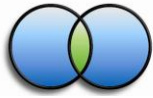
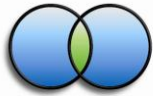


## **GUIDELINES ON RODENT BAIT AND BAITING**

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## PURPOSE

- These Guidelines are to be used by Project Managers conducting rodent eradication projects based on the PII Resource Kit for Rodent and Cat Eradication.
- The Guidelines cover advice on applying bait for rodent eradications.

## 1. BAIT VOLUMES

- How to work out how much bait you need for aerial baiting, hand baiting or bait station operations.

### 1.1 CALCULATING VOLUMES

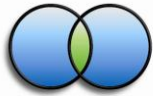
- The baiting information is based on the use of Pestoff 20R containing brodifacoum, either as pellets or blocks for rodent eradication programmes. Bait quantities may vary from operation to operation, it's essential that you get help from experienced people.
- Total amount of bait required is a combination of:

#### **Island Size / Treatment Area**

- Island land areas calculated using a Geographic Information System (GIS) will be more accurate than estimating by eye from a map.
- The total area to be baited is not just the island size (see example in table at end of this section) but also areas that may receive more than the standard bait rate (e.g. coastal edges and cliffs may get additional bait applied), or areas that receive special extra baiting (e.g. inside buildings, large caves, etc). Also add size of any offshore islets that need to be treated.
- Bait calculations have in many previous successful operations been based on actual map (planar) areas not on any 3D calculation of surface area. You do not need to calculate 3D surface area. Steep cliff areas are usually recommended to receive additional bait treatment anyway.

#### **Bait rate per hectare**

- The bait rate per hectare is influenced by the following factors:
- Pest species and density (e.g. higher rates required where there is more than one pest species present and/or the target species is present in high densities)



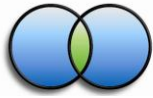
- Ground cover – bait availability and visibility (e.g. higher bait rates may be required where there is dense vegetation and high canopy)
  - Topography –lava rocks and caves (e.g. higher bait rates may be required to allow for bait being lost in rock crevasses, hand-baiting inside caves)
  - Ground moisture, climate – longevity (e.g. higher bait rates may be required if only one drop is possible)
  - Non-target interference – Higher bait rates may be required to compensate for quantities of bait being eaten by non-target specie. See Guidelines on non-Target Species.
  - Consider whether you need to do any non-toxic bait trials before the eradication gets under way. These may be required to assess the likely consumption of bait by non-target species (e.g. crabs, native species) or to assess such things as bait longevity. These issues have an effect on bait rates so need to be understood as much as possible before planning the operation.

#### **Number of drops**

- The number of drops is determined by logistics and cost. Two drops is often better than one because:
  - It covers the risk of young surviving in the nest and emerging after bait has disappeared, therefore not being exposed during the first drop
  - It provides a back-up in case the first drop is washed out by heavy rain.
  - It provides extra security of bait coverage by covering the risk that unidentified gaps existed in the first drop.
- However, there are a number of eradications which have been successful after only one drop. Helicopters are expensive and resources are limited. Make sure you have undertaken thorough planning prior to the operation. Factor in the availability and cost of the helicopter and crew and work with experienced people to determine whether you need to undertake one drop at a higher rate or two drops each of a lower rate.

#### **Areas requiring extra drops**

- Some areas of an island may require additional bait treatment, for example:
  - because of the nature of the terrain (e.g. very steep slopes, tiny offshore islets) where placing enough bait may be practically difficult;
  - or the coastal edge, where rodent densities are often highest and where aerial baiting in particular may have gaps in bait coverage due to the way the bait is applied (bait flow from the bait bucket is stopped manually by the pilot on reaching the edge of the land, so some small gaps may occur depending on exactly when he does this.



- any area of very high relative rodent density, where extra bait may be required to ensure enough is available for all rodents there. Such areas may (or may not) include coconut groves, bird colonies, around human residences, etc.
- any areas where rodents may live that cannot be covered by the main means of bait application (e.g. caves, inside buildings) where bait will have to be specifically placed.
- The ‘extra’ treatments that are recommended are derived from experience, and are a way of making sure the possibility of leaving an area uncovered with bait (or with not enough bait) is reduced as much as possible.

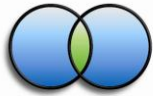
**Contingency**

- Contingency refers to a supply of extra bait, over and above the total amount you expect to use in the operation. Running out of bait before the entire island is covered will almost certainly result in failure.
- It’s always a good idea to have a contingency amount immediately available in case of:
- Unforeseen circumstances (e.g. bait gets damaged in transport, some goes mouldy, gets wet etc)
- Where there is difficult topography (e.g. coastline, caves, cliffs, dense vegetation), or where exact island size is not able to be calculated with confidence.
- Contingency amounts generally vary between 10-20% of the total per-hectare rate volume.
- If the island size has not been definitively established, then allow a greater contingency.

**1.2 EXAMPLE 1 BAIT CALCULATION**

Example of an 80-hectare island, aerial or hand-broadcast

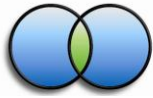
Treatment Area	Details of Area	Bait Rate	Amount of bait required
Island size	80 ha (actual area)	10 kg per hectare (application rate)	800 kg
Coastline	4 km (actual length of coast), x width of coverage wanted (e.g. 40m wide strip 4000m long x 40m wide= 16	10kg per ha (application rate per 100m)	400 kg



	ha)		
Cliffs (anything over 50° in slope)	5 ha (actual area)	10 kg per ha application rate	50 kg
Offshore islets	2 ha (actual area)	10 kg per ha	20 kg
Total Area to Be Covered	103 ha		
Caves, buildings	Number of buildings, caves, etc	20 sites, with 0.5 kg of bait per site (Amount per cave or building plus any re-baiting necessary)	10 kg
Total amount of bait for first round of baiting			1280 kg
Second round of baiting (if any) NB. If bait rate for second drop differs from the first then recalculate using above method. If the same bait rate is used again just repeat the quantity		10 kg per ha	1280
Sub-total			2560 kg
Add contingency (10-20% recommended depending on circumstances)		10% of 2560kg	256 kg
Grand Total (amount you'd need to order)			5116 kg Round it up to

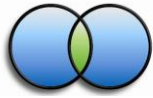
### 1.3 EXAMPLE 2 BAIT CALCULATION

Example of a 25 hectare island to have bait stations



Bait station operations need to continue for several weeks at least, generally for **at least 2 weeks** after the last sign of bait take by rodents from the bait stations. It usually takes at least 2 weeks for most rodent activity to slow, therefore most bait station operations will need to run for a month, and quite possibly longer.

Treatment Area	Details of Area	Bait Rate	Amount of bait required
Island size = 25 hectares	Stations on a 25m x 25m grid = 16 stations per hectare = 16 x 25ha = 400 stations  [a 30m x 30m grid would have 11.1 stations/ha, and a 50x 50m grid would = 4 stations/ha]	Each station to have 100g (0.1kg) of bait  16 stations x 0.1kg = 1.6 kg /ha	1.6kg/ha x 25 ha = 40 kg
Daily replacements, initial high rodent activity period	Expected daily replenishment for 2 weeks	On average, expect 50g/station* required, x 400 stations x 14 days	280 kg
Regular replacement, reducing as rodent activity dies off	Expected 3-daily replenishment for a further 2 weeks	On average, 20g/station required x 400 stations x 14 days	112 kg
Any special treatment areas, e.g. extra bait stations within buildings, around rubbish dump, in caves, etc	E.g. 10 buildings and one cave, each to have a bait station with 100g of bait, replenished with average of 100g of bait every 3 days for 28 days.	11 sites x 0.1kg x 10 replenishments	11 kg
Sub-total			443 kg



Add Contingency of 10%	44.3 kg
TOTAL amount to be ordered	487.3 kg (Round up to 500kg)

\*NB. Amount likely to be consumed can vary very widely, depending on the rodent population density, and that of other species which may eat the bait, e.g. ants, crabs, snails. It would be very wise to do experiments using non-toxic bait on the island first to determine the likely bait consumption rate.

Note also that this example has a very high density of bait stations, and a relatively high amount of bait placed in each – this is a likely scenario in the Pacific for high density rodent populations with small home ranges. However, bait station spacings can be wider, and bait used per station less in many instances. Recommended spacings for grids – see Bait station Operation section within this Guideline.

