of eggs and raising of young.

Chickens are susceptible to parasites including lice, mites, fleas and intestinal worms. Chickens can also be affected by viral Avian Influenza, but more commonly by Toxoplasmosis and Salmonella bacterium[6].

Figure 3: A typical clutch of eggs from a feral hen, 2012

Figure 4: A feral hen with newborn chicks, Spittal Pond Nature Reserve, 2012

[5] Foer, Jonathan Safran (2009). "Eating Animals"Little, Brown and Company, USA.

[6] Shervon DeLeon, Atlantis Mobile Laboratories – *Environmental sources of Salmonella G in Bermuda*, 2013

Feral chickens are ground birds that can take flight in “short bursts” when needed. Chickens establish a pecking order with dominant males asserting right over food and nesting locations. Hens like to lay in eggs in the same locations and will return to areas that have proven successful in the past. Roosters crow to establish territory or to raise an alarm. During the heat of the day chickens tend to keep undercover in a shaded area. At night they will bed down in a group under or in a “roosting tree” where they will stay until dawn. On windy days chickens will typically stay hidden in sheltered areas. It is a mistaken belief that roosters only crow at dawn and can be commonly heard from 4am onwards. Chickens are most active during the early morning and late afternoon when they come out to feed.

High reproduction rate. Observations suggest that feral chickens have both a very high reproductive and chick survival rate, which may explain why areas under management seem to repopulate very quickly. For example, within one year a single hen can have 3-4 clutches of eggs, each comprising 8-15 eggs.

Thus, one hen can lead to the creation of up to 195 chicks per year One hen can lay 60 eggs in a year (4 clutches x 15 eggs); the surviving chicks grow and lay their own eggs – thus in 1 year up to 195 bird can be created by 1 hen. (Figure 5).

Food sources

Chickens are omnivorous in the wild, scratching soil for seeds, insects and animals as large as lizards and crabs.

It is worth noting that chickens will opportunistically feed on cockroaches; however as these insects are mainly nocturnal, they do not form a large part of the feral chicken diet. The main predators for cockroaches in Bermuda appear to be Cane Toads (*Bufo marinus*) and Yellow Crowned Night Herons (*Nyctanassa violacea*.[7]

Time (weeks)	Generations	Breeding females (20 week generation time)	Offspring (clutch assumed at 8 eggs)	Less 25% mortality	Females in clutch (assumes 4:1)
0	1	1	**8**	6	5
20	2	6	46	35	28
40	3	34	269	202	161
60	4	195	1561	1171	937
80	5	1132	9053	6790	5432
100	6	6564			

Time (weeks)	Generations	Breeding females (20 week generation time)	Offspring (clutch assumed at 15? eggs)	Less 25% mortality	Females in clutch (assumes 4:1)
0	1	1	**5**	3.75	3
20	2	4	20	15	12
40	3	16	80	60	48
60	4	64	320	240	192
80	5	256	1280	960	768
100	6	**1024**			

Figure 5: Chicken fecundity

[7] Maderios, personal communication, 2013

If one food source disappears, the chickens quickly adapt and move to other sources. Conversely, if there is a constant source of food the chickens will claim an area and stay. This is especially relevant when feral chickens are subsidized by humans who feed them and the limitation of food is a proven method of control.

Predators
There are no natural or introduced predators in Bermuda that consistently prey on feral chickens as a food source.

Cats (domestic and feral) may opportunistically prey on chicks but rarely on a full grown adult. In fact there is a growing understanding that feral chickens and feral cats co-exist around regular food sources (e.g. cat feeding stations).

The only birds large enough to prey on feral chickens are herons (from a variety of species) and crows (*Corvus brachyrhynchos*). However these species are noted to only opportunistically prey on chicks. Few migratory birds of prey remain long enough in Bermuda to make any impact on feral chicken populations.

Dogs, especially terrier breeds, are known predators of feral chickens. However strict dog laws ensure that contact between dogs and feral chickens is limited. As such, this source of predation is random and opportunistic.

Rats are also opportunistic predators restricted to taking chicks, and perhaps eggs, with limited ability to kill a healthy adult chicken.

2.3. Legal status of target species

There are several pieces of legislation that pertain to the control and care of animals, as well as management of birds, specifically chickens.

Farmyard and domesticated birds (fowl) can be defined to *include birds brought under close control by humans for purposes of communication (e.g. pigeons) clothing and furnishing (e.g. ducks), companionship (e.g. canary and pigeons) and food,(e.g. commercial poultry such as chicken, turkey, duck, goose) which are used for meat and eggs*[8]*.*

The Minister responsible for the Environment has the power to approve the destruction of any bird or bird species if found to be causing a problem to agriculture, fisheries, public health or public safety. Furthermore, it is illegal to allow poultry to wander off one's property and/or into the National Park System.

The Protection of Bird Act 1975 has responsibility for the protection of Bermuda's birds. Under the Act four species are named as pest species including, the house sparrow (*Passer domesticus*), European starling (Sturnus vulgaris), Great kiskadee (*Pitangus sulphuratus*) and the American crow (*Corvus brachyrhynchos*). Additionally all domesticated birds and poultry, including chickens and pigeons, are exempt from protection.

Section (4) *if the Minister is satisfied that for the protection of agriculture,*

[8] Online Medical Dictionary

fisheries, public health or public security it is expedient to control or destroy any bird or species of bird which is a protected bird, he may authorize the conservation officer or any other officer of the department (Department of Conservation Services) to take such measures for such control or destruction as the minister may approve.

The Care and Protection of Animals Act 1975 has responsibility to manage offenses of animal cruelty (8) (1) (b) *being the owner of the person having the custody or control of any animal in confinement or captivity or in the course of transport from one place to another, abandons it in distress or willfully neglects or fails to provide suitable and adequate food, water, shelter and care for it.*

(e) Willfully, without reasonable excuse, administers or causes to be administered to any animal any poisonous or injurious drug or substance; Punishment on summary conviction is imprisonment for 6 months or a fine of $500 or both such imprisonment and fine.

Summary Offenses Act 1926
Offenses against property (19) (i) *being the proprietor of cattle or poultry, permits such cattle or poultry to stray out of any land in his possession or occupation. The punishment of offenders (25) on summary conviction imprisonment for 6 months or a fine of $2,880 pr both such imprisonment and fine.*

National Parks Act 1986
(25) Power to make regulations
(1) Subject to this Act, the Minister may make regulations for administering this Act and for giving effect to its objects and intentions, and without prejudice to the generality of the foregoing, may make regulations for—

d) controlling the taking and use of animals in protected areas for any purpose.

(28) Punishment of offences:
Where a person commits an offence against this Act or any regulations made thereunder:

(1) Punishment on summary conviction: in respect of each offence imprisonment for 3 months or a fine of $1,000 or both such imprisonment and fine and, in the case of a second or subsequent conviction imprisonment for 6 months or a fine of $2,000 or both such imprisonment and fine; and in the case of a continuing offence a further fine of $200 for every day during which the offence continues.

(2) A person found guilty of an offence against this Act or any regulations made thereunder may, if there has been damage done to a protected area and the court thinks fit, be ordered to pay, in addition to any penalty for which he is liable for the offence, a sum not exceeding the cost of the damage done to the protected area, as assessed by the court.

National Parks Regulations 1988

Animals and fowls
(*7) No person shall, being the owner of, or in control of, any animal (including a fowl) -*

(a) cause or permit such animal to graze in a protected area;

(b) cause or permit such animal to stray on to a protected area.

(c) cause or permit such animal to disturb or take another animal (including birds, reptiles, fish or invertebrate animal) in a protected area.

The Agriculture Act 1930
(4) General functions of Minister
The general functions of the Minister shall be the functions hereinafter in this section specified -

(a) the Minister shall exercise a general supervision and control over matters concerning or connected with the practice of agriculture and horticulture in Bermuda; and shall promote the improvement of plants, the improvement of livestock, the prevention and control of animal and plant diseases, and exercise control over poultry and livestock care and management.

Agriculture Act (Control of Animal Diseases) Regulations 1947
(68) Day-old chicks; certificate
All day-old chicks landed in Bermuda must be certified by a competent authority to be not infected with pullorum disease.

(69) Poultry; certificate of vaccination
All half-grown or adult poultry landed in Bermuda must have been vaccinated against both fowl pox and laryngotracheitis before leaving the country of origin and must be accompanied by a certificate to this effect issued by a competent authority.

(70) Poultry; certificate of flock origin
All poultry landed in Bermuda must be accompanied by a certificate to the effect that the birds came from flocks which are not infected with the following diseases, that is to say, coccidiosis, fowl typhoid (Kleins disease) fowl pox, laryngotracheitis, fowl cholera, avian tuberculosis, aspergillosis (pneumonycosis or brooder pneumonia) and avian lice, mites and tapeworms.

