



Maungatautari Ecological Island Trust

Workshop on Pest Control Methods

Held at Out-In-The-Styx Café, Pukeatua

28-29 April 2004

Chaired by John Simmons, Environment Waikato

**Notes collated by Joanna McQueen, University of
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List of attendees

Name	Company	City
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Bruce Thomas	Landcare Research	Nelson
John Innes	Landcare Research	Hamilton
Heiko Wittmer	Vertebrate Researcher	Hamilton
John Simmons	Environment Waikato	Hamilton
Keith Broome	DOC	Hamilton
Gordon Stephenson	Trust	Waotu
Cam Speedy	Epro Ltd	Taupo
Roger Lorigan	Epro Ltd	Taupo
Jo Ritchie	Auckland Regional Council	Auckland
Judy Gilbert	Windy Hill Rosalie Bay Catchment Trust	Great Barrier
Keith Calder	Karori	Wellington
Graham Ussher	Auckland Regional Council	Hamilton
Tim Lovegrove	Auckland Regional Council	Auckland
Roger MacGibbon	Xcluder	Taupo
Tim Day	Xcluder	Hamilton
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Karen Denyer	Environment Waikato	Hamilton
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1. Brainstorming Session

- Risks
- Stocktake what is there
- Decision making process
- Non-target species
- Methods of eradication
- Pre/post monitoring
- Ongoing monitoring
- Multiple versus specific targeting
- Tracking
- Access tracks
- Pest management – capacity building
- Residual methods
- Residual detection
- Importance of tendering content/contracts
- Sequence of eradication
- Costs
- Compulsory conditions to achieve
- Toxin
- Monitor for success
- Constraints
- Adverse and positive consequences
- Failure
- Distinguish fence/poison failure
- Scale and program design
- One-off versus repetitive
- Rodents/tall forests
- Residual commitment (last possum)
- Community involvement
- Fundraising
- Security of fence
- Surveillance
- Post poison monitoring and control
- Adjoining landowner buy in
- Prevention of reinvasion (minimisation)
- Emergency invasion response
- Bounties
- Cost
- Management outside fence
- Regulations/legislation
- Risk management strategies
- Project length
- Fence maintenance
- Contingency planning (post eradication)
- Accessibility
- Research/milestones
- Learning from experience

- Climate
- Practical experience
- Certainty/uncertainty of actions
- Topography
- Trigger points
- Review cycles
- Vegetation
- Prioritisation of species eradication
- Other experiences
- Inter-relationships between activities
- Experiment/ adaptive management
- 'best bet' strategies
- population levels
- carcass disposal
- control alternatives when reintroducing 'valued' species
- decision – pause points/ review procedures
- decision making – elimination – reintroduction
- reintroduction not compromising ongoing eradication
- who will do work
- cells as replicates?
- Technical difficulty of methods
- Species behaviour
- Fence breaches
- Information sharing
- Maximum acceptable eradication duration
- Public relations
- Transparent / honesty in information
- Buffer zones?
- Contractor vs. design failure
- Service providers
- Replication?
- Control history
- Pre-feeding?

2. Mammalian Pest List

- Deer
 - fallow
 - red
- goats
- pigs
- possums
- rats
 - ship
 - Norway
- Mice
- Cats
- Hedgehogs
- Mustelids
 - Ferrets
 - Stoats
 - Weasels
- Cattle
- Rabbits
- Hares

Fallow Deer

Primary Control

Hunting with dogs by professionals

Secondary Control

Jump-out points after fence has been completed
Important to establish where they are present before the hunting to
place jump-out points at right sites

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Habitat (supplejack) makes access and movement difficult

Risks

Adjoining landowner resistance

Timing

Shortly before fencing then as fencing occurs

Ecological Effect

Low

Milestones/Review Points

Secondary control implementation

Monitoring Techniques

Pre

Surveys – for sign by hunters with dogs and at exit locations

During

GPS kill points
Age, sex, jawbone analysis
Sightings/escapes

Post

Observation of sign

Post Eradication Management

Deer farming neighbours – ensure deer fencing maintained in buffer
zone

Potential to use DOC deer plan to establish/police a buffer zone
Use a deer fence outside the pest proof fence?

Additional Information

Probably only 30 animals or so on mountain
Probably only 10 people in NZ who can hunt them at such low densities
(Prohunt, Billy Curnow, Rotohunt)
References (methods, key contacts) are available from John Parks,
Cam Speedy.

Questions still to answer

What are the advantages of pre-fence control?
What time of year is best for eradication?