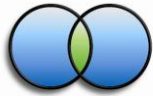
## 2. BAIT MANAGEMENT

- How to order, transport, store and handle bait to ensure that it arrives at the project island in the best condition possible.
- Note that these guidelines are based on the use of Pestoff 20R pellets containing brodifacoum, the most commonly used bait for rodent eradications. Always read and work within the label instructions of any toxins being used.

### 2.1 ORDERING BAIT

- Once you know the volume of toxin you require and in what form (e.g. pellet, block, gel) you need to order it.
- Brodifacoum is the most common bait used for rodent eradication and Pestoff 20R is the best bait formulation because it has been proven to be the most palatable to rodents. This is due to the bait recipe and the very small amount of toxin (.002%) in each bait. Pestoff 20R is made by Animal Control Products (ACP) in New Zealand.
- You need to order bait well in advance of your operation because:
  - Brodifacoum bait is only made at certain times of the year at the factory and it takes time to make the bait because the factory has to clean down all its equipment and set up for making Pestoff 20R
  - Ordering early (i.e. up to 6 months in advance) allows ACP to schedule when they will actually make the bait, to combine all the orders together in one manufacturing run.
  - Your order is likely to be one of a number of orders and the sooner you order it the quicker it is likely to get made.

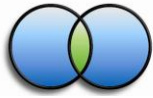




- You need to allow enough time for the bait to be delivered to your location (often it goes to a main port at the destination and is then shipped to the project location, but you may also be able to get it shipped directly to the location). Allow for possible delays and factor this into your timing – the entire operation can be affected if the bait does not arrive when it should!
- In your order you need to specify:
  - The total volume of bait that is required (including the contingency amount)
  - Any specific requirements, e.g. if you want coconut lure added, a change in diameter of bait size, baits placed in smaller bags than the standard 25kg size (e.g. 10kg bags are often better if bait has to be physically carried a long way).
  - The name of the contact person
  - Identify who is paying the bill and how
  - How the bait is to be transported when and to where
  - Consider whether you need to use sturdier pallets (heavy-duty pallets are advised if bait is to travel long distance by sea, or be handled a number of times before it reaches its destination)
  - Requirements of any laws or rules relating to the use of the toxin in the country in which it is to be used (often this requires ACP to adjust labels on the bait bags to comply).

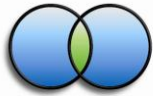
## 2.2 PACKAGING AND TRANSPORT

- Pestoff bait is normally packaged in 25kg, paper-walled bags with polyethylene-coated liners. This method of packaging allows the bait to “breathe”. This is necessary to keep the bait in good condition while at the same time providing a secure means of parcelling that will stand a moderate impact before bags break open.
- The bags are then packed onto wooden pallets measuring 1.6m x 1.1m. There are 40 bags to each pallet. A full pallet load weighs one tonne and stands around 1.1 metres high. Occasionally an extra layer of bags may be placed on a pallet when container space is short. This gives 46 bags per pallet and increases the height of the load by approximately 150 mm. Double stacking of pallets must be avoided, especially during transport, as this can result in crushing of baits in the lower bags of the bottom pallet.
- Pallets are shrink-wrapped to further secure the bags on the pallets for transport. Even with this system damage can occur, e.g. forklift forks can go through bags, pallets can be dropped. Extreme caution is advised. Where forklifts and other lifting machinery is used, it should be driven by skilled operators whenever possible. Shrink wrap must be removed from the bait prior to placing in storage.
- Bait can become unpalatable to rodents if stored with fuels, solvents and other potential contaminants. Take care to ensure that bait is not exposed to any materials which could affect its life in storage and keep handling



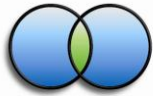
to a minimum to avoid crushing and dusting. Avoid or minimize repeated handling of individual bags during transportation where possible. Never throw or drop bags of bait.

- Animal Control Products Ltd will arrange shipping for both full container load (FCL) and pallet (LCL) shipments and has many years of experience in packing and managing exports for eradications within the Pacific region and elsewhere.
- The erection of condensation-proof polythene film is a very important step in the packing of full container loads. ACP ensures this is in place before exporting container loads of Pestoff Rodent Bait 20R. It prevents the product becoming wet from “container rain” (condensation which forms on the inner walls and ceiling of the container at night when outside temperatures drop).
- Individual pallets sent as exports inevitably become placed in containers of general cargo which are packed by the freight company. As condensation proofing is not erected in these containers, ACP applied a waterproof cover over the top of each pallet to shed the inevitable container rain. These waterproof covers and the shrink wrap surrounding the bait must be removed when the bait is collected at the destination port.
- These waterproofing measures can become a vapour barrier which will encourage condensation to form between the film and the product. This condensation will increase the moisture content of the bait nearest to the film and in warm conditions will accelerate the development of mould.
- In all cases, avoid placing bags of bait in direct or diffused sunlight. Exposure to sunlight causes localised heating inside the bags and causes condensation to form on the inside wall of the bags when the outside air cools. This condensation raises the moisture content of the bait touching the bag wall and encourages mould growth and bait degradation.
- Cyclic heating and cooling of bait either in bags, pallet loads or container loads must be avoided as the first step essential step in managing the potentially damaging effects of condensation.
- While condensation in shipping containers cannot be avoided, the condensation proofing erected in the containers prevents the condensation from affecting the product. It is best to unpack containers during the heat of the day but first open the container doors for two or three hours to allow the heat inside the container to escape. Unpacking containers of warm bait in cool weather can cause condensation inside the bags and under protective film.
- When transporting bait to the operation consider the following:
  - Space requirements - how much room will the volume of bait you are going to use take up?
  - Stability of the pallet loads – you may wish to re-wrap the pallets with shrink wrap, just for the journey.
  - Will you leave the bait on the pallets? (Pallets can be useful for keeping bait off the ground and for loading at the start of your operation.)



- Will you put it in containers? You may need to erect a “tent” of condensation proofing .
- Will the bait cargo be protected from rain, sunlight and sea water?
- Is the vessel transporting the bait rodent free – do you set up traps and bait stations onboard?
- How and where will the bait be unloaded – consider whether this will be by hand or with machinery?
- If the bait is to be transferred to the shore by a smaller boat – how will you do this and how will you keep the bait dry? (large dry bags 30-50L may be useful)
- Carry tarpaulins or use barrels or other waterproof means if there is a chance the bait will get wet (200L waterproof plastic barrels are often used, with tarpaulins to shade and provide further waterproofing for deck cargo)
- General points to ensure bait longevity:
  - Avoid cyclic heating and cooling, to prevent condensation developing in bags or under protective films.
  - Manage condensation by using protective films when necessary
  - As far as possible, avoid placing bags or pallet loads of bait in direct or diffused sunlight.
  - Protect bags and pallet loads from rain and sea water at all times.
  - Store bait away from potential contaminants such as fuels, solvents and similar tainting substances.
  - Check the bait frequently and isolate any which has been spoiled, to prevent unspoiled bait being affected.
  - Separate any flammable materials such as fuel from bait
- Ensuring bait longevity during transport:

Make sure bait is kept dry and secure at all times. Any moisture or movement can affect the quality of the bait and/or damage it. This is especially important in humid tropical conditions where the bait can quickly go mouldy and become useless. When it gets moist bait pellets can stick together. This is a major issue during aerial baiting operation because the bait will jam the spinner in the helicopter’s bait bucket.
- Ensuring bait longevity on land
  - The same principles for dry and secure storage apply. If bait is to be stored in one place for a reasonable period of time, make sure that place is dry, has good air flow and is rodent free. Bait should be stored off the ground (e.g. on pallets).



- Bait storage on the island would ideally use an existing building but tents or plastic containers have been used successfully.
- Undertake regular inspection of bait when in storage and take measures to minimise damage, especially from water leaks or condensation.
- Bait must be kept dry and free from contamination or rodent damage whilst in storage to ensure it is in good condition and highly palatable when laid.

## 2.3 QUALITY MANAGEMENT

- Only use freshly manufactured bait. Do not store for more than three months where possible. This ensures high bait palatability, which has a direct influence on success. Old baits have been used successfully, but are more likely to have mould growth and are likely to be less palatable.
- Quality control samples (toxin concentration, bait hardness) should be taken at the factory (or on receipt) and during the operation. They should be stored frozen for later testing if required. This may allow bait quality issues to be discounted if the operation is later found to have failed.