*(*71) Minister may prohibit importation of poultry *if an outbreak of any of the diseases mentioned in regulation (70) occurs in an area outside Bermuda the Minister may prohibit the importation of any poultry from that area until the infection has subsided.*

Public Health (Milk and Dairy Farm) Regulations 1952

Management of Dairy Farm
(10) With respect to the operation and management of a dairy farm (whether or not the dairy farm is licensed under these regulations) the following provisions shall have effect, that is to say—

(d) no horses, pigs, dogs, cats, poultry or other animals shall be allowed to enter or remain in any part of a cowshed used for milking;

2.4. Policy review of target species

The Government has a mandate to manage invasive species.

A. Environment Charter for the UK Overseas Territories
Annex A (7) *To safeguard and restore native species, habitats and landscape features and control or eradicate invasive species*.

B. Biodiversity Strategy and Action Plan 2003

B.4.1*Identify all relevant Government departments and conduct an audit of their activities to identify areas where these interface with biodiversity (including invasive species, land use, pollution and climate change) and explore opportunities to modify practices.*

B.4.3. *Draft guidelines to ensure incorporation of due consideration of biodiversity conservation into departmental planning (including the issues of invasive species, land use, pollution and climate change).*

Additionally, both the National Parks Commission and the Board of Agriculture (2012) have formally requested the removal of feral chickens from their respective areas of responsibility; specifically the National Park System and all cultivated arable land and dairy farms.

It should be noted that it is not illegal for members of the public to take chickens from parks and nature reserves. However as there is no quality control or health assessments of these animals the government cannot encourage such activity.

2.5. Responsible government organizations

In addition to the general public and farmers, the government of Bermuda has 13 departments that are mandated to control feral chickens due to the ecological damage they cause, for health and safety reasons, or as land managers concerned with chicken infestations from an aesthetic, noise and general nuisance perspective.

Ministry of Environment and Planning

Department of Conservation Services (DCS). Responsible for the maintenance of 200 acres of Nature Reserves. It also has the mandate to manage protected species, biodiversity, threatened habitats and manage invasive species.

The DCS provides direct assistance to both the Bermuda Audubon Society and Walsingham Trust in managing their nature reserves.

Department of Environmental Protection. Responsible for agriculture, animal control and plant protection. It has a shared interest with the DCS with the control of feral animals, but is also responsible for enforcing *The Care and Protection of Animals Act 1975.*

Department of Parks. Responsible for the maintenance of 800 acres of amenity parks, beaches, government buildings, road-side verges and the Railway Trail. This department is additionally responsible for government properties including schools, post offices and roadside verges, all of which can experience major feral chicken infestations.

Ministry of Health and Seniors

Department of Environmental Health. Manages issues related to humans and the environment, such as mosquitoes and rats. Of special concern is the overall health of the public, health care institutions and ports of entry.

This concern is reflected in a relatively recent United Nations press release which states: *"Governments, local authorities and international agencies need to take a greatly increased role in combating the role of factory-farming, commerce in live poultry, and wildlife markets which provide ideal conditions for the (avian Flu) virus to spread and mutate into a more dangerous form..."*[9]

Health Care facilities including the King Edward Memorial VII Hospital, Mid

Atlantic Wellness Center, Summerhaven Rest Home, Sylvia Richardson Rest Home and Lefroy House report continual feral chicken infestations.

Ministry of Public Works

Waste Management.
Responsible for facilities such as the Tynes Bay Waste Treatment Facility and the Marsh Folly composting center. These areas continually have major chicken infestations.

Figure 6: Marsh Folly refuse clean out, 2012

Highways. Responsible for managing Bermuda's network of roads.

Bermuda Land Development Corporation. Responsible for the 700+acres of the former U.S. Base Lands including, Tudor Hill, the East End and Naval Annex. There are significant infestations throughout all residential areas and wooded lots.

West End Development Company.
Responsible for the management and improvement of lands west of Watford Bridge including the former British Royal Naval Dockyard and Boaz Island Housing Complex. Of particular concern is the Dockyard as a port of entry, the former Sally Port dump, Lagoon Park and the large wooded area on Boaz Island.

Ministry of Tourism Development and Transport

On behalf of the Department of Airport Operations (DAO), BAS-SERCO employs a marksman to manage the grounds and runways of the E.F. Wade International Airport to minimize potential for bird strikes to aircraft. Each year DAO applies for a permit under the Protection of Birds Act 1975 to cull birds that could cause problems to public safety.

Government Golf Courses.
Responsible for Port Royal and Oceanview golf courses. These areas continually have major feral chicken infestations.

[9] "UN task forces battle misconceptions of avian flu, mount Indonesian campaign". UN News Center. 24 July 2009.

Ministry of Community, Culture and Sports

Bermuda Housing Corporation. Responsible for the management of a number of housing complexes. These areas also continue to have major chicken infestations.

Bermuda Housing Trust. Responsible for management of senior housing complexes. These areas continually have major infestations.

Department of Youth, Sports and Recreation. Responsible for 10 Recreational parks including Bernard's Park, Port's Island and portions of Shelly Bay Park. These areas continually have major infestations.

Ministry of Home Affairs

Municipalities. Responsible for the City of Hamilton and Town of St George. These areas continually have major infestations in certain residential streets.

2.6. Affiliated non-government organizations

There are several non-government organizations and charities that have chicken infestations on their properties and/or are associated with feral chicken management and animal welfare.

Bermuda National Trust (BNT). One of the largest landowners and managers of privately owned protected spaces, nature reserves and agriculture fields with tenant farmers.

The BNT's properties are being impacted in the same ways as the Government Nature Reserves and Parks.

Bermuda Audubon Society (BAS). The charity whose mandate is to preserve Bermuda's bird species and threatened habitats. The BAS are also the owners of a series of privately owned nature reserves and are assisted by the Department of Conservation Services in their management. The BAS's properties are being impacted in the same ways as the government nature reserves and parks.

Bermuda Feline Assistance Bureau. The charity whose mandate is to provide support and manage the island's feral cat population. There is a strong correlation showing that feral chickens coexist in large numbers around feral cat feeding stations.

Bermuda Farmers Association. The association that advocates for the island's commercial farmers. Farmers are one of the groups worst impacted by feral chickens.

Poultry Fanciers. The charity interested in promoting and supporting different breeds of poultry as a part of their area of interest.

Society for the Protection and Care of Animals (SPCA). The charity whose mandate is to provide care and safeguard the welfare of Bermuda's animals.

2.7. Private sector affiliations

Private golf courses.
Includes Mid-Ocean, Tucker's Point, and Riddell's Bay. These properties regularly request service for infestations of feral chickens.

Meat & egg production.
There are two existing commercial businesses currently operating in Bermuda; Windy Bank Farms and Wadson Farm. Both raise chickens for food ("roasters") and the production of eggs. Both businesses have requested assistance for feral chicken management.

Private sector pest control.
Several private companies have provided some service including:

- **Bermuda Pest Control Services.** Contracted by the Department of Environmental Protection to experiment with Avitrol in the early 2000s. This service was discontinued after being considered to be ineffective.
- **Chickens Plus.** The only commercial business offering the service to trap and euthanize chickens. This service uses traps and the traditional method of "snatching" (which is the term used to describe catching by hand chickens while they roost at night).

It has been argued that it is not in the interest of the private sector to eradicate a problem area as efforts are usually restricted to a client's property only. Therefore a residual population of chickens usually remains in the area and proliferates after management efforts.

2.8. The Public

Breeders, homesteaders and pet owners. Members of the general public are encouraged to raise chickens, so long as they are well cared for as per the *Care and Protection of Animals Act 1975*. These managed flocks are, however, not allowed to wander off the owner's property as per *the Summary Offences Act 1926.*

Historically, chickens were kept by a large majority of households for food. Though this trend has significantly reduced over time there are still many households that keep chickens as pets, for egg production and/or meat.

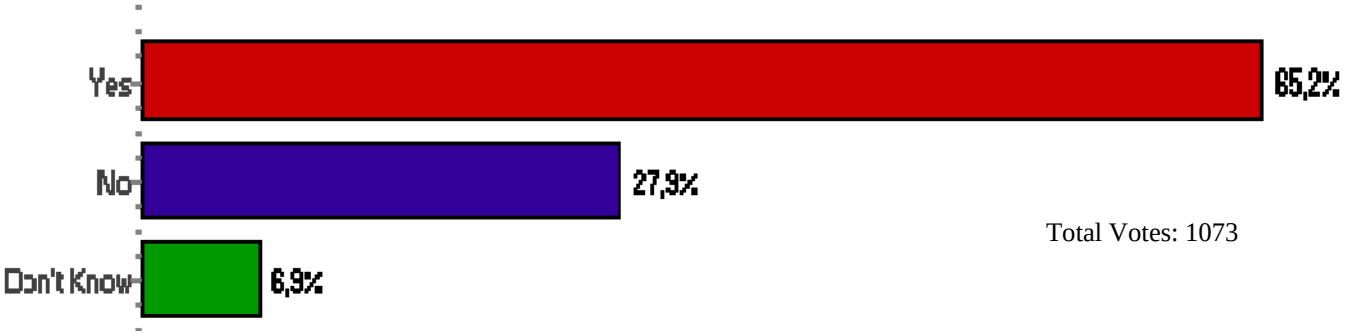
Feral chickens as a public nuisance.
Many members of the general public find feral chickens to be a nuisance either due to noise, physical damage to gardens and/or because of aggressive encounters with roosters.