Action Points for Trust

Public relations with deer farming neighbours
Consider building a deer fence outside the pest-proof fence

Red Deer

Primary Control

Hunting with dogs by professionals, including evening hunts on farmland

Secondary Control

Jump-outs (probably higher success than fallow deer)

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Habitat (supplejack) makes access and movement difficult

Risks

Adjoining landowner resistance

Timing

Shortly before fencing then as fencing occurs

Ecological Effect

Low due to low numbers

Milestones/Review Points

Secondary control implementation



Monitoring Techniques

Pre

Surveys – for sign by hunters with dogs and at exit locations

During

GPS kill points

Age, sex, jawbone analysis

Sightings/escapes

Post

Observation of sign

Post Eradication Management

Deer farming neighbours – ensure deer fencing maintained in buffer zone

Additional Information

No non-target issues

Questions still to answer

Action Points for Trust

Public relations with deer farming neighbours

Goats

Primary Control

Hunting with dogs (not bailers but finders?) by professionals

Secondary Control

Judas goats (goats bearing radiotransmitters which group with existing goats to assist in finding them)

Control History

Recreational hunting

Constraints

Habitat (supplejack) makes access/movement difficult

Risks

Lack of access / bailers too early

Timing

Closely sequential with deer control

Ecological Effect

Low due to low numbers

Milestones/Review Points

Secondary control implementation

Monitoring Techniques

Pre

N/A

During

GPS kill points

Age, sex, jawbone analysis

Sightings/ escapees

Post

Observation/sign/Judas?

Audit with other hunters

Post Eradication Management

Goat farming neighbours in buffer zone

Professional response to future sightings

Additional Information

No non-target issues

Start by quiet hunting (deer, goats), use bailing after deer eradication

Questions still to answer

Carry out goat control concurrently with deer control?

Action points for Trust

Public relations with goat farming neighbours

Primary Control

Secondary by-kill from Brodifacoum, closely followed by trapping

Secondary Control

Hunting with dogs and Judas pigs (may be difficult to sight/shoot companions)

Control History

Recreational hunting

Constraints

Habitat (supplejack) makes access/movement difficult
Animal welfare (need food and water in traps if not checked everyday)
Number of traps needed (cost of traps)

Risks

Lack of access making it difficult to trap
Illegal releases

Timing

Closely sequential with aerial Brodifacoum drop. Wait for 1 month after poison drop and then assess need for trapping.

Ecological Effect

Moderate: Low numbers but noticeable at perimeter

Milestones/Review Points

Secondary control implementation

Monitoring Techniques

Pre

N/A

During

Sightings/sign

Age, sex

Post

Observation/sign/Judas?

Audit with other hunters

Post Eradication Management

Professional response to future sightings

Buffer control zone

Additional Information

No non-target issues
Trapping could start while fence is being constructed (funnel effect through gaps in fence).
Pigs are probably the most damaging to the fence
Cam Speedy and Theo Stevens (DOC) should be consulted about trap design

Questions still to answer

Action points for Trust

Cats

Primary Control

Secondary by-kill from Brodifacoum
Emigration out of fenced area

Secondary Control

Cage traps
Leg hold traps
Auditory lure, scent trail, trap

Control History

None

Constraints

Access – need for tracking ridges especially

Risks

High survivability/adaptability

Timing

August to October

Ecological Effect

High, especially once rodents eliminated

Milestones/Review Points

Search for cat sign 30 days after poison drop and trap using auditory lure/ leghold traps

Monitoring Techniques

Pre

Idea of numbers needed to assign ecological benefits later

During

Look for sign, trap using lures

Post

Use dogs to find, trap using lures

Post Eradication Management

Incursion risk high

Maintain a buffer zone

Desex domestic cats in surrounding area

Additional Information

Cats successfully eradicated on Little Barrier, Raoul, Marion (South Africa), Mayor and McQuarie Islands.

Better chance of elimination possible on mainland islands than on off-shore islands (no additional food washed in by sea on mainland island).

Suitable lures include salted rabbit meat (keeps fresh longer in trap), used cat litter from catteries.

Cat calls available on internet.

Questions still to answer

Action points for Trust

Consider subsidising cost of desexing cats to surrounding households (sponsorship from local vet?).

Investigate a simple device to play cat calls which can be left in bush for short periods.

Mice

Primary Control

Brodifacoum 20R dropped aurally. Two applications approx. 10 days apart.

Secondary Control

None available

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Bait formulation set by code of practice for aerial use of Brodifacoum so can't alter to make more suitable for mice.