## 2.4 DISPOSAL

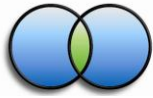
- Dispose of bait responsibly
- If bait gets damaged or wet and cannot be used, separate the damaged bait out and store in a sealed container clearly marked “unusable bait”.
- When replacing bait in bait stations don’t throw the bait away. Take it back to your base and store in a sealed container clearly marked “unusable bait”.
- Have a system for disposing of old or damaged bait, e.g. remove from island and bury in a landfill, burn if conditions (including wind direction) allow, incinerate or process through a sewage treatment facility. The best means of disposal is to use the product for its intended purpose.

## 3. SPREADING THE BAIT

### 3.1 GENERAL SPREADING GUIDELINES

Note: to be read in conjunction with specific guidelines for each method, further below.

- Consider non-target species present on the island, such as pigs and crabs. If they are present and wild they may have to be removed or contained before the rodent project begins. If they are domestic and/or a food source you may have to ensure they are contained in enclosures (pigs), or that harvesting areas are closed for a set period (crabs). These species can eat large quantities of bait, making it unavailable to rodents and



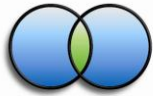
increasing the chance of failure of the eradication. See the Guidelines on non-Target Species for more information.

- Ensure the local community, particularly those who live on the island or visit regularly, are supportive of the operation and ensure that food supplies are either removed or made inaccessible to rodents. Rubbish, food waste, household foods and all food scraps from the field teams should be stored inside sealed containers. All emptied food containers and tins should be stored inside solid containers. This will minimize the risk of rodents finding alternative foods in preference to the toxic baits.
- Clearly define the treatment area. It must include all land within the designated project to ensure all animals have access to bait. Assess how treatment of all areas is to be achieved – steep cliffs, offshore rock stacks, etc. If some areas cannot be accessed or treated by hand, other options must be considered or the operation cannot proceed.
- With ground-based operations, every field worker has the potential to cause the project to fail. Planning systems such as task specifications and training needs to be clear and simple. Complex instructions increase the chance of mistakes and put the project in jeopardy. Create a task for team members to use when broadcasting bait. Prior to the eradication, practice using the task specification with non toxic-baits to ensure everyone understands what to do and make any necessary changes to make the job easy to understand.
- Have the Operational Plan reviewed by experts to ensure the eradication design matches the terrain and ecology of the island and that all logistics have been thought through.
- Have an independent technical advisor conduct a readiness check before starting the eradication operation.

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### 3.1.1 TIMING OF OPERATIONS

- When to undertake the operation involves trade-offs between the weather conditions on the day and the coming few days. Timing tends to coincide with times of natural food scarcity (meaning rodents are more likely to eat baits because they are hungry), lower numbers of rodents and no young rodents in the nest. It can also coincide with times of low non-target species activity. It's important to get advice from aerial baiting specialists and those with knowledge of local conditions as well as rodent ecology to pick the best time to undertake the operation
- Where natural food is abundantly available to rodents all year round, undertake bait acceptance trials during the feasibility study to determine whether all rats will eat the bait.
- Larger islands requiring longer time to bait completely require a correspondingly longer period of fine weather. A decision to go ahead with the drop involves trade-offs between the weather conditions on the day and the coming few days.
- Get advice from a local person experienced with weather conditions on the island. Undertake the operation in the best conditions you can (dry, minimal chance of rain). If the weather is too rough when applying bait, the

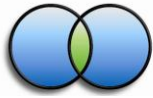


risk of gaps in coverage increases; If the weather is too wet after bait application, the target animals may not eat it before it is destroyed or no longer palatable

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### 3.1.2 BAIT APPLICATIONS

- Prepare as much in advance as you can so that the baiting operation is the only task to focus on when you arrive to start the job. Diversions and other tasks create the risk of lack of focus, with greater risk of undetected errors occurring.
- For aerial and hand-broadcast operations, bait should be applied in two separate applications, ideally 7-10 days apart, especially if there is more than one species of rodent present. This helps counteract unforeseen losses, such as a deluge washing out the first drop. It also allows young rats emerging from nests after the first drop, to be exposed to fresh bait in the second drop. The second baiting for single-target species can occur the following day. This will reduce potential bait gaps but will place all bait at risk of weather damage, so only consider this option where logistics prevent a 7-10 day wait.
- For aerial and hand-broadcast operations, a standard application rate is to apply 8kg/ha, followed by 4kg/ha for the second application for New Zealand operations, but in many areas of the Pacific higher sowing rates may be necessary if there are other species present which will take bait (e.g. crabs). Advice from eradication specialists will help you set rates for the specific needs of your project location.
- Cliff areas should also be the priority for use of any surplus bait after island-wide baiting has been completed. This ensures adequate bait is applied to steep terrain which has a larger actual area than that calculated from maps and to counter uneven bait distribution from bait falling down-slope.
- Ensure other 'special' areas are treated, by specifically targeted actions. These areas may include buildings (all portions, including roof spaces, underneath etc), on and under wharves, in large caves, on offshore rock stacks that are still exposed at high tides. They will need to be hand baited. List every site beforehand, and tick them off as each site is baited. Consider every area with spaces that a rodent could hide in and include these on your list.
- Apply poison bait on rock stacks above high water around an island even if it seems unlikely that there are any rats on them. Use the known or suspected swimming ranges for the target species of rat very conservatively when deciding which rock stacks do not need treatment. Any islands on inland water (lakes) should be treated in the same way. This will eliminate the possibility of rats surviving on rock stacks to reinvade the island.
- If, during the first application, it is found that bait application rate has been greater than planned, make adjustments to bring the rate down to (but not less than) the required level. It is important to complete the first application over the entire island at the prescribed rate or higher, even if this comes at the expense of a reduced rate for the second application.
- Wherever possible, aim to bait the entire island in a single day. Completing bait coverage in a single day poses the least risk of failure due to rats moving from areas that have not been baited into areas where bait has degraded or disappeared.



- On very large islands which cannot be treated in a single day the risk of rat movement between treated/untreated areas can be managed by re-applying bait in buffer zones (areas between those treated and those yet to be treated) at the beginning of each day. Seek specialist advice for all species. Buffer sizes will depend on species, terrain and time interval between baiting.

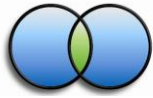
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### 3.1.3 BAIT TYPE

- Pestoff Rodent Bait 20R is the most commonly used bait during rodent eradication operations. These baits have the most consistent size and hardness due to the machinery used in manufacture. Other successful baits used include Bell “Brodifacoum Conservation 25” for aerial application, and Ditrac wax blocks for hand-broadcasts.
- Risks
- Native non-target species may be susceptible to brodifacoum or other anticoagulant poison operations for rats. Environmental effects (positive and negative) need to be carefully considered.
- Community views on poisoning can vary, effective consultation is required, especially if there are human residents or regular visitors to the islands.

## 3.2 HAND BROADCASTING

- Read the following in addition to the general guidelines above for hand-broadcasting operations.
- In addition to the bait being broadcast at grid points, extra bait should be applied at 25m intervals at the established standard bait rate around the island’s entire coastline (to the water’s edge) if possible. This acknowledges that in most circumstances rat density is highest at the coastal margins so this margin is given a double dose of bait during each of the two applications.
- Very steep areas (i.e. slopes exceeding 50 deg) that are more than 25m in vertical height, need to have additional or specialized treatment. Consider how bait can be placed in adequate density on steep cliffs and trial methods of casting cast bait as far as possible up, down or across cliff areas. For larger cliff areas (where all other options may leave gaps of more than 25m x 25m) abseiling to spread bait or installing bait stations along the cliff tops and at the bases (above the tide line) may be an option. Slingshots have also been used with some success in these situations. Also consider spreading extra quantities of bait at the top and bottom of cliff areas to help compensate for less than ideal spread on the cliffs.
- Carefully calculate the quantity of bait to be spread at each grid point to achieve the desired number of kilograms per hectare. Divide this by the number of (pre-established) scoopfuls you wish to throw at each site (recommended 4-5, to achieve 360° coverage) Ensure you have the appropriate-sized scoop to achieve this. Always be consistent about the number of scoopfuls thrown at each stop, to avoid confusion. Have spare scoops of appropriate size.