Two performance surveys of the Department of Conservation Services were conducted in January 2012 and then June 2013. The first survey noted strong public opinion that not enough was being done to control feral chickens. The second survey indicated that feral chickens were still an issue to the public and that their control was the only area of department responsibility that drew significant numbers of complaints (24 of 400 interviews)[10].

An informal poll run by the Bermuda Royal Gazette in August 2012 illustrated that a large section of the public feel strongly that feral chickens should be eradicated (Figure 7).

[10] Measures to Improve Survey, Department of E-Government, (June 2013)

Figure7. Bermuda Royal Gazette Poll: *Should the Island's feral chicken population be eradicated?*
16th- 17th August, 2012



Without assistance, members of the public have taken the problem into their own hands in order to remove nuisance birds. This often results in the use of poison, which is a contravention to the Care and Protection of Animals Act 1975 8 (1).

Subsequent to the announcement of the Feral Chicken Management Program in August 2012, the Department of Conservation Services has received over 250 formal requests through a web based reporting system, from a diverse cross section of society, including hospitals, churches, rest homes, government departments, housing complexes, hotels, restaurants, golf courses, waste management sites, as well as private residences.

Of note is the finding that since the inception of the DCS program, the majority of members of the public are either unwilling to pay for the service or willing to pay for service only when the infestation has become particularly severe and therefore much harder to manage themselves.

Figure 8: Feral chickens scavenging in garbage, 2012

Figure 9: Handsome but aggressive rooster, 2013

3.0. Assessment of existing conditions and management

3.1 Distribution & concentration

Feral Chickens have been observed in every parish, habitat and setting throughout Bermuda. Chickens seem to concentrate in specific areas where supporting conditions are particularly good. These fowl now occupy open spaces, wooded areas, golf courses, farm lands, parks, nature reserves, residential areas, hotel and commercial properties. A sampling of the distribution and concentration of feral chickens is illustrated in Figure 10. Flocks typically range from 1-5, 1-10, and 1-30+ individuals. Several flocks can reside in one area, however as they are territorial, the individual flocks can be distinguished from each other.

3.2. Analysis of potential use of feral chickens as a resource

During the development of the plan a common question that frequently arose was "*Why can't humans eat this problem away?*" In order to answer this question the following were considered:

1. Safety and quality of the meat
2. Feasibility of a "capture and consume" campaign
3. Valuing the "resource"
4. Costs of meat and egg processing
5. Competition to private enterprise
6. Potential for exportation
7. Options for non-commercial use/consumption

Safety and quality of the meat.
The quality of the chicken extracted from the wild is dependent on several factors including:

- the variety of chickens being released by owners e.g. bantam (a typically small breed of bird commonly seen in the wild)
- age and sex, with random young and old, male and female, being captured.
- quality of food available to the chicken which ranges from the equivalent of free ranging on greenfield sites, to contaminated brown field and waste treatment sites.
- potential meat spoiling during the length of time from field to refrigeration. The culling method can also spoil the meat e.g. shooting has a high probability of spoiling the meat due to internal rupture.
- the meat of the local feral chickens is known to be very tough due to lack of fat content as a result of their active life style. As such the meat needs to be heavily tenderized in order to make it palatable. This would marginalize the appeal and use of the product.

As such there can be neither consistency of the product nor surety of quality. A recent research study has confirmed that Bermuda's feral chickens are carriers of Salmonella bacterium (2013[11]).

[11] Shervon DeLeon. Atlantis Mobile Laboratories – *Environmental sources of Salmonella G in Bermuda*, 2013

Currently there is limited motivation for catching chickens in the wild for food due to reasons already noted.

Consideration was given to encouraging the "harvest of feral chickens from parks and nature reserves. However there is human health concern regarding the consuming of chickens taken from the wild.

Consideration of a "capture and consume" campaign. Trapping can provide a number of chickens for any enterprise. However it has proven inadequate as the sole method for managing the feral chicken population. While it may satisfy a local demand, it will not address the primary problems of the high fecundity of feral chickens.

Potential value of the resource. Based on the estimated distribution across the island it is estimated that there are 30,000 – 50,000 chickens of varying pedigree, age, and gender roaming island-wide (2011[12]).

The retail cost for a locally raised roaster chicken that is 3-6lb in weight ranges from $24-$35 ($8 per pound, compared to an imported organic chicken that retails for $5 per pound[13]. Using the local rate of a roaster as a basis, the feral chicken population has a total value estimated to range $750,000-$1,050,000. It is useful to restate that the control of feral chickens is the management priority, and that domesticated chickens will always be preferable for human consumption over feral chickens for reasons of health, safety, consistency and cost.

Costs of meat processing for commercial sale. It can be assumed that in order to be commercially competitive, the cost of processing a feral chicken for consumption must be in the same range as a locally raised equivalent.

The potential benefit of using the feral chicken population as a food resource must be offset by the estimated costs of:

- Trap capture ($10 - $20 per bird)
- Feeding and housing during cleansing and/or rearing ($5-$10 per bird)
- Processing ($10 per bird)
- Packaging ($2 per bird[14])

The estimated base cost to process a 3lb feral bird for human food can be calculated in the range of $27-$42. Therefore the cost of utilizing this resource is estimated to range between $810,000-$1,260,000. This does not include for the costs associated with overseas toxicology testing of samples ($80 per bird)[15].

In conclusion, the total cost of processing exceeds that of the base values of the resource.

Comparison of imported chicken. An imported non-organic broiler chicken can be purchased at a local grocery store for $3.50 per pound, whereas an imported organic chicken can be purchased for $5 per pound (grocery store pricing comparison[16]).

Other products. Consideration was also given to the use of feral chickens for their feathers and manure. This was

[12] Pettit, personal communication, 2012
[13] Pettit, retail comparison, 2013
[14] Wadson, personal communication, 2012
[15] Walker, personal communication, 2013
[16] Pettit, personal communication, 2013

found not to be economically viable due to the high capital start up and operating costs associated with a local product, in comparison to commercially available products available from international suppliers. Similar limitations would apply to the local manufacture of manure.

Establishing a market and competition to private enterprise. In considering the feasibility of developing a market using feral chickens, the following must be taken into account:

- a large portion of the existing population are roosters (approximately 15,000 assuming an equal sex ratio) and not useful as egg layers.
- the majority of feral birds are of bantam descent and are small in size.

This renders a significant portion of feral chickens, if not all, either unproductive or undesirable in comparison to commercially available products. Additionally, it provides little incentive to expend significant effort to trap these animals for such a purpose.
An alternative considered would be to start a commercial enterprise using imported chicks, made up of high quality "layers" of known sex.

The concept of developing a government managed chicken industry was considered but deemed not to be cost effective as well as unfair competition to existing business. Currently existing local producers meet the local demand for eggs and meat.

Should global markets change through a breakdown in medium to long term availability, then the local use of feral chickens could become a more cost effective enterprise.

Exportation of product. There is no substantial difference from any Bermuda product compared with those found in the U.S, Europe or the Caribbean.

The low cost of production in the United States compared to the high production and transport costs associated with all components of a Bermuda product(s) makes it cost-prohibitive to develop an export market, without subsidy from the government. This would further be in competition with local businesses.

Non-human consumption of feral chickens. Consideration was given to the use of feral chickens as fish and lobster bait. This would also have the additional benefit of reducing their reliance on diminishing local bait-fish stocks. This was trialed using both feathered and plucked chickens, and found not to be effective as bait (2009[17]).

Conclusion. Due to the high costs associated with extraction, processing and packaging, lack of consistency and low quality of meat there is limited commercial use for Bermuda's feral chickens.

There is a lack of legislation or policy to manage the consumption of feral chickens. Without quality control the government cannot encourage this activity. Until such time as the private sector finds a suitable use that meets the need to eradicate feral chickens, the priority for management must be culling.

[17] Board of Agriculture, minutes, 2009

3.3. Current Management Programs

Historically, the Bermuda Government has made many efforts to address the feral chicken problem with mixed results. In the mid 1990s cage traps were provided to crop farmers who were experiencing significant losses. The strategy was evaluated as not cost effective and as such was discontinued. Another trial was conducted with a private firm in 2004, and again was deemed to not be effective.

The Department of Environmental Protection (DEP). Historically DEP provided service to manage feral chickens, predominantly using cage traps. However their efforts have been curtailed with a lack of transport and realized inefficiency of trapping. DEP has in the past has experimented with a variety of culling methods including net guns, traps, shotguns, air rifles and Avitrol (a commercially available bird poison used for flock dispersal).

The Department of Conservation Services (**DCS)**. In October 2011 DCS began an experimental program aimed at addressing the problem within government managed lands and adjacent areas that acted as "recruitment sources" for those areas.