Risks

Bait acceptance level (how many will take the bait)
Bait coverage (possible very small home range of a mouse, bait needs to land within home range)
Bait accessibility (needs to be small enough for a mouse to handle)
Not killing all mice (rapid breeding means population will build up very quickly)
Birds bringing live mice in

Timing

Poison in July to September (may be wider period)

Ecological Effect

High

Milestones/Review Points

Non-toxic bait penetration of canopy trial – how small can bait be and still penetrate canopy?
Review post poison

Monitoring Techniques

Pre

Tracking tunnels, snap traps to index numbers

During

Post

Extensive network of tracking tunnels, dogs, snap traps

Post Eradication Management

Fence surveillance

Vehicles, visitor protocols e.g. mice nests in packs

Additional Information

10mm bait (2g) may be preferable to a bigger bait for mice, but will need to assess whether a smaller bait can penetrate canopy. Also need to decide if other target species will get lethal dose with a smaller bait.

Cells create opportunity to monitor mice numbers at smallest possible level and thus determine the minimum monitoring needed over the whole mountain.

Mice successfully eradicated from:

Storm and Mana Islands (200ha – brodifacoum)

Enderby Island (710ha – 20T/A)

Motutapai Island (50ha – Brodifacoum A)

Warrenheip (Brodifacoum G)

Karori (Brodifacoum A/G in 25m² grid)

Rabbit Island (Brodifacoum 20P)

Allports Island (Brodifacoum G in 50m² grid)

Failures to eradicate mice:

Mokoia

St Paul

Mokoia Island:

- Bait stations at 50m intervals
- Eradicated Norway rats and mice population exploded
- Aerial drop of Talon 20p
- However, ICI had added bitrex to bait
- Some animals rejected bait with bitrex, so may be palatability issue

Best baits to use include:

Non-waxed baits

Non- bitrex baits

Questions still to answer

How small can bait be and still be effective?

Action points for Trust

Non-toxic bait penetration trial of different sized baits to assess what size falls through canopy easily and can still be manipulated by mice.

Norway Rats

Primary Control

Brodifacoum 20R dropped aurally. Two applications approx. 10 days apart.

Secondary Control

Trapping, alternative toxins

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Knowledge of Norway rat breeding etc.
Valley bottom access (need to have access for kill and monitoring devices) and track network for intensity of detection devices
Uncertainty of scale
Uncertainty of distribution on mountain

Risks

Swimming through culverts
Timing of breeding seasons
Bait shy
Vehicle protocol (nests in e.g. tractor toolbox).

Timing

May to August (probable?)
Potential to go to October?

Ecological Effect

High

Milestones/Review Points

Post poison drop; positive detection response

Monitoring Techniques

Pre

Traps in likely locations (stream sides)

During

Post

Tunnels, snap traps, gnaw sticks, bait interferences especially in high probability sites.
Pest off in bait stations
Dogs

Note: Trapping required to differentiate Ship and Norway rats

Post Eradication Management

Bait stations
Surveillance (especially of culverts)
Maintenance of buffer zone

Additional Information

Potential to test timing of poison drop in cells, or at least to put monitoring in place to find out about breeding cycle.
Norway rats have been known to cache bait on Breaksea Island – potentially leaving less bait for other animals to eat.

Questions still to answer

How late can poison drop be?
What is timing of breeding season?
Are Norway rats present and in what numbers?

Action points for Trust

Ensure protocols are in place for vehicle entry so that no rats enter on vehicles.

Ship rats

Primary Control

Brodifacoum 20R dropped aerially. Two applications approx. 10 days apart.

Secondary Control

Trapping
Alternative toxins

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Access and track network for intensity of detection devices
Arboreal rats
Uncertainty of scale

Risks

Timing – breeding seasons
Incursions – jumping in/falling from nearby trees/entrance via vehicle



Bait shy
Birds bringing live rats in
Bait palatability/preference

Timing

May – August
Potential to go to October?

Ecological Effect

High

Milestones/Review Points

Post poison drop; positive detection response
Know density and reproductive status of ship rats before poison drop

Monitoring Techniques

Pre

Tunnels
Snap traps

During

Post

Tunnels, snap traps, gnaw sticks, bait interferences especially in high probability sites.
Dogs

Post Eradication Management

Bait stations
Surveillance (especially of culverts)
Maintenance of buffer zone

Additional Information

- Potential to test timing of poison drop in cells, or at least to put monitoring in place to find out about breeding cycle.
- Ideal time to poison is before breeding season (spring) to ensure that females on nests are not missed or that young survive in a nest despite losing their parents.
- Eradication of rats has been achieved in Tongariro in mid-September, and in late November at Warrenheip. Few lactating females were found in late November at Warrenheip.
- Few attempts to eradicate rats have been made outside winter season.
- To eradicate ship rats at Karori involved 4 full time staff with volunteers.
- No evidence that rats are permanently arboreal and baits lodge in trees anyway.