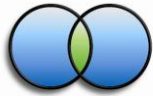
- Spread bait as widely as possible at each site – casting bait to each side, plus forward and behind you, and a little around your immediate. Do not place bait in piles. Don't waste time placing bait in burrow entrances etc – rats will locate bait by smell, it doesn't need to be placed in front of them.
- Minimise the number of different baiting rates across the island – this may cause confusion with bait scoop sizes and start/stop lines. Where bait rate changes are deemed necessary, ensure the physical boundary between baiting areas is clearly marked and known to all team members.
- Where possible, baiting should be done by a team working in contact with each other (all people spreading bait on adjacent transects work at same pace and time across the island). It is easier to ensure accuracy when people spreading bait on adjacent lines are in regular visible contact with each other.
- Establish logical start points and work out how much each person can carry. Create bait depots where necessary before commencing baiting (or have a separate support team whose responsibility is to ensure sufficient bait is deposited ahead of the spreaders). From the known number of grid points on each transect, calculate the amount of bait required for those transects plus a small contingency. Protect bait from rain or ground moisture and from attack from all wildlife. Plastic barrels or buckets with sealable lids are ideal, provided the bait is completely dry when filled. Moist bait may 'sweat' and deteriorate in wet and/or humid conditions, making it less palatable to rats.
- Set up some internal boundaries of known size in the treatment area which allows a check to be made independently on the sowing rate i.e. how much land has been covered vs. how much bait has gone (based on number of bags emptied). The simplest test may be to check the number of grid points completed at prescribed rate compared with actual quantity of bait used. Always double-check calculations before making any alterations. This will tell you early in the day whether there is a sowing rate problem that needs to be addressed.

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### 3.2.1 LAYING OUT THE GRID

- Pre-establish a marked grid at the desired spacing. This should be a 25m x 25m grid (16 sites per hectare), unless terrain and vegetation demand a closer spacing to ensure complete coverage. Bait must be easily thrown at least half the distance between grid points in all directions. If terrain or vegetation does not allow, the grid has to be reduced until it can be achieved.
- There are two options for establishing hand baiting grids:
  - A measuring tape (or known length of cord or rope) and an accurate sighting compass or
  - Hand-held GPS units.
- GPS is recommended where the personnel on the project are experienced in their use. For personnel without GPS experience, the measuring tape & compass method is easier to understand.
- If using GPS, consider using a GIS and a computer shape file of the island to overlay the required grid points and then load these into the GPS for establishing in the field. Practice this before going to the island if



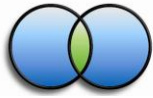


unfamiliar with how to achieve it with the equipment you have. Accuracy of GPS fixes should be  $< \pm 8\text{m}$  for a reliable grid

- Where GPS is not used, grid points can instead be laid out manually by two-person teams. One person extends cord out to the desired spacing, while the other locates the correct transect with a compass. Once desired distance and direction are achieved, the position is marked with a highly visible marker flag or pole. Repeat until entire transect line and island is covered. Several teams working side by side also helps to ensure accuracy. Where lines created by adjacent teams appear to converge or diverge, halt the process until the cause is identified and rectified.
- The grid/transect system needs to be as simple as possible, preferably parallel lines across the entire island. However, natural features (cliffs, lakes, etc) may preclude this, and the island may need to be divided into sub-sections. In some cases ridgelines or other natural features may be easier to follow, and sub-sections created from those. Great care needs to be taken to ensure end/start points are clearly identified for each sub-section and ensure there are no gaps between the end of one sub-section and start of another.
- Start the transect lines at a logical point. Preferably this is the centre of the island, so a straight 'backbone' or reference line can be established. This reduces potential for significant error in establishing transects, as each transect from centre to coast is shorter than a coast-to-coast line, and hence has less margin for error. Establish 'cross-island' transects at right angles to this clearly identified central line. Where dense vegetation makes a central line impractical, transect lines should start from the coast, and wherever possible, head parallel across to the opposite coast. All transect lines should be individually numbered. The number of grid points along that transect should also be established and mapped.
- Each grid point where bait is to be distributed should be clearly marked. Use brightly coloured marking tape on plastic or fibreglass poles. Bamboo or other natural materials can be used for poles if all biosecurity issues have been addressed. Marking tape can also attached to wire pegs or existing vegetation. Visibility of grid points is very important – where practical, ensure the subsequent grid point is clearly visible from the prior one. Where this is not feasible (i.e. very dense forest), mark the route to the next grid point using a cut track and/or a different coloured tape. Adjacent transects should have different coloured grid point markers, to help to ensure each person stays on their designated transect when broadcasting bait.
- Once these sites are established and marked, use the information to check prior calculations on amount of bait/bait sites required – does the reality on the ground match prior planning? Check carefully for potential gaps both on the map and in the field, before starting the grid. Use a tape measure to randomly check distances between grid points,  $\pm 5\text{m}$  is ok, anything more than that may require the addition of another baiting point (it may be easier to do this rather than re-do the entire line, so long as there are no further errors. If there are multiple errors, then consider re-doing the entire line(s). Ensure you have enough bait on hand to cover all baiting sites, with extra allowed for contingency

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### 3.2.2 BAIT SPREADING EQUIPMENT

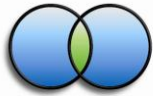


- Bait-scoops – use robust plastic commercial scoops. Purchase those of appropriate size (or slightly oversize). Carefully weigh out the amount of bait required in each scoopful into a plastic bag. Use accurate weighing scales, such as Pesola scientific scales or digital kitchen scales. Remember to subtract the plastic bag from the overall weight! Once you can see how much bait that amount looks like, you can purchase or make a scoop that takes exactly this amount of bait. Cut down edges of scoop with a knife or hacksaw if necessary until the scoop holds precisely the amount required. Test several times with different samples of bait until results are within c.5% of each other. Repeat for this for the number of scoops required, and allow for plenty of extra scoops as well – they will get lost or worn out, so always take spares
- If your eradication operation uses different application rates for different areas on the island then you will need to calculate the scoop size required for each application rate. Clearly label the different size scoops and make sure that people have the right-sized scoop when baiting each area.
- If your eradication operation covers more than one island and you plan to use different grid sizes (different distances between transects) on each island then you will need to calculate the scoop size required for each grid size.
- The on-site manager of the baiting operation should have developed;
  - a table of which scoop to use for different application rates;
  - a table showing how much bait to take for different transect lengths;
  - a diagram showing how to throw bait at the throwing points to demonstrate to each team member.
- Strong plastic buckets with sealable lids are the preferred option to carry bait. Carry bags, tree planting bags and backpacks can also be used. Consider the nature of the environment the spreaders will be travelling through. Will they be able to travel over rough ground or through tight vegetation without spilling bait?
- Whatever method is chosen, the device(s) must carry enough bait to complete a full transect before running out. If very long transects make this impossible, stockpile bait (before spreading starts) at a suitable location partway along the route. Running out of bait part-way through a transect causes confusion and hold-ups, as well as the potential for bait gaps to occur.

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### 3.2.3 DATA COLLECTION AND GPS

- All baiters should be personally allocated numbered lines to complete, and this information should be recorded. If issues arise later it may be possible to determine if a single individual is responsible – if so, other lines completed by that person should also be inspected.
- Where possible, all baiting grid points should be recorded on GPS and this information safely stored and mapped. This should be checked by someone trained in GPS mapping systems to identify if any gaps in coverage are apparent. (Boundaries of the island and/or actual treatment area will have been mapped prior to commencement of operation).