This program was expanded to include privately owned areas in order to effectively address point sources of infestations. This was officially announced by the Minister of Public Works (August 2012).

DCS experimented with a wide range of techniques that included cage traps, modified turkey "Snap" traps, drop and cast nets, net run/cage combinations, air rifles, shotguns, traditional methods such as alcohol soaked bait and "snatching", as well as the use of an alpha-chloralose pest control product.

The program concentrated its efforts on a broad spectrum of "hot spots" that included:

- areas surrounding the Airport, including Cooper's Island Nature Reserve and Clearwater Park;
- Oceanview golf course, Tynes; Bay and the Bus Depot;
- The Botanical Gardens park;
- Spittal Pond Nature Reserve;
- Railway Trail/Riveria Crescent area;
- Government Quarry/Midocean and Tucker's Point golf courses;
- City of Hamilton;
- Marsh Folly and Tynes Bay waste management facility;
- private housing;
- Housing complexes such as Fergusson Park, Alexandra Road and Southside;
- agricultural fields.

Euthanasia methodologies
Between August 2012 and October 2013, 11,500 feral chickens were culled using approved and humane methods which have included a carbon-dioxide gas chamber, cervical dislocation or use of firearms (Figure 10).

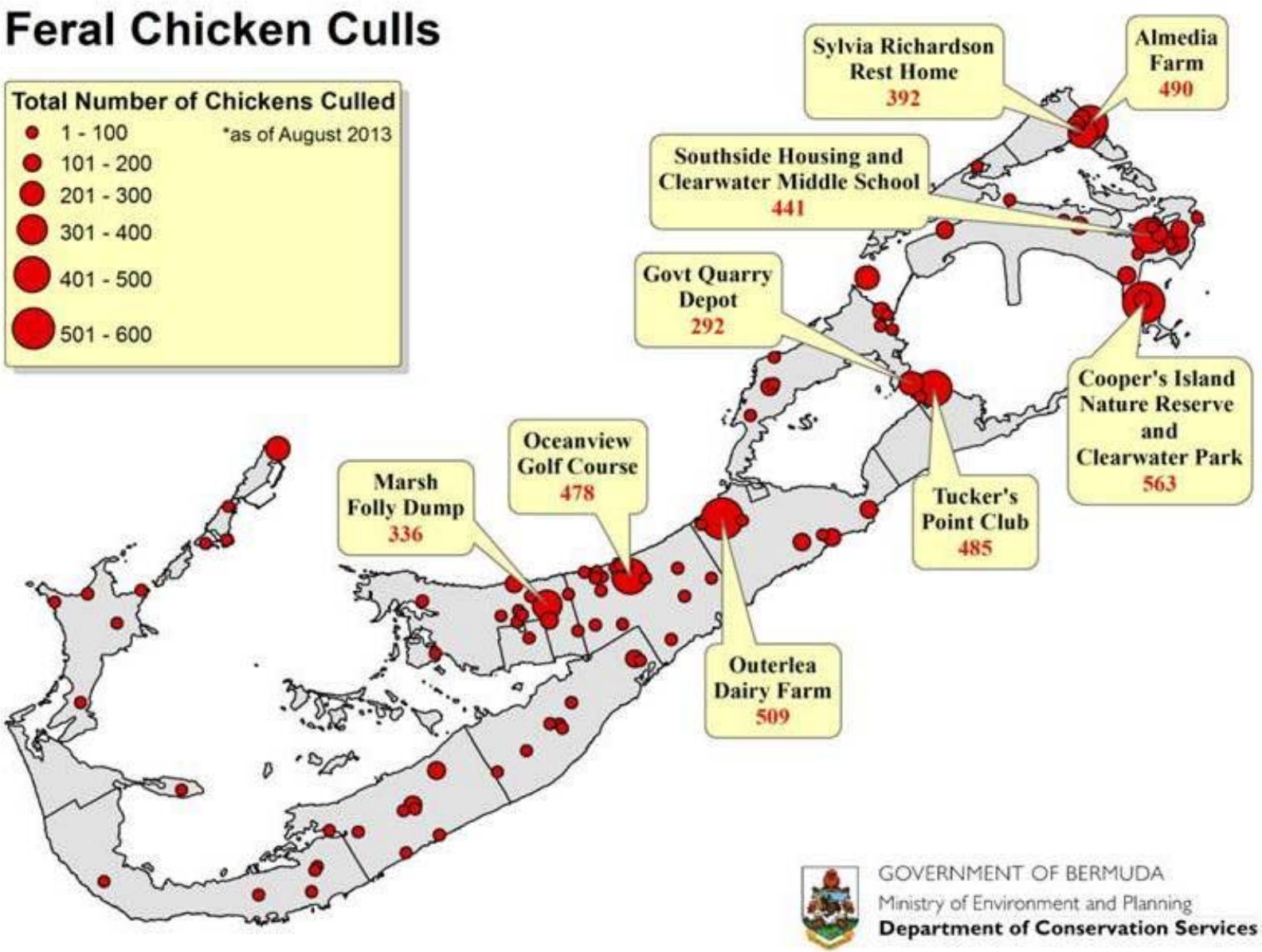


Figure 10: Feral Chicken culls

4.0. Comparative effectiveness of control options

Feral chickens are gregarious and territorial ground birds with restricted ability for flight. The following details a comparison of all the control options researched and trialed during the Department of Conservation Services' pilot study.

4.1. Mechanical Control

A. Trapping

This involves the capture of chickens alive, using a custom made device. All trapping methods rely on euthanasia and disposal of the remains after capture.

The duration of trapping operations can vary considerably from minutes to many weeks and in some instances trapping attempts can continue for months.

Typical bait used is bread and/or bird Scratch (a blend of grains used by animal breeders/farmers as a supplement to encourage natural pecking and feeding instincts).

Trapping has a high body retrieval count and one of the lowest "by catch" rates for non-targeted species.

A critical lesson learned was that an increase in manpower did not result in more efficient trapping of birds. It was found that feral chickens eventually learned to stay away from any type of trap and the residual population eventually reseeded the area.

Three types of traps were trialed:

Cage trap

This method relies on chickens being attracted by bait (figure 11). Once inside the trap they are restricted from leaving by a one way swinging door. These traps can catch on average 1-3 chickens per trapping session. They are deployed strategically in a problem area and baited with bread or Scratch.

These traps can be constructed locally and are relatively inexpensive to make.

Birds can familiarize themselves with foraging around and inside a cage trap after pre-baiting for 3-7 days. This reduces 'trap shyness' and improves the chances of trapping more birds. During pre-baiting the cage trap is fixed open.

Cage trapping operations should be successful after one week. If not it should not be attempted for at least 3-4 weeks between settings.

Figure 11: Cage Traps, 2012

Useful for:

- Properties with small flocks (1-4 chickens).
- Private landowners and farmers where time is not a priority and little training is needed.

Challenges:

- Cage traps are bulky and need dedicated transport using a large van or truck.
- Traps are prone to vandalism in public areas.
- Cage traps have been stolen and converted to illegal fish pots.
- Chickens need to learn to use the trap and survivors become trap shy.
- Highest level of servicing needed to monitor deployed traps, euthanize and dispose of caught birds.
- Must be combined with other methods to eradicate a problem in an area.
- Tend to receive complaints from public regarding cruelty to birds if left in cages too long.
- Takes the longest time of all methods.

Drop door trap

Similar to cage traps the drop trap (figure 12) is based on the well known box supported on a stick trigger that is pulled manually by a string. There are several designs and depending on size, these traps can catch 1-5 chickens each trapping session.

Traps are laid strategically in a problem area and baited with bread or Scratch. Chickens usually respond more quickly to entering this type of trap versus the cage trap. Drop door traps are less prone to vandalism due to constant supervision of the trapping personnel

Figure 12: Drop door trap. 2012

Useful for:

- Sites where chicken populations are fed by members of the public e.g. parks.

Challenges:

- Traps are bulky and need dedicated transport.
- Time consuming to operate.
- Dependent on materials traps could illegally be converted to fish pots.
- Labour intensive as personnel need to trigger, kill and dispose of caught birds.
- Always leaves a residual breeding population that is “trap shy”.
- Must be combined with other methods to eradicate a problem in an area.

Snap trap

A modified Turkey “Snap” trap which captures chicken inside a net (figure 13). This trap type was modified to be set off with a manual trigger on a pull string in order to increase capture rate.

The Snap trap is very portable and lightweight. Imported from the U.S. it is a recent experiment that has proven effective for small groups in specific situations. The Snap trap is best

Figure 13: Snap trap, 2012

deployed in areas where chickens are being fed by members of the public such as car parks, picnic areas and farms. Typically each trap can catch between 1-4 chickens per “trapping session”. The greatest number caught in a single trap was14 individuals (2012[18]).

Useful for:

- Sites where populations are fed by the public.
- Small dispersed populations.
- Useful for both chickens and pigeons.

Challenges:

- Relatively expensive to purchase and import.
- Chickens learn not go into the trap if used too often in one place. (Typically 2 week intervals are needed between use).
- Labour intensive, personnel needed to trigger, cull and dispose of caught birds.
- Ineffective for birds not used to being fed.
- Could be misused to deliberately trap other animals.