Questions still to answer

How late can poison drop be?
What is timing of breeding season?

Action points for Trust

Ensure protocols are in place for vehicle entry so that no rats enter on vehicles.

Weasels

Primary Control

Brodifacoum 20R dropped aerially. Two applications approx. 10 days apart.
(secondary poisoning)

Secondary Control

Trapping
Dogs
Emigration from cells over fence

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Ability to trap very low numbers
Knowledge

Risks

Lack of knowledge for elimination
Weasel numbers likely to increase once stoats controlled

Timing

Poison drop mid August – mid October
Young vulnerable October – November
Young found in traps in February to April

Ecological Effect

Medium - high

Milestones/Review Points

About 3 months after poison drop can assess for official zero status

Monitoring Techniques

Pre

Tracking tunnels, especially for cells

During

Trap network on fence, tracks, ridges
Hair DNA – before and after?

Post

Dogs
Track tunnels

Post Eradication Management

Audit
Maintenance of buffer zone

Additional Information

Distinction between stoat and weasel footprints in tracking tunnels difficult.
Radio-collar studies not realistic with weasels.

Questions still to answer

Still questions over elimination

Action points for Trust

Ferrets

Primary Control

Brodifacoum 20R dropped aurally. Two applications approx. 10 days apart.
(secondary poisoning)

Secondary Control

Trapping
Dogs
Smeuse traps (trapdoor in fence)
Emigration from cells

Control History

Two 1080 carrot applications (1997 and 2003)



TB control for ferrets on perimeter

Constraints

Trapability – probability higher than stoats
Lack of knowledge for elimination?

Risks

Timing

Poison drop mid August to mid October (females pregnant)
Young vulnerable October - November

Ecological Effect

Medium (mostly on periphery – because rabbits are preferred prey)

Milestones/Review Points

About 3 months after poisoning can assess for official zero status

Monitoring Techniques

Pre

Radio collared ferret in cells to determine behaviour
Tracking tunnels

During

Trap network – fence, tracks, ridges
Hair DNA – before and after
Monitor radio-collared ferret to determine effectiveness of secondary poisoning

Post

Dogs
Track tunnels

Post Eradication Management

Audit
Maintenance of buffer zone

Additional Information

Scott Theobald (DOC Northland) has trained mustelid dogs.
Ferrets take carrion more readily than stoats
Ferrets successfully killed with brodifacoum drop at Warrenheip.
Best time for control is spring
Stoat traps will catch ferrets as well.

Questions still to answer

Action points for Trust



Stoats

Primary Control

Brodifacoum 20R dropped aurally. Two applications approx. 10 days apart. (secondary poisoning)

Secondary Control

Trapping (especially around fence in cells)
Dogs

Control History

Two 1080 carrot applications (1997 and 2003)
TB control for ferrets on perimeter

Constraints

Trapability – 15% probability of trapping trappable stoats. 20% will not go into a trap at all.

Risks

High risk to wildlife at low numbers
Pregnant stoat incursion a high risk

Timing

Poison drop mid August to mid September (females pregnant)
Young vulnerable September – early November
Young will be caught in traps by January

Ecological Effect

High

Milestones/Review Points

Review about 3 months after poison drop

Monitoring Techniques

Pre

Radio collared stoat (especially in cells) to determine behaviour
Tracking tunnels

During

Trap network along fence, tracks, ridges
Monitor radio collared stoat to determine effectiveness of secondary poisoning

Post

Dogs
Track tunnels

Post Eradication Management

Strict protocols to manage against incursion risk
Maintenance of buffer zone

Additional Information

Two times that stoats can be put under pressure:

Gestation

Young in nest

Stoats born in October, young appear in traps in December. Food supply critical for females in mid-August. If body condition low, abortions occur. If rodents removed at this time, will have major effect on stoat fertility. Young are vulnerable September to November.

Good chance stoats will leave cells once rats at a low level.

Questions still to answer

Action points for Trust

Possums

Primary Control

Brodifacoum 20R dropped aerially. Two applications approx. 10 days apart.