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### 3.2.4 SKILLS REQUIRED

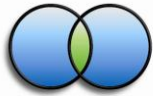
- Those involved in the operation need to understand eradication is different from control as all pest animals must be put at risk. It requires commitment from the whole team to achieve this.
- In ground-based rat eradications, every team member must be fully committed to the operation – a mistake, careless action or failure to carry out work in accordance to operational requirements by any one person could easily result in failure of the entire project. Select the team very carefully, try to have as many experienced people as possible. If you can't do this, undertake training prior to the operation and ensure everyone is familiar with the task specification and has a copy with them in the field. Do everything possible to maintain positive morale, e.g. ensuring working conditions are comfortable, setting the work schedule according to the abilities of the slowest team members.
- There is a trade-off in team size. More people allow the project to be completed quicker but also mean greater logistics for transport and living on the island. More people increase the chance of someone doing substandard work but too few people lead to fatigue and subsequent mistakes. Inexperienced or extra people should be deployed on non-critical tasks such as transporting bait to depots to allow the more experienced people to focus on spreading bait correctly.
- Considerable fitness is required for ground-based, rat-baiting operations – often large distances are walked with heavy loads over uneven country with dense vegetation and in humid conditions.
- Project managers need a high level of skill in project management and organising logistics. Keeping teams in good morale with comfortable working conditions on remote islands for extended periods is a major component of successful ground-based rat eradications.
- Project managers need a good working knowledge of rat ecology and native prey ecology to manage operations effectively
- For projects involving extended stays on remote islands, all people involved need the ability to live and work harmoniously in such an environment. Poor group dynamics can lead to mistakes which can affect the success of the project.
- Hand-broadcast operations are highly weather dependant making the exact timing of the operation unpredictable. Get advice from a local weather expert on a regular basis.

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### 3.2.5 CALCULATING THE AMOUNT OF BAIT PER THROW AT EACH THROWING POINT, AND SCOOP

**SIZE**The baiting grid should generally be 25m x 25m. It can be wider (e.g. 50m x 50m) in open areas or poor rodent habitat, when targeting the larger rat species, but do not use anything wider than 25m x 25m for mice or Pacific rats. If in doubt, always use the smaller spacings. Remember 1 hectare = 100 metres x 100 metres.

- For example:



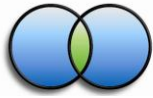
- If you wish to create a **25m x 25m** grid of baiting points, then you will have **16** baiting (grid) points per hectare.
- If you wish to create a **30m x 30m** grid of baiting points, then you will have **11.11** baiting (grid) points per hectare.
- If you wish to have a **50m x 50m** grid of baiting points, then you will have **4** baiting (grid) points per hectare.
- You should have already determined how much bait per hectare is to be applied, through your bait calculations. Work out how much bait is therefore to be applied per baiting point. This is the sowing rate for the application (in kilograms per hectare) divided by the number of baiting points per hectare.
- Examples:
  - You wish to spread **12kg** of bait/ha on a **25m x 25m** grid. There are **16** baiting points per hectare so  $12\text{kg} \div 16 = \mathbf{666\text{g}}$  (approx) per baiting point. To ensure you spread the bait thoroughly, you wish to throw **4** scoops at each stop (one scoop in each direction), so  $666\text{g} \div 4 = \mathbf{166\text{g}}$  per scoop. You will need to find a scoop that holds approximately this much or slightly more and cut it to size if necessary.
  - You wish to spread **20kg** of bait/ha on a **30m x 30m** grid. There are **11.11** baiting points per hectare, so  $20\text{kg} \div 11.11 = \mathbf{1.8\text{kg}}$  per baiting point. You wish to throw **5** scoops out at each baiting point, one in each direction and one at your feet.  $1.8\text{kg} \div 5 = \mathbf{360\text{g}}$ . You will need to find a scoop that holds approximately this much or slightly more and cut it to size if necessary.
- The amount of bait per throwing point, divided by the number of throws, gives you the amount of bait per throw. This gives you the scoop size you will need for that bait application rate and that grid size.

### 3.3 AERIAL BAITING

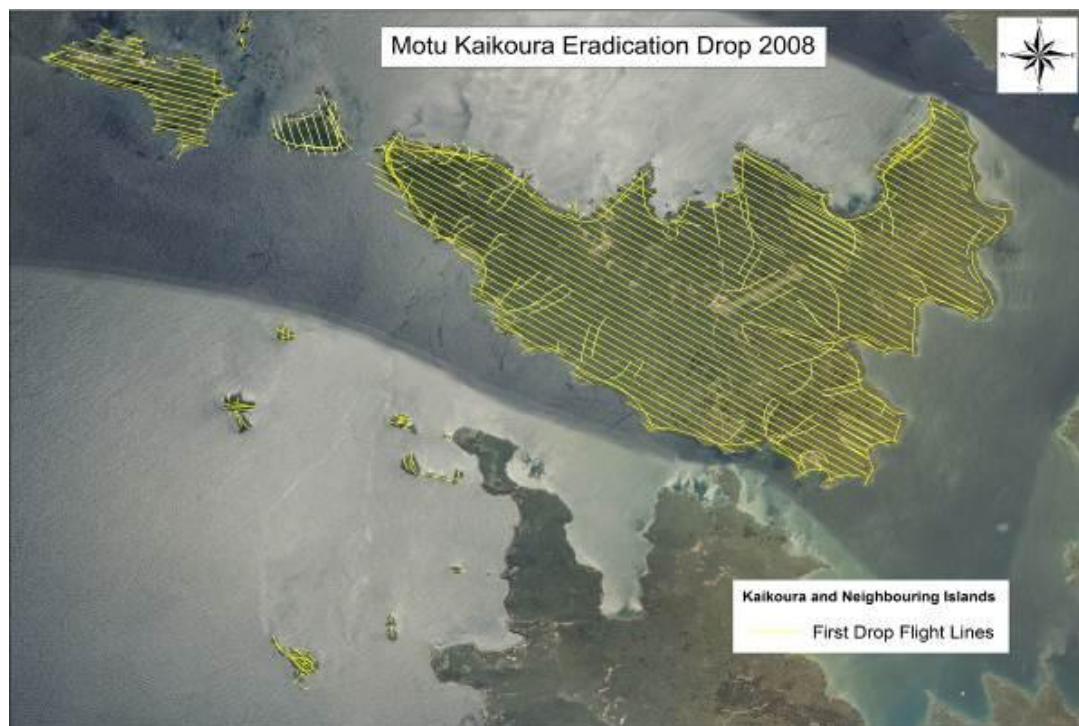
- This section will help to plan an aerial baiting operation that minimises the risk of leaving gaps in the bait coverage.
- Every island will have its own particular characteristics that will influence some tasks. Aerial baiting operations are expensive and involve a lot of technical procedures to get them right, but do not be put off – done properly they have been proven as one of the most successful rodent eradication tools available. Ensure you have tailored your eradication design exactly to the conditions of your island by seeking advice from experienced people as well as using the best practice guide.

#### 3.3.1 USING GPS AND GIS

- No aerial baiting operation should be undertaken without using GPS or DGPS combined with a GIS – use them to plan the flight lines for the aircraft.

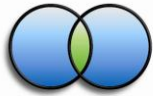


- During aerial baiting operations it's very hard for the pilot to accurately place bait by eye. There's a lot going on when you're flying! Experienced baiting pilots use GPS (and often DGPS) to help them put the helicopter on the right flight line and stay on it.
- It's always a good idea to fly the island in the helicopter before you do the operation. It allows the pilot to get familiar with the area and point out any issues but more importantly it allows the pilot to log the boundaries of the island and any no fly areas (e.g. houses, ponds). Do not rely on co-ordinates or other means – you must fly and log prior to every operation.
- The GIS system then allows you to download the information from the helicopter onto an aerial photo of the island and check accuracy of spread
- The photo below shows an example of GPS-derived flight lines on an aerial photo



Example: Motu Kaikoura Island, Hauraki Gulf, New Zealand aerial bait drop for rodent eradication

- Being able to do this means you can check that the spacing between the flight lines is even and that all of the island has been covered equally.
- It also means you have a very accurate picture of where the bait was dropped. This is really useful to show people who may be concerned about aerial baiting – that you did only go where you said you would.
- Note: this system does not measure the amount of bait dropped only where it has been dropped but you can check this with the pilot as he knows how much is in his bucket and how much area he covers with each load



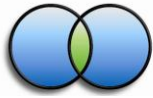
(if you divide the volume in the bucket with the area sown each load this should equal your rate per hectare – check this regularly during the operation).

- Island boundaries (coastline) must be physically flown and logged into the helicopter navigation system before sowing begins. The project manager should be in the helicopter when this is done to make sure the boundary is logged correctly and any no fly areas are excluded (e.g. pig pens). This also gives a more thorough indication of total land area to be flown.
- Create a task specification for team members to use when broadcasting the bait. Prior to the eradication, practice using the task specification with non-toxic baits to ensure everyone understands what to do and make any changes necessary to make it clear and easy to understand.