B. Shooting

Shooting involves a licensed pest control marksman, using a registered firearm, to target a chicken from a distance.

Shooting has proven to be one of the most effective means of controlling individual feral chickens. Without this means the issue cannot be managed.

Use of firearms is strictly controlled to ensure public safety and marksmen must abide by all police regulations. Current government policy is to restrict pest control firearm licenses, mainly to historically held licenses and government officers only (5 licenses maximum, 2013).

Concerns include security of shooters both on site and in transit as well as storage of equipment. This is addressed through strict adherence to police procedures including:

- Required firearms and ammunition licenses.
- Notifying Police Operations when on and leaving site.

[18] Pettit, personal communication, 2012

- Ammunition and firearms stored in separate alarmed safes when in residence and separately stored in a secure state when in transit.
- When not in use for prolonged periods the firearm and ammunition must be stored in the Police armory.

Firearms in use are restricted to:

Air rifle
The air rifle is a prohibited weapon under the Firearms Act 1973 and permitted use is only by a Temporary Firearm Permit**.** When used by an experienced marksman the air rifle is one of the most efficient methods of culling pest birds at a distance, and has proven to be the only effective method of culling pigeons and crows in Bermuda.

To illustrate, of the 7000+ chickens culled by DCS between October 2011-February 2013, 4200 (60%) were taken using the air rifle. Additionally, in a 4 hour period on Oceanview golf course 168 chickens were culled compared with the best record of 42 culled using the Drop trap for a similar period in a residential area.

The air rifle in use is .22 caliber, with an effective kill range of approximately 40 feet, using a lead pellet weighing 14.3 grams.

Of the five active marksmen, two provide routine volunteer assistance to the Department of Conservation Services on a case by case basis and one is a part time contractor. Two marksmen are government employees, one with the Department of Conservation Services and the other with the Department of Environmental Protection. This level of service, when used in combination with other methods, is believed to be adequate for the purpose.

Useful for:
- 1-2 isolated individuals at a time.
- Trap or bait shy birds.
- Birds that can only be controlled from a distance (e.g. in fields or trees).
- Critical for dealing with residual individuals left over from previous trapping or baiting efforts.
- Most sites except the densest urban housing area.

Challenges:
- Public fear of accidental shooting of human or non-target species.
- Lead contamination of the environment (minimal due to size of single pellet used).
- Security.
- Limited number and service capacity.
- Slow rate of fire.
- Risk of non-fatal wounding of target animals.
- Lower body recovery rate than other methods (some injured birds evade capture).

Shot gun
With a higher rate and wider field of fire than an air rifle, the shot gun uses a cartridge consisting of multiple steel pellets (not lead).

There are 4 active shot gun licenses for pest control. The shot gun is proven to be extremely effective at close range (up 20 feet) and is able to manage multiple targets with one firing (typically up to 4 chickens).

Useful for:

- 1-4 isolated individuals at a time in undeveloped open areas e.g. parks, golf courses and fields.

Challenges:

- Use of shotguns is very noisy and can cause public distress leading to 911 calls to the Police Communication and Operation Centre.
- Restricted use in public or residential areas.

C. Netting

A variety of nets have been employed, using different mechanical systems, such as cast and barrier nets. The results have not been satisfactory in terms of time, effort and cost of implementation.

Net Gun
The Department of Environmental Protection has experimented with a hand-held net gun with limited success. It is loud, cumbersome, the relatively small net is slow to deploy and is only useful in open areas[19]. A firearms license is required.

Air powered net launcher
The Department of Conservation Services will be experimenting with an air-powered net launcher in 2013 to field test its effectiveness in capturing large numbers of birds during each trapping session. It is anticipated that it will also be used or the control of feral pigeons.

Dip Nets
Dip nets have been shown to be essential as a secondary method for picking up birds which have been trapped, baited or shot.

D. Restriction and non-lethal methods

As a matter of good policy all domesticated chickens should be cooped in a suitable structure and owners should be advised to band their birds in case they do wander off their property; otherwise they are liable for destruction or for prosecution.
The Department of Environmental Protection S.P.C.A and the Bermuda Bird Fanciers can be contacted for advice on proper care guidelines.

There are a variety of commercially available products designed to scare pest birds from an area using windmills, flags and sonic repellers. These products tend to be novel stimuli to birds and are more effective as short term deterrents.

There are a number of exclusion devices that have been used to prevent nuisance birds from nesting or roosting in an area, such as electrified wires, monofilament lines, spikes, wire and nets. These methods were not trialed as they were unlikely to prove effective for managing feral chickens. Chicken nests tend to be carefully hidden on the ground and chickens roost in tall trees.

Fencing is not an effective means of containment, since feral chickens can fly for short periods and roost in trees, and fencing has a high cost.

[19] Pettit, personal communication, 2012

E. Snatching

Chickens have a habit of bedding down for the night in a roosting tree (figure 14).

Once there they do not move even if disturbed. As such it is possible to "snatch" chickens while they sleep.

Figure 14: Chickens in their nesting tree, Google

Using this traditional method a hunter can either noose or hand catch the chicken out of the tree and then humanely euthanize.

Useful for:

- Private landowners or groups who can manage the problem at night when they know exactly where the chickens roost.

Challenges:

- This method relies on knowing where the chickens roost at night, being able to access the area and physically reach the bird.
- Relies on working after hours, at night.

4.2. Chemical Control

A. Avicides and anesthetizing agents

Careful consideration was given to the use of avicides for bird control, with specific attention given to:

- Efficacy
- Toxicology
- Animal warfare
- Residue
- Public and operator safety
- Non-target risks

Starlicide (DRC 1339). A pesticide considered but not trialed due to its relatively slow acting nature.

Avitrol (4-aminopyridine). A commercially based poison specifically made for the control of pest birds. This product was designed as a flock dispersant and is commonly used in the U.S.A. It acts by causing pain to the animal which in turn results in the expression of alarm and panic. This product was trialed in Bermuda during 2006 and discontinued for the above reasons. This does not meet the aim of the program, which is to remove the animals from the environment by the most efficient and humane means possible.

Over proof alcohol. Alcohol soaked bread acts as a sedative on birds and is used as a traditional method of capture in the Caribbean. Experiments were conducted in Bermuda and found to be ineffective.

Alpha-chloralose paste. Alpha-chloralose is a commercially available pest control product that has been recently used in Bermuda for bird control (2012).

Alpha-chloralose is classified as a soporific or narcotic agent that anaesthetizes birds. It is designed not to kill but instead depress central nervous activity, slowing heart and respiration rates, as well as eliminating the sense of pain. It is considered the most humane of the available avicides (Tracey et al. 2007).

Alpha-chloralose is a paste that can be spread on bread and hand fed to target birds as per the pest control guidance note (appendix 1). Once ingested, comatose birds can then be collected and humanely euthanized. Non-target species can be revived by placing them in a warm dark place for a few hours.

The culling operation typically lasts for 1 -2 hours, during which as large numbers of feral birds can be sedated, captured and humanely euthanized. <u>It should be noted that extreme care must be taken in bait management to minimize exposure to non-target species.</u>

Useful for:

- Efficiently removing large numbers of feral chickens in an area. Alpha-chlorolase has proven to be the only effective and humane method of clearing large infestations.

Challenges:

- Uncontrolled and unregulated use of poison is illegal under the *Care and Protection of Animals Act.* The use of Alpha-chloralose is not authorized for use by the public and is only approved for use of the Department of Conservation Services.
- Complaints from concerned members of the public who have witnessed its soporific effect.
- Concerns over possible secondary poisoning of non-target species, including protected bird species, as well as cats and dogs who accidently consume the bait.
- Secondary poisoning of other pest bird species that have similar feeding habits as feral chickens (e.g. sparrows, starlings, pigeons and kiskadees).
- Consumption of feral chickens by scavengers or humans.

All of the above concerns can be mitigated by following the strict guidelines as set out in the *Pest Guidance Note - Alpha-Chloralose* (Appendix 1).

Alpha-Chloralose treated wheat product. A treated wheat version coated in alpha-chloralose product was trialed in Bermuda (2012). Its use was discontinued due to its greater impact on non-target species (e.g. protected birds) and the difficulty of retrieving any unused bait.

B. Sterilization

Research was undertaken into sterilization methods for Bermuda's feral chicken population. The intent was to allow existing chickens to remain in the wild but stop population expansion through reproduction.

Birth control. Chemically treated feed (e.g. "Ovocontrol" designed for pigeon control) is fed on a daily basis to the same birds as a mean of birth control.

Useful for:

- Homeowners who wish to have a pet population but who do not want to breed their chickens or have eggs.

Challenges:

- Damage and nuisance is still caused by existing birds.
- Costly, time consuming and technically difficult to ensure that the adequate dosage of chemical is on average regularly administered during the 7 breeding years for each female bird.
- Secondary impacts on native and song bird populations.
- Not a practical solution for the majority of sites.