Secondary Control

Trapping

Dogs

Bait stations with Brodifacoum

Control History

Two 1080 carrot applications (1997 and 2003)
Bait stations and trapping on margins

Constraints

Bait shyness

Access – detection of survivors

Risks

Competition for bait with rats

Bait shyness

Neophobia

Non-target risks e.g. morepork



Timing

Post fence completion
June to October

Ecological Effect

High

Milestones/Review Points

Review post poison
Review pre monitor design

Monitoring Techniques**Pre**

Residual trap catch (RTC), low numbers

During**Post**

Good knowledge for design/ probability

Post Eradication Management

Maintenance of buffer zone (TB management)

Additional Information

Possums eradicated from the following islands:
Kapiti, Codfish (1350ha), Motutapori (50ha), Rangitoto (2200ha),
Motutapu (1580ha), Karori (220ha).

Questions still to answer

Should the two cells be used for trial on eradication techniques?

Action points for Trust

Hedgehogs

Primary Control

Brodifacoum 20R dropped aerially. Two applications approx. 10 days apart.

Secondary Control

Trapping
Bait stations

Control History

Two 1080 carrot applications (1997 and 2003)

Constraints

Hibernation
Lack of knowledge on behaviour
Brodifacoum not registered for use on hedgehogs

Risks

Lack of knowledge
Timing for optimal ecological benefit
Critical to avoid hibernation

Timing

Need to avoid hibernation for maximum kill rates
Later in year?
November?

Ecological Effect

High for invertebrates, frogs etc

Milestones/Review Points

Monitoring Techniques

Pre

Rodent tracking tunnels

During

Radio tracking
Bait station interferences
Fenn traps

Post

Bait station interferences
Fenn traps

Post Eradication Management

Maintenance of buffer zone

Additional Information

Hedgehogs hibernate over winter, but still wake to feed periodically. Males waken from hibernation earlier than females. In warmer regions, hibernation is short or doesn't occur at all. At Maungatautari, all hedgehogs may be out of hibernation by September (but this needs to be tested).

Experts on hedgehog ecology:

Raewyn Empson (Karori paper), Daryl Jefferies (thesis), Bob Brockie, Chris Jones.

Questions still to answer

Should the cells be used to compare timings to target hedgehogs while still killing rats, mice etc?

When do hedgehogs come out of hibernation on Maungatautari?

How large is a hedgehogs home range?

Action points for Trust

Hares

Primary Control

Brodifacoum?

Shooting

Baiting – oats, carrots

Smeuse traps

Secondary Control

Control History

Shooting on grassland

Constraints

Very large home range

Detection difficulty

Knowledge of home ranges

Access



Risks

Large home ranges, up to 100ha. Will include some forest.
Rabbit/hare relationship?

Timing

After poison drop

Ecological Effect

Low

Milestones/Review Points

Monitoring Techniques

Pre

Sign (spotlighting)

During

Post

Sign/dog detection

Post Eradication Management

Weekly fence surveillance
Maintenance of buffer zone

Additional Information

Questions still to answer

Action points for Trust

Rabbits

Primary Control

Brodifacoum 20R dropped aerially. Two applications approx. 10 days apart.



Secondary Control

1080 carrots localised
Dogs
Trapping

Control History

Shooting

Constraints

Fence for shooting
Access (Blackberry)

Risks

No digging proof inside of fence
Digging out – risk to fence integrity
Survival potential in forest in absence of predators

Timing

Post fence completion / after poison drop
Constant pressure needed
Possible need for trapping pre-fence closure

Ecological Effect

Low

Milestones/Review Points

N/A

Monitoring Techniques

Pre

Sign
Inside fence surveillance

During

Decoy animals - Animal welfare act / AEC?
Sign
Dog location

Post

Fence monitoring and audit

Post Eradication Management

Weekly fence surveillance
Maintenance of buffer zone

Additional Information

Questions still to answer

Action points for Trust

Trap rabbits before fence becomes enclosed.

3. Timing of Brodifacoum drop

See attached Gantt chart.

Poisoned bait should be dropped when food is at a minimum and animals are hungry and will eat all the bait. It also needs to occur when there is little chance of missing animals e.g. babies inside a nest or hibernating animals.

Timing will be a trade-off between certainty of getting all rodents and also getting hedgehogs.

There will be two aerial drops, traditionally 10 days apart, weather dependent. It may be possible to extend this gap to have one drop in August and one in October.

Alternatively, could go for two operations (i.e. 2x drops 10 days apart x 2). This would require a change in the code of practice for Brodifacoum use. This is unlikely to be feasible at this stage (at this stage, changes could hold up the code of practice for another year).

Also, hedgehogs have not been approved for killing by Brodifacoum, and thus cannot run an aerial operation on the basis of killing them. There would have to be significant numbers of rodents left to justify the second operation (and hopefully this would not be the case).

The cells provide an opportunity for trialling the timing of the Brodifacoum drops.

Weather might be an issue – needs to be stable and fine. There is a risk of more unstable weather if poison drop is carried out later.

