WAX BLOCK MONITORING GUIDE

A simple guide detailing the use of wax blocks for monitoring during control/eradication of introduced mammalian species in New Zealand and abroad

WMIL Wildlife Management International

Version History:

VERSION	DATE	AUTHOR	REASON FOR CHANGE
1	11 March 2020	WMIL: Bell, E. & Burgin, D.	First complete version
2	15 February 2021	WMIL: Bell, E. & Burgin, D.	Updated complete version
3	15 March 2021	WMIL: Bell, E. & Burgin, D.	Updating photos, adding in extra information.

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Cover image: South Island Robin (Petroica australis) Nelson Lakes National Park. Image by Dan Burgin.

INTRODUCTION

Flavoured wax blocks are a simple and effective monitoring tool that can be used to detect rodents (*Rattus* spp*., and Mus musculus*), common brushtail possums (*Trichosurus vulpecula*) and European hedgehogs (*Erinaceus europaeus*) during the control and/or eradication operations of conservation groups throughout New Zealand and abroad. Reptiles and mustelids (to some degree) are also able to be detected using this method, which may be desirable depending on your project. Many additional species will nibble the blocks; invertebrates (e.g. weta, cockroaches and slugs) for example will likely leave additional marks on the blocks. Wax blocks are easy to both make and use and their use in monitoring has been shown to be incredibly effective. They can help detect whether rats are still present after an eradication operation, or to get a pre/post density index to establish control operation success, and effort for analysis during control projects. Wax blocks can also help establish the density of rats in an area, to then inform adaptations needed in a group's control regime. Additionally, the use of wax blocks as monitoring tools can increase the involvement of people who do not want to do the actual control phase but do want to help with the project. Therefore, wax blocks are a fantastic tool during control and/or eradication efforts for myriad reasons.

Figure 1: Chocolate flavoured wax in position during a Caribbean rat eradication operation (WMIL).

WHY USE WAX BLOCKS?

The vision described in the recent Parliamentary Commissioner for the Environment's report is an important one; to strive to restore New Zealand's biodiversity to abundant, diverse and resilient communities (Parliamentary Commissioner for the Environment 2017). In order to meet this, and the New Zealand's Predator Free 2050 vision, eliminating introduced mammalian predator communities is our most urgent need. New Zealand's species are considered *taonga*, and contribute to every New Zealander's economic, social and personal wellbeing (McArthur & Bell, 2019), making a major contribution to the nation's wealth; over $46 billion (Department of Conservation, 2000). With current and projected impacts of global climate change, a landscape with higher biodiversity integrity and environmental value will bring a more sustainable future for New Zealand. Findings show improvements to threatened taxa attributed to successful conservation management, including trapping projects and community involvement (Robertson, *et al*., 2017). Through best practice control or eradication and monitoring, it is possible to humanely suppress and eliminate introduced mammalian predators that are pushing New Zealand's native and endemic species to the brink of extinction, and avoid the huge environmental, economic, social and cultural losses that would ensue if nothing were done.

It is well established that you need to know what you are targeting before, during, and after control and/or eradication efforts, and this is achieved through monitoring and tracking. Conventional methods have been plastic tracking tunnels and chew cards. Their effectiveness has been questioned but a more pressing question is: are they creating more harm over the long term? Global plastic pollution is a major problem of similar significance to climate change. Plastics are known to exist in the environment for hundreds of thousands of years because of their durability and presents a global concern to all ecosystems (Xanthos & Walker, 2017). Using large numbers of plastic chew cards that then end up in landfill or the surrounding environment is unsustainable. Wildlife Management International Ltd (WMIL) encourage the use of plastic free options where best available, to reduce the quantity of single-use plastics needlessly going into the environment. There are a growing number of alternatives, and it is important to use a range of tools to detect your target species. We actively endorse that groups think about sustainability **at all times**. Using batch made wax blocks, as opposed to single-use plastic chew cards for example, as described here, can dramatically reduce the quantity of plastics entering the environment. Throughout and after your project, the wax blocks can be continually melted down, refreshed with flavour and reused. Wax blocks effectively support control and/or eradication efforts through successful monitoring of target species before, during and after control and/or eradication efforts, and have been used by WMIL staff during eradication projects around the world to great effect. This document provides technical guidance on that process.

Figure 2: Rat caught on a trail camera consuming flavoured wax blocks (WMIL).