Rendering eggs non-viable.
Eggs can be coated in paraffin oil or corn oil to suffocate the developing embryo inside, or they can be pierced with a nail and addled.

Useful for:

- Encouraging the hen to brood for the normal incubation period, thereby prohibiting her from laying additional eggs.

Challenges:

- Time consuming.
- High labour cost.
- Great difficulty in finding enough nests to make a discernible difference to the feral chicken population.
- Damage and nuisance is still caused by bird.

4.3. Biological Control

Caponizing (testicle removal) of roosters. The testicles are located internally which makes this a relatively complicated and costly procedure to undertake by surgery. This method is also costly as it includes trapping, surgery and recovery (estimated $200-300 per bird[20]).

Useful for:

- Allowing rooster to live out natural span of life.

Challenges:

- Must capture rooster.
- High labour cost.
- Needs the services of a licensed veterinarian.
- Rooster still crows and impacts the environment after being released.

Introduction of a pathogen or predator. This type of control was not considered due to the potentially long term and unknown risks to Bermuda's ecology.

4.4. Team organization

It has been determined that teams of 2 to 3 persons are most effective, regardless of the means of control. Furthermore, in order to be successful the teams must have transport.

4.5. Technique Summary

Observations from the field trials:

- **Trapping**. The most successful traps used to control feral chickens

[20] Bermuda Veterinarian Association, meeting discussion, 4th September 2013

in Bermuda are the Snap traps, rather than the labour intensive Cage traps, for flocks of up to 4 birds. However Cage traps are useful for small numbers of birds in rural situations or farm fields.

- **Shooting**. The most versatile tool is the air rifle for single or dispersed birds. This type of firearm is both quiet and accurate and any management program must include the use of an air rifle. The shot gun is useful as it can to target multiple chickens with one shot. However it can only be used in certain situations and as such should be considered as an ancillary method.

- **Chemical control**. The most efficient tool to manage large flocks of pre-baited birds is the sedative Alpha-chloralose. This plan recognizes the potential negative impacts that it has upon on non-target species; however this can be offset by controlled use of the chemical using the pesticide guidance note (Appendix 1).

- **Netting, sterilization, restriction and snatching** were methods tested but found to have limited effectiveness. Further sterilization using products such as Ovocontrol were deemed to be impractical and expensive but might find use in specific situations.

In summary, the most efficient means to address most situations of feral chicken infestations is the combined use of alpha-chloralose paste on bread and the air rifle to enable an efficient removal and retrieval rate.

5.0. Implementation

Realizing the long term and open ended nature of the problem the plan recommends a pragmatic control strategy with no finite date for eradication. Rather it sets a target to cull 8,000 birds per year, which it is anticipated will reduce the problem to a manageable level in 6 years while best using the available resources. This number will be adjusted on an annual basis.

It is useful to restate the goal of the plan which is *eradication within priority areas, coupled with population suppression to limit spread and reduce impacts in all other areas, until such time as eradication is possible.*

This section outlines accepted methodology, requirements for personnel, equipment, and other resources, anticipated budget and priorities necessary to meet the goals and objectives of the plan.

5.1. Authority

Plan approval

The Plan is approved under Section 4 of Protection of Birds Act 1975 by the Minister of the Environment after consultation with stakeholders listed below and consideration by Cabinet.

- The Board of Agriculture
- The National Parks Commission
- Bermuda Audubon Society
- Bermuda Farmers Association
- Poultry Fanciers

- Society for the Protection and Care of Animals (SPCA)
- Bermuda Feline Assistance Bureau (BFAB)
- Bermuda Veterinarian Association
- Bermuda National Trust

Legislation
It is proposed to create or amend legislation to make it illegal to allow invasive species, including chickens to wander, be released, fed and or supported in the wild. Furthermore, it is proposed to make it an offense to interfere with an officer in the course of their duty and/or to interfere with their equipment. Until such time as this legislation is developed the *Summary Offenses Act (19) (i)* and the Protection of Birds Act 1975 will be the legislative tools used to manage this issue.

Notice and prosecution
In addressing a suspected infestation the first course of action will be to investigate whether the subject chickens are indeed feral and not owned.

Should they be owned, the landowner will be advised that it is an offense to allow poultry to wander from his/her property and that they will be required to coop the chickens within two weeks of official notice.

If after that time the chickens have not been cooped or restrained, the land owner will face prosecution under the ***Summary Offenses Act 1926***. The landowner will be given the option of using a private contractor or the government service, which is free of charge, to remove the birds.

5.2. Management organization

The plan will be carried out by government staff with limited participation of private landowners and commercial pest control companies.
In order to increase efficiency an inter-ministerial working group will be created comprising officers and non-government stakeholders to coordinate the program. This will be coordinated by the Director of Conservation Services.

The primary team will be led by the Wildlife Ecology team of the Department of Conservation Service using department approved volunteers and specialist contractors as required.

Assistance will be provided as required from the:

Ministry of Environment and Planning
- Department of Environmental Protection
- Department of Parks

Ministry of the Public Works
- Waste Management
- Bermuda Land Development Company
- West End Development Company

Ministry of Health
- Department of Environmental Health

Ministry of Tourism Development & Transport
- Department of Airport Operations /BAS Serco
- Golf courses

Ministry of Home Affairs
- Corporation of St Georges
- Corporation of Hamilton

- Bermuda Housing Corporation
- Bermuda Housing Trust

Non-Government Organisations
- Bermuda National Trust
- Bermuda Audubon Society

Support can take several forms such as:
- personnel on a case by case basis.
- providing transport such as golf carts or other internal transport.
- informing staff of plans.
- keeping facilities open after hours.
- trapping.
- providing trapping data.
- on site direction.
- providing security during operations.

Advisory stakeholders
Information meetings with selected stakeholders will be held to gain input and address concerns as needed.
1. Bermuda Audubon Society
2. Farmers Association
3. Bermuda Poultry Fanciers
4. Society for the Protection and Care of Animals
5. Bermuda Feline Assistance Bureau
6. Bermuda Veterinarian Association
7. Bermuda National Trust

5.3. Early detection

The Department will develop an internet based map reporting form pinpointing sightings of not only this target species but eventually all invasive species. The application will be hosted on the department's website (www.conservation.bm).

This on-line application will allow technical staff and members of the public to quickly detect new areas where feral chicken populations have become established, as well as monitor areas already under management

Information to be captured will include GPS location (latitude and longitude), general site description, species identification, estimated number observed, site picture (wherever possible), date and time of observation.

This, coupled with the web based incident reporting process, will create a robust early detection system.

5.4. Rapid response & incident reporting

Incident reporting and response
All requests for assistance must be submitted via the online form on the Department of Conservation Services' website www.conservation.bm.

Information required includes address, parish, contact details, pest species, estimated number in pre-established ranges, pets on the property and acknowledgement of the methodology used. Upon submittal of the form, the date and time, as well as IP address of the sending computer are captured. An automatic acknowledgement of receipt is sent back to the submitter if an email address has been supplied.

The information from each form automatically populates an excel database which is used by technical staff to track work activities on each site. The system also generates a work order and sends it automatically via email to staff.

Requests can also be made in person at the Department's main office.

Department of Conservation Services
Shorelands, #17 North Shore Road
Flatts, Hamilton, FL03
(T) 441-293-2727

Requests will be addressed by the date received.

Field teams will record locations and numbers culled on a monthly basis. This will be consolidated into a single report and distributed to team members as well as the Bermuda Police Service to support firearms license requirements.

Priority

Priority will be given to the following areas due to commercial damage, human health & safety or impact to protected species and threatened habitats:

- Agricultural fields
- Ports of entry
- High density residential areas
- Nature reserves and parks
- Health institutions and senior housing
- Dairy farms
- Horse stables
- Golf courses
- Restaurants
- Schools

All other areas will be addressed as soon as possible.

5.5. Control & management

The proposed management methodology recognizes that feral chickens are:

- non-migratory and territorial
- restocked in the wild through local release and/or natural breeding
- omnivorous and have no significant predators in Bermuda
- a pest and not protected under legislation
- Only active during the day

Understanding the many scenarios in which feral chickens can be found and the nature of these birds, no one single control method has proven completely effective; rather a variety of methods must be employed. All of the methods have been reviewed for effectiveness and will be employed to minimize any element of cruelty.

As such an Integrated Management Strategy will be used based on the general strategy outlined below. This strategy will be amended as necessary to best manage each individual situation.

A. Primary methods

1. Chemical – alpha chloralose paste

Situation - 5+ birds that have been pre-baited

Will be used under strictly controlled conditions and by authorized government employees, only as per the pest guidance notes for alpha-chlorolase (Appendix 1).

2. Air rifle

Situation 1-2 birds and/or dispersed wild populations

Will be used under strictly controlled conditions and by authorized government employees. All proper precautions will be taken with

landowner's permissions given and police notified of action.

3. Combined use of chemical control & air rifle

It is recommended that the most effective combination of methods is the use of alpha-chlorolase paste to reduce chicken numbers and the air rifle to remove any residual individuals from an area.