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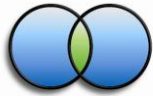
### 3.3.2 BAIT APPLICATION

- These measures are designed to minimise the risk of leaving gaps in the coverage of bait over the whole island.
- Undertake some random monitoring of bait application rates. This gives an early indication if there is a sowing rate problem that needs to be addressed. Sole reliance on navigational guidance systems have led to problems in past operations - an independent check gives the project manager confidence that application rates are correct.
- Ideally, bait should be applied in two separate drops of 8kg/ha followed by 4.5kg/ha. Higher sowing rates are necessary when other species are present which will take bait (e.g. crabs). However you need to consider logistics and cost – often helicopters and personnel are only available for short periods of time so you may not be able to do two drops. Instead, you may do one drop at a higher rate per hectare. The most important point is to plan for weather conditions that will allow the drop to be completed within the time available. Advice from eradication specialists will help you set rates for the specific needs of your project location and ensure you cover all potential variables.
- During the operation the helicopter flies a series of parallel lines known as flight lines. When setting up these flight lines you need to know the swath width of the bucket. This is how far the spinner in the bucket will throw baits out. There will be a maximum swath width and an average swath width. It is important that you work with the average swath width as this will be the most consistent sowing width and reduces the risk of leaving gaps in bait coverage.
- Many baiting operations use a half overlap system which means that one swath overlaps the other by about 50%. This further reduces the risk of gaps. Whether you do this or not is a decision you need to make with the help of eradication specialists.
- Experience has shown that it's better to fly the contours of the coastline rather than to using parallel flight lines. It can be harder to achieve even bait coverage over the cliffs and bays of the coast. Flying the contour allows the pilot the maximum chance of getting bait to sit in crevices and on vegetated rock ledges.



- Very steep areas (where slopes exceed 50 deg) should receive an additional application of bait in each drop. This is to ensure adequate bait is applied to steep terrain which has a larger actual area than that calculated from maps. It also counters uneven bait distribution from bait falling down-slope.
- View flight-line data at a realistic scale to enable gaps to be identified easily. This is best done using a laptop with mapping software so you can overlay the flight lines onto an aerial photo or a topographic map. It must be compatible with the aerial contractor's equipment and needs to be available on the day of the operation (**Link to GIS and GPS tool**) so you can identify possible gaps in coverage and fill these gaps during the operation.
- Looking at small-scale printouts or GPS screens in the aircraft are insufficient to eliminate the possibility of bait gaps. Ideally, you need to be able to print out aerial photos with the flight lines marked on so you can check these on the ground as well as give them to the pilot to get bearings to re-fly those areas.
- Your first bucket load should involve making sure everything is set up and working. You should then download flight lines regularly during the operation (i.e. after each bucket load) to enable gaps in coverage to be identified and filled before the end of the day. Completing bait coverage in a single day poses the least risk of failure due to rats moving from un-baited areas into areas where bait has degraded or disappeared.
- On very large islands which cannot be treated in a single day the risk of rat movement between treated/untreated areas can be managed by retreating buffer zones (starting the next day's baiting operation by overlapping the last swath from the previous day) at the beginning of each day. Buffer sizes will depend on species, terrain and time interval between baiting. Make sure there are viable baits in every rodent habitat on every day of your operation.
- Re-sow even the smallest gap in bait coverage indicated on the navigational guidance printout. The DGPS printout will show where the helicopter went but not necessarily where the bait ended up on the ground.
- Apply poison bait on rock stacks above mean high water mark (MHWM) around an island even if it seems unlikely that there are any rats on them. Use the known or suspected swimming ranges for the target species of rodent very conservatively when deciding which rock stacks do not need treatment. Any islands on inland water (lakes) should be treated in the same way. This will eliminate the possibility of rats surviving on rock stacks to invade the island. Clearly identify all of the rock stacks to be baited when flying boundaries with the pilot.
- Where to apply bait is the decision of the project manager not the pilot. It is a good idea to have an observer in the helicopter when fly sensitive areas such as around houses, the coastline and rock stacks.
- Minimise the number and size of exclusion zones for aerial coverage of bait. Alternative baiting techniques to cover these areas usually carry a higher risk of failure than aerial. However be realistic, you will need to hand bait or place bait stations in places aerial baiting cannot reach.
- Make a list of any areas that aeri ally applied bait will not get too. Consider every area that has spaces that a rodent could hide in and include all of these on your list. These areas may include buildings (all portions,





including roof spaces, underneath etc), on and under wharves, in large caves, on offshore rock stacks that are still exposed at high tides, etc. They will need to be hand baited. List every site beforehand and tick them off as each site is baited.

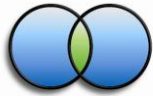
- Aerial baiting operations are highly weather dependant, making the exact timing of the operation unpredictable. Get advice from a local weather expert. If the weather is too rough when applying bait, the risk of gaps in coverage increases; If the weather is too wet after bait application, the target animals may not eat it before it is destroyed or no longer palatable.
- Ideally, you need 2-3 fine days before (so the ground is dry) and after an aerial baiting operation to maximize the time good quality baits are on the ground. Flying days also need to be very calm as wind can blow baits off course.
- If you are doing more than one drop, wait 7-10 days between bait applications. This may counter an unforeseen deluge washing out the first drop and allows young rodents in the nest at the time of the first drop to emerge and be exposed to fresh bait in the second drop.

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### 3.3.3 AIRCRAFT AND BAIT COVERAGE

- Differential GPS should be used to ensure consistent, even and total coverage of the area. Where more than one aircraft is used, the navigation systems must be compatible to allow integration of flight-line data between aircraft. This allows you to produce the same information on all bait coverage maps.
- All equipment (e.g. navigational guidance, bucket) should be calibrated and tested well in advance of the operation to ensure they function and integrate correctly when multiple aircraft are used. Any faults that are found must be rectified before the equipment gets to the island.
- Back-up aircraft, loading equipment and GPS equipment including base stations must be on site or available at short notice. Having alternatives for all critical machinery will reduce the risk of breakdowns preventing the operation being completed in the chosen weather window. However, it is acknowledged that in Pacific Island situations this may be difficult. Therefore the pre testing of loading (buckets etc), GPS equipment and calibration is essential.
- Using extra capacity (i.e. more than one aircraft or larger aircraft with a bigger bucket) to complete the bait sowing sooner allows extra time to fix problems that may arise. Even small problems can use up valuable daylight hours during an operation. More than one aircraft or using a bigger aircraft may cost more than the alternatives but the trade-off is potentially getting the job done quicker.
- Choice of aircraft will depend on:
  - Availability – the primary concern is to select the best pilots with the best equipment. Best pilots means those that are experienced in eradication operations, using DGPS and have a genuine interest in doing the work to a high standard.





- Loading options - very large capacity buckets require a mechanical loading system, smaller buckets can also be loaded by hand.
- Distance from loading site to treatment area – where the haul is more than five minutes flying time, it's more cost effective to do fewer trips with bigger loads.
- Smaller helicopters can be more useful on small islands or in areas where there are a lot of short flight lines (e.g. narrow islands, dissected coastlines) – they are easier and quicker to turn.
- Landing options – larger aircraft need larger sites and more fuel.
- Sizes available – size and type of machine dictates what loads they can carry.

Note: Be wary of local operators who say they can do the work but lack any previous experience. It is the combination of an experienced pilot with good equipment and a reliable helicopter that makes a successful operation. You must have this combination - you risk failure if you do not.

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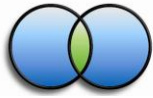
#### 3.3.4 SOWING BUCKETS

- Should produce a consistent swath pattern and constant rate of spread whether full or near empty. The swath pattern is the average distance the bucket can spread the bait. A constant rate of spread means the bait coming out of the bucket is always equivalent to the rate you have set per hectare. This must be checked by calibrating all baiting buckets prior to the operation.
- It also pays to monitor swath pattern and rate of spread on the days of the drops. You can monitor swath pattern by downloading DGPS flight data into a laptop with GIS. You can monitor rate of spread either by setting up random bait grids ([link to tool](#)) and counting the number of baits in each grid, or you can get the pilot to record what size area he drops a bucket of bait over – divide volume of bait in the bucket by the area in hectares and this should equate to your rate per hectare.
- Use a bait bucket specifically designed for distributing cereal pellets to minimise bait breakage during sowing. A spinner designed for spreading fertiliser may increase the number of broken baits.
- The aerial contractor must have a proven and reliable system for the pilot to start and stop bait sowing (e.g. bucket on/off switch is interfaced with the DGPS system). This minimises the risk of bait gaps undetectable in the DGPS printout and the risk of sowing bait outside the control area.