For eradication work on islands WMIL staff will only use wax blocks prior to the trapping and/or poisoning phase of the eradication to trial flavours to see if they are attractive to local rats. Often, we are not trying to determine an index or presence/absence as we treat the entire island for an eradication. However, for local groups undertaking a pre-control monitoring index is important to establish what species are present in your area. This is further explained in the DOC (2019) Trapping Guidelines and we would recommend reading these, particularly Section 5 – Monitoring before trapping. Using wax blocks as a post-control monitoring index to be able to assess your project success, as opposed to just counting the number of dead animals can increase the effectiveness and success of your control efforts.

Figure 3: Three different flavoured wax blocks being tested in the field (WMIL).

HOW TO MAKE AND USE WAX BLOCKS

The more monitoring you have out, the greater the chance you will detect rodents, hedgehogs, and possums. On top of this, having a range of flavours is important, do not rely on one type or flavour only. Rats in particular are remarkably fussy animals, and what is attractive for one is not always good for another!

Figure 4: **Piles of wax blocks with holes drilled into the centre and ready for deployment in the field (WMIL).**

The basic method is to melt down wax pellets, add flavour (peanut, aniseed, caramel, cocoa, mango, coconut etc.), pour the wax into silicon muffin trays and then let them harden. Holes are drilled into the wax once cooled so that wires can be pushed through to adhere them to trees or push into the ground. Flavour also adds colour to your wax blocks, aiding analysis of teeth marks on wax blocks. You always want to colour the wax as plain white wax is very hard to see the teeth marks on, particularly for older volunteers. Figure 3 shows three flavoured wax blocks, blue is flavoured with aniseed, brown with chocolate, and yellow has been flavoured with peanut butter. Chocolate wax is very attractive to all rodents; however, we recommend using a mixture of flavours to begin with as rats can be quite fussy, then you can see which ones are most popular and use those flavours. They are less suitable for mustelids unless they are made up with fish oil or meat juices. These will go rancid quicker though so it's always good to test out different flavours to see what works for your project. We highly recommend making them on gas rings outside rather than inside on a kitchen stove as they can be quite messy to make.

When you are adding flavours to the melted wax, you sometimes need to add more rather than less (especially when using essences). If you can smell the flavour when it is being made, then it is often strong enough, as rats have a better sense of smell than humans. However, don't skimp on the flavours as when they harden the scent fades. Wax dyes are

readily available and make great options for batches of flavours, for example blue for aniseed and green for coconut. This will also make it easier for your group to keep track of what flavours are in use. You can either use the same flavour all at once and then alternate it, or another option is to have multiple flavours at the same site as it can give the target species options.

Do think about targeting your flavour combinations to the target species, for example, all rats like chocolate and peanut, and in particular ship rats (*Rattus rattus*) have been shown to really enjoy aniseed flavour. WMIL staff have utilized flavours local to the area trapping is being undertaken in, for example outside of New Zealand, rats in the Caribbean are known to like coconut flavoured wax. Local plants that the rats, or mice are feeding on, and other flavours such as crab, fish, bacon, and chicken, can be utilised, the latter is particularly effective if there are food scraps and rubbish dumps to compete with. You can adapt your flavour combinations if you find active areas, or you notice a local plant, flower, or fruit that mice, rats or possums are feasting on.

GRID SIZES

The number of blocks needed depends on the species of rat and size of grid used.

Table 1 shows the maximum grid sizes and minimum number of blocks per hectare for *Rattus* spp. and mice during 'Control' and 'Eradication' project phases. In an eradication it is recommended that you have this grid, with additional monitoring at and in between each trap/bait station (dependent on operation). This is because you will need to know whether there is a microhabitat that the rats are utilizing or if they are avoiding entering a bait station or trap. You may find that a percentage of your rats will never enter a bait station/trap due to neophobia, and this is where the additional monitoring helps you. See Figure 7 for an example of a ship (or black) rat grid for an eradication. If you are trying to confirm you are below a control threshold then the monitoring in between traps or bait stations/lines is **not** required. You can offset your monitoring grid from your bait stations or traps as shown in Figure 5 and alternate between the two to see if you get different results.

For the monitoring phase during eradications, we recommend placing a wax block at the bait station and one halfway between two bait stations, usually along the bait station track. Additional monitoring points should be placed along any coastline or significant peripheral habitats, to capture target species movements along these habitat gradients. So, for a ship (black) rat eradication, the monitoring is actually on a 25m x 50m grid (i.e. every 25 metres along each bait station line). However, you can increase this, so for example in the Caribbean, where there is better rat habitat, an intensive 15m x 30m grid was used during an

eradication. However, this is to confirm that the eradication has been successful, so we are adding as much monitoring as we can. We also overlap wax monitoring with the full range of monitoring tools such as chew cards, tracking tunnels and trail cameras, many of these in the same locations as the wax blocks in case there are fussy rats that don't like one flavour or monitoring tool.