A staggered poison drop in September and October was agreed amongst the experts present to give provide the maximum chance of success for killing both rodents and hedgehogs.



4. Use of the cells

Ideas as expressed at meeting:

1. First cell in year one, pests eradicated using best possible techniques. Second cell in year 2 to same formula.
Trust desire to put both cells in place ASAP
2. First cell early, second cell later. Apply findings to 3200ha. Analyse failure – what are the reasons?
Larger area then at risk (untested)
3. Non toxic trials outside cells to verify bait selection/timing etc.
4. Both cells done at same time. If successful, proceed to whole mountain, if unsuccessful, rethink and redo cells before attempting mountain.
***Trust does not have a chance to learn from different treatments for reintroduction of species.
5. Experimentation with timing. Southern cell early in year (rodent kill assured, but not hedgehogs). Northern cell later in year (hedgehogs killed, risk that not all rodents will be).
Not reproducible – any differences between cells can't necessarily be attributed to differences just in the time of year
6. Do cells at the same time using same technique and non-toxic trials to find best practice techniques. Learn the constraints under which the whole mountain will operate under.
7. Chance northern cell will have no possums by the time of the aerial drop (due to emigration out of cell). Also possible that stoats and cats will also be gone. Thus need to consider this when using cells to find best practice techniques for eradication of whole mountain.

Consensus amongst attendees that pest eradication in cells should be carried out at the same time using same techniques. Also carry out non-toxic trials to find best practice techniques. Analyse outcomes carefully and learn constraints under which whole mountain will operate under. Do not proceed to whole mountain until complete pest eradication has been achieved in cells.

Note: this consensus is largely to accommodate the will of the trust to move quickly. The attendees accepted that a scientifically stronger use of the cells could be made if their eradications were staggered by one year, because this would maximise learning opportunities.

5. Monitoring

Why monitor?

- To detect survivors
- To determine where survivors are (a tool for action)
- To detect incursions

What does Department of Conservation do?

- Monitoring on off-shore islands is dependent on logistics (e.g. length of trip often determined by use of Navy ships to get to island).
- DOC waits 2 years after operation before going back to search for survivors – if survivors were present, after 2 years, population should be large enough to detect.
- Use tunnels, traps and dogs (as many as logistically possible) e.g. chickens eggs in grids to find stoats, chocolate to find rats.
- Stratify for high risk areas – put more effort into surveying areas where pests are likely to be e.g. near a seabird colony and in huts.

What considerations must we take into account when monitoring?

- Essential to do a probability analysis of capture e.g. 20% of stoats will never walk into a tunnel, therefore can never monitor 20% of the population.
- Need to use search theory to determine the probability of detection – this is the same principle applied to finding lost yachts at sea. How many passes does the aircraft have to make in the search area to have a chance of spotting the yacht? For pests, how much search effort, how many monitoring devices are needed for detection?
- An array of detection devices will be necessary.
- Frequency and timing of monitoring – if done more frequently, can pest free status be officially achieved earlier? If monitor frequently, can use spot treatment if required to kill any pests before population expansion to a scale requiring aerial poison drop.
- Census really only option – sampling has to be systematic
- Remember that sampling has flaws
- Monitoring program needs to have statistical design to give assurance.
- Highest risk of pest incursion is on perimeter – have a greater number of detection devices closer to the perimeter and less higher up the mountain.
- Consider the actual risk of incursion versus the probability of detection – what level of risk is acceptable?
- How long can really intense monitoring be sustained?
- Maintenance of a track network (rough tracks, not a graded track) for quick access to monitoring devices.
- Can only detect incursions versus failure to eradicate in the first place from looking at spatial data (where was pest first noticed and spread of population if population spread is slow) e.g. Karori knew mice were new

incursion because initially found by perimeter and slowly detected further in reserve – also fortunate to observe mice entering fence.

- Can possibly combine pest monitoring and bird monitoring if feasible (in future, once translocated populations need monitoring).

What about the use of the cells?

- One year window to monitor using cell data (**must do!**)
- Opportunity to use cells to find best monitoring techniques and find minimum level necessary.
- Cells must be monitored to the maximum level to show the success of the project.
- Two levels of monitoring:
 1. Sensitivity to detect presence/absence of pests
 2. Sensitivity to detect presence/absence of pests and to also know where they are for control (spatial location).
- More monitoring devices would be needed for the second option (a closer grid network), so can deal to any incursions immediately.
- Use cells for more intensive sampling points – variable to validate probability
- If use maximum sampling points in cells, can then run a statistical exercise to work out the probability of finding a pest at lesser sampling points e.g. at 25m² grid, at 50m² grid, at 100m² grid.