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#### 3.3.5 SKILLS REQUIRED

- The pilot needs to be experienced with aerial baiting and be willing to follow instructions. Those involved in the operation need to understand eradication is different from control as all pest animals must be put at risk.
- All pilots (including back-up) must be proficient in bait sowing using DGPS navigational guidance and ideally use it as part of everyday flying as it is a skill that is only mastered with constant use.



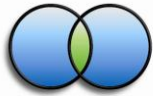
- The pilot also needs to be experienced with operating in remote locations.
- Pilots need to be qualified to commercial aviation standards. Check what is required in your country. In New Zealand this is specified by the Civil Aviation Authority (CAA). NZ Pilots need to also hold an agricultural operators certification issued by the CAA under CAA rule part 137.
- The aerial contractor needs to be able to provide a back-up pilot and a trained ground crew person who is able to undertake running repairs in the field and supervise loading
- Those in charge of aerial operations must have had training in relevant standard procedures and aircraft safety, on-the-job experience of previous aerial poisoning operations and be able to analyse DGPS print-outs.
- Project managers need a very high level of skill in project management and organising logistics.
- Project managers need to be practical and have access to good knowledge of rat ecology and native prey ecology to manage operations effectively.
- Operators of bait loading equipment and systems must have received training in the use of the equipment.
- For those projects involving extended stays on remote islands, all people involved on the island (including pilots) need the ability to live and work harmoniously in such an environment. Poor group dynamics can lead to mistakes which can affect the success of the project.

## 4. BAIT STATION OPERATIONS

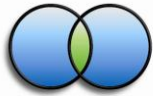
- This section is designed to help plan a bait station operation that minimises the risk of leaving gaps in the bait coverage.
- It is important to note that every island will have its own particular characteristics that will influence some tasks, e.g. size and the presence of non-target species such as crabs will influence bait volumes. Ensure you have tailored your eradication design exactly to the conditions of your island by seeking advice from experienced people as well as using the best practice guide.
- Read the following, in addition to the generic guidelines above, for all bait station operations.

### 4.1 ERADICATION DESIGN

- Bait stations need to be established in every territory of every target species individual. Enough fresh bait needs to be maintained in each station for as long as it takes for every individual to find a station and eat a lethal dose of bait. It is important that stations are spaced so that no individual could remain without visiting at least one station over the time bait is available. The difference between this and hand broadcasting is that the target species must learn to come to the bait in the station, as opposed to when bait is broadcast - the bait comes to the target species.



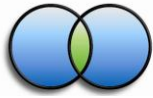
- Ensure other 'special' areas are treated, by specifically targeted actions. Bait should be applied in and around all buildings (all portions, including roof spaces, underneath), on and under wharves, in large caves, on offshore rock stacks that are still exposed at high tides, etc. Create a comprehensive list of every site beforehand, and tick them off when baiting has occurred. Consider every area that has spaces that a rat could hide in and include all of these on your list.
- The grid of bait stations should be established at least one week, and preferably two weeks or more, before the introduction of bait, as this reduces potential neophobic (bait station shyness) reactions from rats. This allows the rats to become accustomed to the presence of the bait stations and once the bait is added they are much more likely to readily enter the bait stations.
- Number each bait station before securely fastening them to the ground, taking into consideration potential interference or disturbance from other wildlife present. In dense vegetation, use marker flags or similar to indicate the location of the station, which may otherwise be difficult to relocate. Use a different coloured marker tape to indicate the route to the next station if it is not clearly visible.
- Cut tracks where necessary or desirable – cleared tracks will greatly aid the efficiency of regular servicing and minimize time spent looking for lost bait stations or the associated risk of some stations being left un-serviced. Make sure you have permission from landowners to cut vegetation.
- Cutting tracks may not be an option – it's generally very time-consuming, impacts on the environment and may not be supported by local people. Other methods such as marking tracks with pegs or coloured tape when done in advance of an operation have run into problems when people have returned and found their marking systems removed. Hand-held GPS can provide an alternative.
- Once you have confirmed where your gridlines will go and the spacing between them, you can load these into hand held GPS units. On the island, you can simply go to the track line you want on the GPS and the unit will take you to that line and to each position where you want to have a bait station or trap or where you need to hand bait.
- Try to start baiting at all bait stations on the same day, or within as close a time period as possible. Apply a known quantity of bait to each station, either by counting out individual baits or using a scoop or a set number of block baits. This will allow the amount of bait taken between checks to be calculated. It will be important toward the end of the project to be able to distinguish any possible bait take from individual stations.
- Stations should if possible be checked with bait take recorded (and replenished if necessary) on a daily basis. Regularity of checking can reduce where logistic constraints are in place, but only when you are confident that bait will remain available in all stations over the entire time between checks
- Replace any bait that has become mouldy or damaged with fresh bait, whenever necessary, or at least on a two-weekly basis regardless of take or condition. Dispose of old bait away from possible rodent or non-target species access. Ensure it is stored for disposal in sealed containers labelled old bait so it does not get re-used.



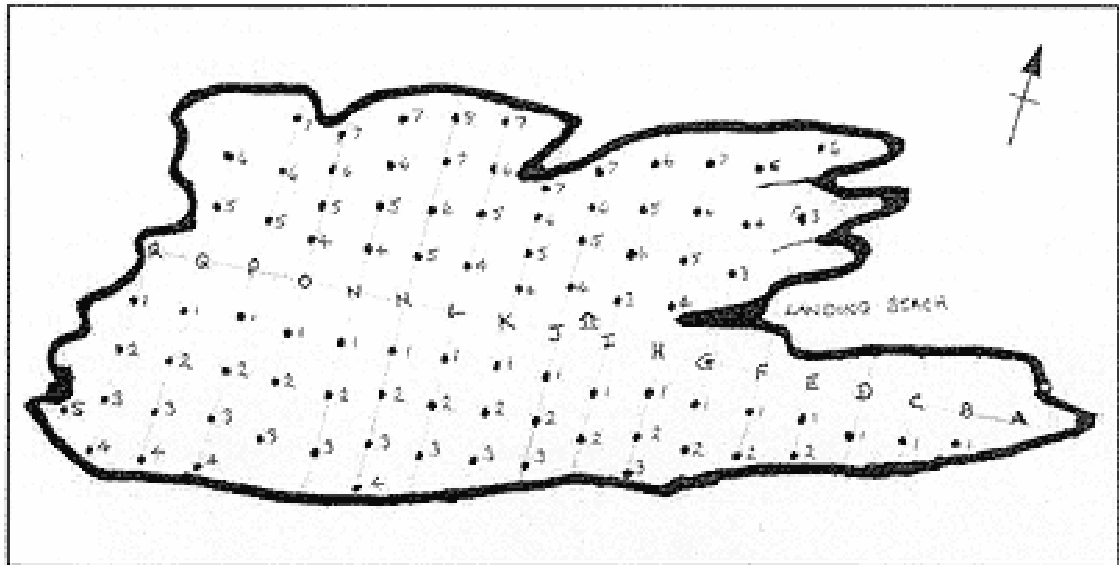
- Leave bait stations in place (baited) for at least one month after the last evidence of rat bait-take or suspected take. Where possible, also place an alternative type of bait/toxin in the station, in case any surviving rodents have an aversion to the original bait type.