The reason for placing wax blocks between bait stations or traps, is to see if rats, mice, hedgehogs or possums are avoiding the stations or a microhabitat is important. If undertaking an eradication project, you also want to detect surviving rats as quickly as possible to target them within the eradication project timeframe. This is therefore why a larger amount of monitoring is essential during an eradication project. Figure 5,

Figure 6, and Figure 7 illustrate the differences between the 'Control' and 'Eradication' grids as detailed in Table 1.

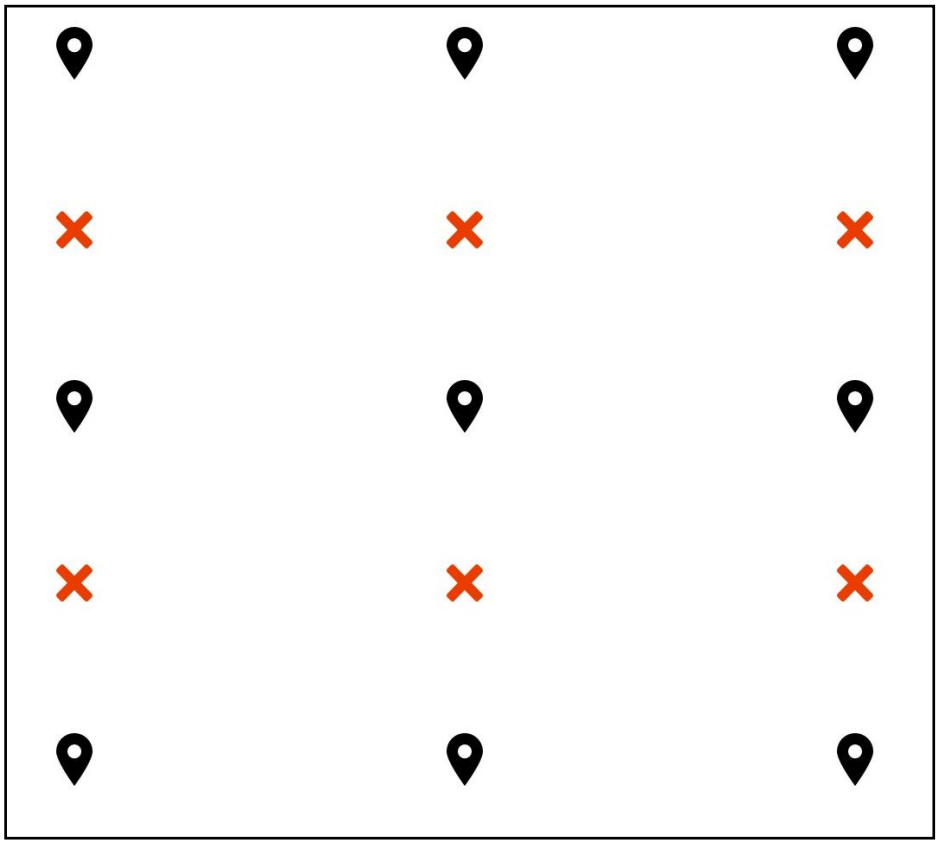


Figure 5: Control Grid Layout (A). Wax blocks (Orange X) are offset between traps (Black bubble)