What are the detection devices?

Rats, stoats, mice, weasels, hedgehogs, ferrets:

- Use tracking tunnels (ink prints for identification).
- Option of putting brodifacoum into tunnels to kill and detect BUT need to consider the impacts on non-target species, especially as more are introduced to mountain.
- Lure mustelids to traps using rabbit meat for three days then switch to peanut butter to lure rodents (or vice versa).
- Gnaw sticks
- Lay out fresh dead chicks and eggs before and after operation to detect presence of stoats.

Goats, deer, pigs:

- Intensity of monitoring?
- Surveillance longer term?
- Low risk of future incursions?

Cats, hares, possums:

- Incursion risk
- What is monitoring process for incursions?
- What is the probability of detection?
- Increase detection on perimeter
- Use ridges, streams, spurs for detection devices (on tracks)
- Use dogs.

What are the issues that need to be addressed?

- Three options if new animal detected:
 - Isolated control
 - Immediate aerial
 - Aerial after time when population has increased
 - Who will do the monitoring? (trapping network too large to be maintained by volunteers, also health and safety issue – dealing with poisons, plus rugged country, need to be able to navigate out)
 - Full time staff required for monitoring (trapping etc)
 - Note that to eliminate rats from Karori took 4 full time staff and volunteers
 - What resources are necessary to ensure monitoring is carried out to full extent in cells?
 - What size grids should bait stations be placed within cells?
 - Who will run the monitoring program – needs a project co-ordinator
 - What will be the chain of command when a pest is found?
 - What will be the action taken when a pest is found?
 - Who will analyse the data and run statistical analyses for application to the whole mountain?
 - Who can accurately identify bite marks and paw prints from gnaw sticks and tracking tunnels?
 - After one years intensive monitoring in the cells, how often will monitoring be carried out?
 - Who will carry out the long term monitoring? (feasible to employ contractors for 1 year initial high intensity monitoring, but longer term may need permanent staff).
 - When should reviews be undertaken?
 - Who will audit the pest control operators work?
 - Need to know why any failures occurred – research.
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6. Questions raised by MEIT Science and Research Committee

Monitoring:-

- 1) *The main emphasis of the workshop is on the two enclosures, but lessons have to be learned for when the additional 3 200ha are enclosed. Recognising the need to kill every last pest, monitoring such a large area of dense bush presents huge problems, if 'traditional' techniques are used. Any ideas?*

'Traditional' techniques are all we currently have to use. Need to weigh up risk of not monitoring intensively versus risk of pest populations increasing beyond reasonable ground control measures.

- 2) *What lessons can be learned from other similar operations? (This question applies to all three main headings)*

See notes – lessons from Karori and DOC.

Need to have good planning in place. Need to have adaptive management for when things change.

- 3) *What monitoring/knowledge is essential prior to pest control? When? How?*

Need to know pest numbers and distribution before control – essential for monitoring ecological gains as well as for pest control operation.

Use standard indexes for monitoring numbers e.g. RTC for possums.

Use standard indices for monitoring where they exist.

- 4) *Will special techniques be needed to monitor particular species (rats, mice etc)*

For mice, need tracking tunnels closer together (5m²?)

NB. Information on mice movement in Miller (1999) – mean range length 58m in sand dunes: Fitzgerald et al (1981) – mean range length 123m in Orongorongo Valley.

- 5) *What special knowledge of mice is needed? Are some of them long term arboreal?*

A non-toxic trial would answer this question if tracer is placed in bait and autopsies performed on animals killed up trees. Can put tracking tunnel in tree to see if any mice/rats up there. Consider radio-collaring rat to determine behaviour. Has not been a problem in e.g. Mapara. Mice are known to use trees but it is not known if some individuals live only up trees or in live in trees for periods of time e.g. for the duration of a poison drop

Pest control:-

- 6) *Are any pest control measures needed before the main July/August programme?*

Goats, deer, pigs already identified.

- 7) *What bait and poison is needed? (Cereal bait is proposed) It is assumed that current negotiations for protocols for aerial application of brodifacoum (being undertaken by the Trust) will be finalized soon.*

Bait is confined to what is being registered in the Code of Practice – now too late to make changes if pest control is to be carried out this winter.

1080 is available for use also.

Important to remember that Brodifacoum is only registered for use on rodents – everything else must be treated as favourable by-kill.

What is the feasibility of using two baits in one application?

20R has worked on mice. Is going through acceptance trials on Lord Howe Island.

Difacenone may be another option.