B. Secondary methods

The methods detailed below will be employed when necessary and in combination, depending on the specific situation.

Traps

Snap traps

Situation – 1-4 birds that have been pre-baited in areas where the approved chemical, cage trapping or shooting is problematic. (E.g. a small number in a public space).

A snap trap could also be issued to each stakeholder group from the Department of Conservation Services. That member will report back catch statistics on a monthly basis.

Cage traps

Situation – 5+ birds in rural or private areas with limited public accessibility to reduce vandalism (e.g. farmer's fields).

Cage traps are a longer term solution than the above methods and require daily supervision of each trap.

Cage traps will be built and stored at the Department of Conservation Services' storage facility at Cooper's Island for use. These will be signed out as needed.

Shot Gun

Situation – 3-5 bird flocks in rural/open areas (e.g. parks, nature reserves and golf courses).

All proper precautions will be taken with landowner's permissions gained and police notified of action. The use of the shot gun will be employed as a secondary method after all other methods have been deemed impractical for the situation.

Air powered net launcher

Situation – 5+ birds in level and open rural or private areas (e.g. farmer's fields, gardens or parks).

All proper precautions will be taken with landowner's permissions gained and police notified of action. The use of the air powered net launcher will be employed as needed for large groups in situations where there is a possibility of high by-catch of non-target species.

Netting, restriction and snatching will be used as and when needed.

5.6. Disposal

Retrieved carcasses will be disposed of at no cost at the Tynes Bay Waste Treatment facility. Carcasses will not be buried.

5.7. Hours of operation & fees

In order to encourage the public to support the management of feral birds the government will provide a full complement of service, as noted in Section 5.5. *Control and Management,* with no fee for service.

This service will be provided, during normal business hours - Monday to Friday 8:30am to 5pm excluding public holidays, unless otherwise approved. Users of the government service must use the approved application system, agree to the terms and conditions of the service and on the understanding that the service is provided on a first come/first serve basis - unless in a noted priority area.

Should members of the public require service outside of the above parameters the government will encourage the use of private pest control services to undertake management of feral birds, using unlicensed methods, that do not contravene the Care and Protection of Animals Act 1975 e.g. trapping and traditional methods such as Snatching - using humane euthanasia practices. Members of the public who chose this service will be charged at market rates directly by the contracted company.

5.8. Monitoring

DCS will monitor its outputs against the plan's objectives and protocols in order to monitor effectiveness.

Tracking and Mapping. DCS will compile request sites and statistics into a single database which in turn will be linked to a GIS generated map. The map will be issued in conjunction with the monthly report.

Follow up visits. Sites will be revisited the day after any baiting has been used and monitored every two weeks for residual populations or secondary populations that claim territory from the removed primary group.

5.9. Research & risk assessment

The plan will provide guidance on research monitoring and assessment tools. This will support statistically sound and repeatable standard techniques that can be applied to multiple habitats.

5.10. Education & outreach

Education and outreach is vital to the success of this plan especially with gaining understanding of the public, special interest groups, pet owners, as well as provide current information on the target species, impacts, methods of and control.

Training. Mandatory training will be given to all new employees including techniques to catch, euthanize and monitor the target species.

Public relations and education campaign. Press statements will be released as needed to update the public.

All information will be placed on the Department of Conservation Services website www.conservation.bm.

Signage will be develop and placed in feeding hot spots to advise the public not to feed feral chickens.

A handbook, pamphlet and poster will be developed to promote responsible chicken ownership; require persons owning chickens to keep them cooped or otherwise controlled. These will be distributed to pet stores, stakeholders and will also be made available

electronically on the Department of Conservation Services' website.

In the interim, the Departments of Environmental Protection and Environmental Health Department to give advice on care and welfare issues.

5.11. Budget

The plan will use existing government personnel, as well as registered volunteers and contractors, to deliver the program.

The expected budget for the plan, excluding costs associated with government staff is $30,000 per annum. This operating budget will cover the fees for firearm licenses, security alarm costs, materials for traps, chemicals and contractor wages. This level of budget is accounted for in the forecasted operating budget of the Department of Conservation Services.

5.12. Action plan priorities

Action items will be updated on a yearly basis:

1. Creation of working group expanding on the existing program.

2. Approval of recommended management methods, service request system, data tracking and mapping system.

3. Manufacture of cage traps by DCS. To be stored at the maintenance building at Cooper's Island.

4. Supply approved traps to farmers/team members and the public.

5. Create an early detection web-based form to be hosted on www.conservation.bm.

6. Amendment/creation of legislation to address release of and feeding of invasive species, including feral chickens.

7. Public education campaign promoting good ownership practices, the damage invasive species do to Bermuda's habitats and wildlife, fines etc.

Information Sources

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APPENDIX 1

ALPHA-CHLORALOSE PESTICIDE
GUIDANCE NOTES

Alpha-chloralose

for Feral Chicken Control

1.0 Introduction

This product is to be used as part of an integrated pest management program to manage Bermuda's feral chicken population (***Feral Chicken Management Plan 2013).*** Alpha-chloralose is to be used specifically in urban situations where trapping has proven ineffective or air rifle use is not possible.

This guidance noted includes a description of alpha-chloralose, pharmacology, toxicity, recommendations for safe preparation, use and disposal. It describes its health effects, first aid, treatment of non-target species, limited environmental concerns, and symptoms of poisoning. Observations have been included from trials conducted by the Department of Conservation Services (August 2012).

These notes are issued as guidance only. Always READ THE PRODUCT LABEL and comply with all handling instructions before using, and understand symptoms of poisoning and the recommended first aid treatment.

1.1. What Is Alpha-chloralose?

Alpha-chloralose is classified as a soporific or narcotic that anaesthetizes/immobilizes birds rather than as a lethal poison. It typically does not kill but acts on the central nervous system, depressing central nervous activity, slowing heart and respiration rates and eliminating the sense of pain. It is generally considered the most humane of the available avicides (Tracey et al. 2007). As a result comatose birds can then be collected and humanely euthanized. Non-target species can be revived by placing them in a warm dark place for a few hours.

Alpha-chloralose was developed in the 1940s by the USDA.APHIS Wildlife Research Centre in the United States, to meet the need for an effective, safe, slow-acting toxicant to allow control of bird pests including starlings and blackbirds. Today it is used under specialized license in the U.K and is one of the main control methods used in New Zealand for nuisance bird control since the 1950s.

Alpha-chloralose is a white crystalline powder, with melting point 187deg C and low solubility in cold water. It may be dissolved in hot water and is much more soluble in alcohol. It is converted by acids and alkalis into glucose and chloral. Baits under trial include alpha-chloralose treated wheat supplied in 10 kg pails and alpha-chloralose paste in 500g tubes. Active Ingredient: 10% alpha-chloralose powder.

1.2. Pharmacology - How does it work?

Following ingestion alpha-chloralose is metabolised in the body to chloral, which in turn is largely converted to trichloroethanol. The latter compound is a CNS depressant, which combines with glucouronic acid in the liver to form a pharmacologically inactive urochloralic acid. This derivative is readily excreted in urine. (Segec et al. 2006).

Studies of the effects of alpha-chloralose on birds report alpha-chloralose-induced sedation did not appear to cause stress. Untreated birds showed no negative response to birds in the same cage undergoing alpha-chloralose-induced sedation' (Woronecki et al. 1990). Affected birds in this study displayed torticollis (lateral flexion contracture of the cervical spine musculature so that the head is tilted to one side), fluid in the oral cavity, respiratory

irregularities and shivering. Tonic convulsions such as those induced by strychnine poisoning were not observed, but convulsion-like was behavior observed when birds in mid- to deep sedation were disturbed or startled by other affected birds staggering in near proximity (Woronecki et al. 1990). The latter observation is suggestive of hypersensitivity, and was also reported with alpha-chloralose use on gulls (Woronecki et al. 1990).

The main advantage of alpha-chlorolase is that is does not induce pain and therefore panic in the birds as some other avicides do. It has selective oral toxicity to birds, with mammals apparently less susceptible.

Typically, active concentrations of 2–2.5 percent alpha-chloralose in cold climates is suitable to stupefy birds that ingest it, allowing them to be collected and either recovered and released, or killed humanely. Concentrations in bait greater than 6 percent are necessary in warmer climates presumably due to the limited effects of alpha-chloralose on thermoregulation. Due to weight of feral chickens 10% concentration will be used for effect and appropriate precautions will be taken to minimize by catch of non-target species.

Comparative values of alpha-chloralose in a range of species (Krieger 2001).

Acute oral LD50 for rats 400mg/kg, mice 32 mg/kg, cats 100 mg/kg, dogs 600 to 1000 mg/kg (Cornwell 1969). The compound is often more toxic to birds than most mammals. Oral LD50 for starling 75 mg/kg, pigeon 178 mg/ kg, house sparrow 42 mg/kg, chicken 42 mg/ kg, mourning dove 42 mg/kg (Schafer 1972).