#### 4.2 LAYING OUT THE GRID

- Pre-establish a marked grid at the desired spacing. Spacing will vary with target species. For multiple target species use the smallest grid recommended. For Norway rats and ship rats a 50m x 50m grid may be sufficient, but distances between stations should be reduced in areas of very high rat density or in very dense vegetation. If in any doubt, use a smaller grid (e.g. 30m x 30m, or 25m x 25m). For kiore the grid should always be a 25m x 25m grid or smaller. For mice a 25m x 12m grid may be required. Wherever reliable biological home-range information exists for the target species from the project island, use the minimum home-range size to determine the size of the grid.
- Consider using a computer shape-file of the island to overlay the required grid points and then load these into the GPS for establishing in the field. Practice this before going to the island if unfamiliar with how to achieve it with the equipment you have. Accuracy of GPS fixes should be  $< \pm 8\text{m}$  for a reliable grid to be established.
- The grid/transect system needs to be as simple as possible, preferably all parallel lines across entire island. However, natural features such as cliffs and lakes may preclude this, and the island may need to be divided into sub-sections. In some cases ridgelines or other natural features may be easier to follow, and subsections created from those. Great care needs to be taken to ensure end/start points are very clearly identified for each sub-section, and ensure there are no gaps between the end of one sub-section and start of another.
- Start the transect lines at a logical point. Preferably this is the centre of the island, so a straight 'backbone' or reference line can be established at correct spacing between transects. It also reduces potential for significant error in establishing transects, as each transect from centre to coast is shorter than a coast-to-coast line, and hence has less margin for error. Establish 'cross-island' transects at right angles to this clearly identified central line.
- Where dense vegetation makes a central line impractical, transect lines should start from the coast, and wherever possible, head parallel across to the opposite coast. If possible, choose the direction of the lines so that they are the shortest possible (i.e. if the island is long and thin, the transects should run across the thin width rather than along the long length of the island), to reduce the potential for errors. All transect lines should be individually numbered. The number of grid points along that transect should also be established and mapped. On steep islands transects may be more practical to establish by following the contour.
- Each grid point where a bait station is to be established should be clearly marked. Use brightly coloured marking tape on poles or attached to wire pegs or existing vegetation. Visibility of grid points is very important – where practical, ensure the subsequent grid point is clearly visible from the prior one. Where this is not feasible (i.e. very dense forest), mark the route to it using a cut track and/or a different coloured tape. Adjacent transects should have different coloured grid point markers where a close grid is required, to help to ensure each person stays on their designated transect when checking bait stations.



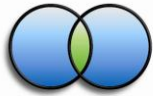
- Where GPS is not used, grid points can instead be laid out manually by two-person teams. One person extends cord out to the desired spacing, while the other locates the correct transect with a compass. Once desired distance and direction are achieved, the position is marked with a highly visible marker flag or pole. Repeat until entire transect line and island is covered. Several teams working side by side also helps to ensure accuracy. Where lines created by adjacent teams appear to converge or diverge, halt the process until the cause is identified and rectified.
- Once these sites are established and marked, use the information to check prior calculations on amount of bait station sites required – does the reality on land match the prior planning? Check carefully for potential gaps both on the map and in the field before starting to bait. If there is any doubt, use extra bait stations to fill potential gaps.
- Once the sites are established and marked, position the bait stations. Number every bait station, GPS their location, and map these. It is far easier (and you probably get a more accurate result) to mark the grid out when not carrying bulky loads of bait stations. Concentrate on doing one job at a time, and doing it well.



Example of a Bait Station grid

Top Island Norway rat eradication, Falkland Islands 2001. A central line of stations A-R was established at 50m spacings (for Norway rats) along the main ridge of the island. Each line e.g. N1-8 was run perpendicular to this until no portion of the island was more than 50m from a bait station – this was checked using a tape measure once the bait stations had been placed out – if there was a gap, an extra bait station would be added. Note that no bait was placed out until weeks after the stations had been placed out.

#### 4.3 EQUIPMENT FOR ESTABLISHING A GRID



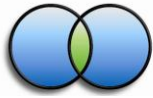
- There are two options for establishing bait station grids:
  - A measuring tape (or known length of cord or rope) and an accurate sighting compass or
  - Hand-held GPS units.

#### 4.4 BAIT STATION EQUIPMENT

- Use only those types of bait stations proven in prior eradication projects. Extensive field testing would be required to ensure all individuals of the target species will willingly enter a new design. Wooden tunnel designs are most favoured by rats but plastic tunnels are most often used because of their lower cost, weight and durability. Consider whether to use some wooden tunnels if reinvasion risk is relatively high or they will continue to play a part in the ongoing biosecurity of the island.
- Use a bait station with appropriate-sized entrance holes for the species being targeted - 90mm minimum for *R. norvegicus*, 60mm minimum for *R. exulans*. The entry hole size may play a part in eliminating non-target risks. Ship rats are effectively controlled on mainland NZ using 45mm entrance holes so consider reducing entry hole size to this minimum only if non-target species are an issue.

#### 4.5 SKILLS REQUIRED

- Those involved in the operation need to understand eradication is different from control as in eradications every single pest animal must be put at risk. It requires commitment from the whole team to achieve this.
- In ground-based rat eradications, every team member must be fully committed to the operation – a mistake, careless action or failure to carry out work in accordance to operational requirements by any one person could easily result in failure of the entire project. Select the team carefully, try to have as many experienced people as possible. If you can't do this, undertake training prior to the operation and ensure everyone is familiar with the task specification and has a copy with them in the field. Do everything possible to maintain positive morale by ensuring work conditions are comfortable and setting the work schedule according to the abilities of the slowest team members.
- There is a trade-off in team size. More people allow the project to be completed quicker but also mean greater logistics for transport and living on the island. More people increase the chance of someone doing substandard work, but too few people lead to fatigue and subsequent mistakes.
- Considerable fitness is required for ground-based, rat-baiting operations. Often large distances are walked with heavy loads over uneven country with dense vegetation and in humid conditions.
- Project managers need a high level of skill in project management and organising logistics. Keeping teams in good morale and working condition on remote islands for often extended periods is a major component of successful ground-based rat eradications.
- Project managers need a good working knowledge of rat ecology and native prey ecology to manage operations effectively.



- For those projects involving extended stays on remote islands, all people involved need the ability to live and work harmoniously in such an environment. Poor group dynamics can lead to mistakes which can affect the success of the project.
- Get advice from a local person experienced with weather conditions on the island. Undertake the operation in the best conditions you can (dry, minimal chance of rain). Weather conditions are less of an issue with bait station operations because the bait is protected but wet weather can still cause problems with personnel safety, keeping bait dry as you are putting it into stations and if the weather is too wet after bait application, the target animals may take longer to come to bait stations.

## 5. MONITORING THE ACCURACY OF AERIAL BAIT SPREAD

- The purpose of this section is to provide a simple technique to check that the amount of bait being dropped by the helicopter is accurate and consistent (i.e. the same as the per hectare rate you have set).

### 5.1 STEPS

#### Step 1:

- Set up a series of 10x10m grids (refer diagram below). It is best that these are placed in areas where there is different ground cover. Different cover helps explain away bounce and fragmentation as baits hit the ground. (See also advice note below with heavy vegetation cover.)

#### Step 2:

- Divide each grid up into four 5x5m grids. This makes it easier to count baits in the wider grid.

#### Step 3:

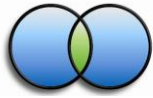
- Once the helicopter has baited a grid, count the number of baits in each 5x5m grid. Work methodically back and forth over the grid as it's easy to miss baits.

#### Step 4:

- Add up the total number of baits counted for each 10x10m grid

#### Step 5:

- Relate the total number of baits in each grid back to your per hectare rate. For example :
  - 2gm baits flown at 8kg/ha will give an average distance in meters between baits of approximately 1.58m. This will equate to 10-11 baits per 5 x 5m grid or 40-44 for each 10 x 10m grid.
  - 2gm bait sown at 13kg/ha equates to approximately 15 – 16 baits per 5 x 5m grid or 60 -64 per 10 x 10m grid



5.2 ADVICE NOTES

- Do not let the helicopter pilots know where the grids are as this may impact on desired outcomes if they overfly these areas deliberately.
- Care should be taken so that the grids are not too close to flying area boundaries where there may be overruns, especially if the aerial contractor flies a couple of lines around the boundary perimeter such as a coastal margin.
- You can also maintain these grids after the drops and do daily counts to give an indication of bait uptake and/or bait breakdown.
- If there is vegetation cover (particularly tall trees with thick vegetation), bait count may increase from Day 2 as baits caught in foliage may be displaced by wind movement and drop to the ground

5.3 GEAR NEEDED

- Measuring tape to mark out grids
- Pegs or sticks to mark the boundaries of each grid
- Coloured tape to mark corner pegs of each grid
- Notebook and pencil to record information

5.4 EXAMPLE OF A 10 X 10M GRID SUBDIVIDED INTO FOUR 5 X 5M GRIDS

# = bait

<.....10.....>