8) *What size of bait? Pre-feeding?*

Size of bait to be trialled to see what penetrates canopy. Needs to be small enough for mice to handle but large enough to still deliver lethal doses to larger animals that will need to eat a lot more of it. Using mixed bait sizes may compromise spreading. Bait shatter may be useful in this operation.

Brodifacoum bait does not require a pre-feeder in it, so no pre-feeding is necessary.

9) *Assuming GPS, is one application sufficient? Two applications at right angles? Two applications at an interval of a few days?*

Two applications 10 days apart each consisting of two complete coverages (with 50m overlaps) at right angles to each other. 50m swathe overlaps. 30kg per hectare (2 lots of 15kg applied). Generally only a maximum of 15kg per hectare is applied in total, but there was consensus to increase this. This may require justification to authorities processing the resource consent application.

Bait will persist long enough in environment to achieve good kill rates.

10) *What by-kill will be achieved? Mustelids? Hedgehogs? Pigs?*

See species notes.

11) *What control programmes will be needed for pigs, goats, deer (the latter two in low numbers)? (No known cattle)*

See species notes: professional hunters needed.

Post pest control operations:-

12) *In general, what monitoring is essential post the pest control operation?*

Essential to monitor the cells intensely and to use information for making informed decisions for how to proceed on whole mountain. Essential to monitor to show pest-free status has been achieved (1 year of intensive monitoring, or longer if monitoring less intense).

13) *What design of monitoring is needed to distinguish between fence failure and pest eradication failure, if pests are detected after the operation?*

At first, there is no practical way of doing this. Monitoring stations at a precise enough level to allow spatial knowledge to be gained might show if a pest has a higher population near the perimeter, which could indicate incursion. Once officially zero, will know it was an incursion. If animals are marked before the poison operation, will know if survivor is from before the poison drop.

- 14) *How are pest survivors of the control operations detected at very low levels?*

By having a very comprehensive grid network of monitoring stations, close enough to each other to encompass the animals home range, which are checked frequently.

- 15) *While techniques are reasonably well known for many pests, do mice present a special problem?*

Yes, mice may have very small home ranges which could mean a very tight grid of monitoring stations needed to ensure they encounter one.

- 16) *How long do we have to monitor, or wait till we monitor, before we declare an enclosure pest free?*

Can begin monitoring soon after poison drop and providing additional poison/traps to pests found. If monitor intensively for 1 year, should be reasonably confident of being pest free.

- 17) *Would monitoring at a greater intensity enable an earlier determination of a pest free status?*

Yes. DOC declare islands pest free after 2 years and one intensive search effort.

- 18) *If populations of any pest are found post-poisoning, how to control?*

With secondary methods described for each species. Having monitoring stations at close enough densities to allow spatial location to be determined so can target a precise area with secondary control.

- 19) *Should the presence of two enclosures be used to trial two differing control and/or monitoring programmes?*

Pros and cons for each approach – this requires discussion.

- 20) *How is it best to apply the lessons learned from the enclosures to the control of the main mountain later?*

Need to monitor fully to ensure all information is gathered and accurately record all happenings (e.g. if small quantity of poison spilled etc).

Someone with appropriate skills needs to analyse the data and carry out statistical analyses.

7. Research Questions

(Questions raised during the discussion)

1. Environmental testing of poison residues in system before reintroduction of kiwi etc necessary?
2. DNA samples of pests (from hair tags) to determine family groups before eradication to show if any found are new incursions – cost vs. benefit?
3. What is the density and reproductive status of ship rats before poison?
4. What size bait will capture the most pests? Non-toxic trial?
5. What size bait will penetrate canopy? Non-toxic trial? What has been used elsewhere? Is there any literature on this?
6. What is the ecology of hedgehogs on the mountain? When are they active? Radiotracking study of hedgehogs caught at different altitudes on the mountain needed.
7. How efficiently are feral pigs of various ages/sizes able to pick up large (4-12g) baits versus small (2g) baits?
8. How do we best use the cells? To test for timing/bait volume/monitoring?
9. What are the effects on non-target species?
10. What degree of risk is acceptable to take – less monitoring = higher risk that incursions are not detected until population is large.
11. Are detected animals survivors or immigrants? Mark a large sample in and out of fence before and after drop to find out.
12. Will deer, possums, stoats etc climb over the fence before the operation starts?
13. Will ship rats and stoats (the most arboreal species) jump into the fenced area from surrounding tall trees? Mark many individuals of both species to find out.
14. How can the use of the fence to export animals be maximised? Jumpouts etc.
15. How can the use of the fence to monitor species responses to eradication be maximised? Tracking tunnels against fence?