Fatal secondary poisoning as a result of eating a bird that has ingested alpha-chloralose should be considered, however it is highly unlikely for domestic animals to receive a fatal dose in this manner, as the quantity consumed is too small.

It is probable that hypothermia always accompanies anesthesia with alpha-chloralose in all species of animals. The deeper the level of anesthesia the greater the fall in body temperature. This explains why lethal toxicity is more likely when ambient temperature is below 15 deg celsuis (59 Fahrenheit). This temperature range is limited in Bermuda to only the coldest winter months. However it is noted that the optimum time to use Alpha-chloralose is during the cooler months of the year

1.3. Effects of alpha-chlorolase

Symptoms of narcosis in birds proceed through the following stages (Department of Conservation Services trials 2012)

a) After ingestion normal activity will continue (1-15 minutes).
b) Some reduced activity and affected birds will begin to stagger ‘drunkenly’ but still be interested in bait. Eyes remain open and affected birds cannot readily be captured (15-25 minutes).
c) Affected birds still interested in bait but stand with difficulty or in a hunched position with eyes closed or flickering. They will not move if approached quietly but will elude capture if disturbed. (25-35 minutes).
d) Affected birds become recumbent with head drooping and eyes closed. They remain still, apart from occasional wing and tail flapping, but will move when touched or handled. Birds can be captured with a hand net (35-45 minutes).
e) Affected birds remain motionless even when touched and may die from hypothermia if left undisturbed (45+ minutes).

2.0. General procedure

The following lays out the general steps for successful application:

1. Pre-baiting
2. Preparation of bait
3. Laying of bait
4. Euthanasia & collection of carcasses and bait
5. Disposal and decontamination
6. Monitoring

2.1. Pre-baiting (feeding)

The key to success for toxic feed is feed acceptance. Pre-feeding with untreated feed before using treated feed is essential. This may take a few days or as long as two to three weeks for some individuals. Any change in routine will be noticed by the birds, adversely affecting the result.

Pre-feeding for 3-5 days will usually be sufficient, but it may be necessary to feed for up to 10 days where chickens are naive to hand feeding. If using grain baits, lay in bait trays or on smooth surfaces (this allows for the recovery of any uneaten bait). Observe birds feeding to ensure that the target species (rather than non-target species) are eating the bait.

Always lay baits at the same time each day and wear similar coloured clothing.

Approach and depart from the operation area in the same direction each day and avoid any unnecessary disturbance of the operation area.

Prior to laying alpha-chloralose bait ensure that all pre-feed bait has been eaten or removed.

The day before you use it, half the pre-feed to ensure that no un-eaten non-toxic bait is left and that the birds will be hungry and readily eat the treated bait.

2.2. Preparation of bait

Pre- Treated Pest Off Wheat

Use pre-treated pest off wheat as per manufacturer's instructions. Generally keep wheat in sealed container until immediate use.

Keep all body parts covered, in particular use surgical plastic gloves at all times, and pour into plastic dish/plate.

Pest Off Paste on bread bait

Note chickens have limited ability to bite or chew off pieces of food, and rely on side to side shaking of their head and beak to break up bread pieces that are too large to swallow whole.

Select thinly sliced white sandwich bread at least one day old but not too stale. Before applying the paste, massage the tube well to mix the bait thoroughly. Spread the paste onto each piece of bread 1mm thick, like butter and make into sandwiches. Flatten "sandwich" to reduce thickness using heal of hand. Cut each "sandwich" in about 10mm squares to give about 25 small baits. If the baits are larger, they may not swallow them easily.

To increase the amount of alpha-chloralose paste on bread, warm it in a microwave after applying the first layer of paste (clean your microwave thoroughly afterwards). This will melt the paste into the bread allowing another layer of paste to be applied.

Health and Safety precautions

All persons handling alpha-chloralose in pure form or as a treated feed must use all the protective clothing and equipment listed in the material safety data sheet. All product must be handled in a well ventilated area, using a fume hood where possible. Avoid contact with skin and eyes. When preparing treated feed wear long pants, long sleeves (or equivalent coveralls) a washable hat, elbow-length PVC gloves, effective eye protection and a respirator fitted with dust particle cartridge. Place prepared bait in a sealed tupperware container.

Place all unused materials in separate tupperware containers including bread, cutting board & knife and paste.

After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash clothing, gloves and safety equipment.

All alpha-chloralose and treated feed should be safely stored in a dry locked container and be clearly labeled.

2.3. Laying of bait

Baits can be laid at any time during the day, however early morning and dusk are the most active periods for feral chickens.

For maximum control, more than one day's baiting will be necessary, but allow at least two days between successive baitings. Baiting should continue for 1 to 2 days for best results.

Alpha-chloralose works quickly. Hand feed or lay treated bait out when you can be sure that the birds will not be disturbed for at least 30 minutes. Ideally allow 30-40 minutes to pass before entering the area again, by then the birds should have had enough and will be asleep.

For treated bread bait best results are obtained by throwing bait piece by piece to single feral chickens. Bait in the open where possible to make it easier to retrieve target birds. Field trials show 4-5 pieces of bait for each bird are effective for full sedation.

For treated feed lay at the same time of day as the untreated feed was being put out. Feed should be placed in protected areas where wind will not blow it away, and where remains may be collected up and removed. Feed should be spread in several bands rather than a single heap, to maximise the number of birds feeding at one time.

Precautions to follow:

- Prior to the operation warn anyone who has access to the area not to touch bait or carcasses. Gain permission, name and contact details from the land owner. Ensure that all pets are restrained or housed, as they are attracted to flapping (semi comatose) birds and will scare other birds from the bait area. Ideally the general public should be excluded from the operation area and close surrounds.
- Never leave bait unattended. Maintain supervision while feed placement is underway, monitoring any non-target birds or animals taking the feed and following up on their fate.
- Do not drop treated feed in water or allow it to fall into water.
- Do not place treated feed if significant numbers of non-target species are present and likely to take feed.

- If possible place the treated feed on days when no rain is expected and the temperature low.

2.4. Euthanasia & collection of carcasses and bait

All chickens must be quickly and humanely euthanized by cervical dislocation or use of a CO2 chamber. Bodies must be placed immediately in a heavy duty trash bag.

It is unknown what diseases chickens might carry or transmit so as a precaution staff collecting and disposing of narcotized chickens must wear appropriate equipment such as coveralls, rubber gloves and dust mask. All equipment should be thoroughly washed after the operation.

After the treated feed has been placed, watch the area from an appropriate location in a calm manner. Note number of chickens feeding and the direction that any wander too.

To ensure success collect comatose birds with a hand net at 40 minute to 1 hour intervals. This can be done carefully during the operation without panicking the target birds. Birds will remain comatose for 2-3 hours.

- Ensure that no birds are removed for human or animal consumption.
- Ensure that there is no interference from other people or dogs.

2.5. Disposal & Decontamination

All carcasses are to be disposed of at the Tynes Bay incinerator to limit secondary poisoning. Once all birds have been destroyed or revived, all surplus bait must be collected, stored for immediate re-use or incinerated.

Make a final search for affected birds 45 minutes after all alpha-chloralose bait has been picked up.

After use all chemicals and/or treated bait to be placed in an approved chemical storage.

2.6. Monitoring

Reintroductions of chickens are likely to occur. As such monitoring will be required, even if eradication of the resident population is successful.

Continued monitoring and a combination of shooting and targeted poisoning using alpha-chloralose is recommended to remove the last individuals. Allow at least two days between successive placements of treated feed.

3.0. Environmental concerns

Alpha-chloralose is very stable in sunlight and treated feed can remain toxic for several weeks. Treated feed left out may dry and harden and appear unpalatable to birds, but will readily re-soften when exposed to dew or light rainfall.

As mentioned it is important to carefully collect all uneaten treated feed and dispose of it properly. Uneaten treated feed should be collected in a sealed plastic bag and burned at the Tynes Bay Incinerator.

4.0. Treatment for non-target animals

If bait is consumed by non-target animals the following treatments are recommended to maximise the chance of a full recovery. As the hypothermic action of the drug contributes to

its toxicity, sufficient warmth should be applied to keep the animal close to normal temperature level (25 to 28deg C).

The animal should be gently restrained in a towel to prevent self-injury. Place the animal in a well padded cage or box and placed in a warm dark and quiet place.

Affected animals will need to be kept under the above conditions until fully recovered and released.

Alpha-chlorolase should only be use on feral chickens and not purposefully used to target other pest species such as feral pigeons without further study.

5.0. Human Health effects

- Swallowed: poisonous if swallowed
- Eye: avoid contact with eyes
- Skin: avoid contact with skin
- Inhaled: harmful if inhaled, use a respirator.

5.1. First aid

If poisoning occurs call 911 immediately and get to a doctor or hospital quickly.

If swallowed: induce vomiting if patient is conscious

Eye: immediately flush with plenty of water for 15 minutes

Skin: wash skin thoroughly with soap and water.

If inhaled: remove to fresh air. If not breathing give artificial respiration. If breathing is difficult give oxygen.

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