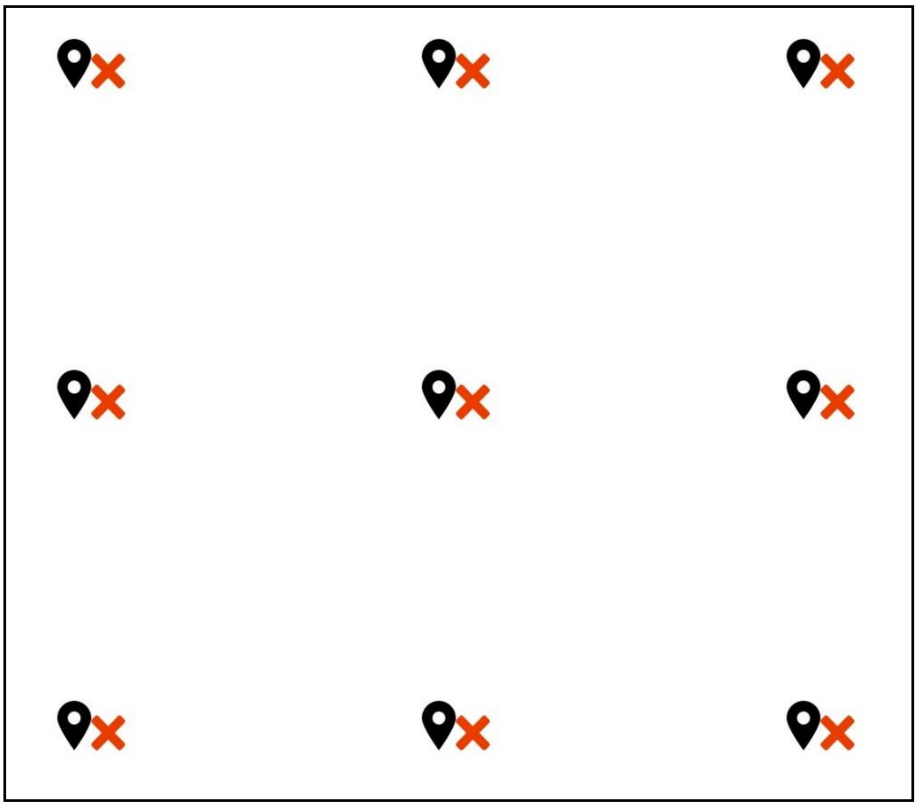


Figure 6: Control Grid Layout (B). Wax blocks (Orange X) are set next to traps (Black bubble)

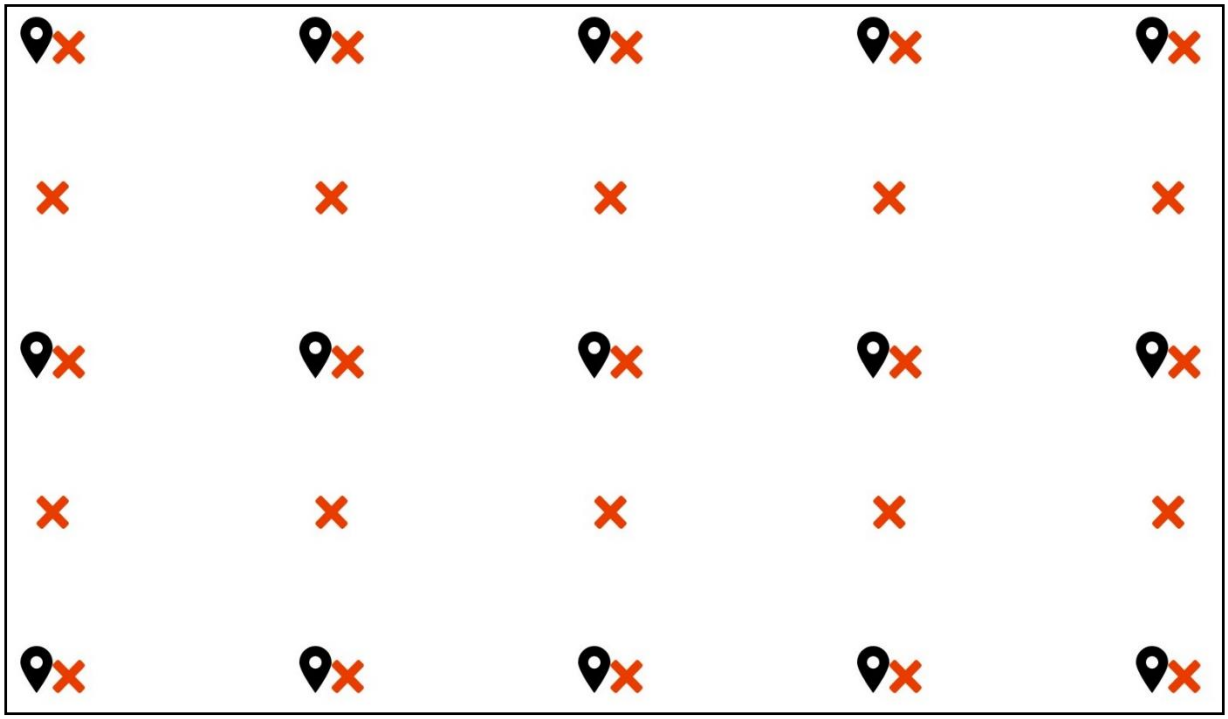


Figure 7: Eradication Grid Layout. Wax blocks (Orange X) are laid next to and also offset between traps (Black bubble)

Distances between units are not given in Figure 5, 6 and Figure 7 as this grid layout can be modelled on the target species as well as whether the project is undertaking 'Control' or 'Eradication'. An **important note** is within 'Control Grid Layout (B)' and the 'Eradication Layout' wax blocks, or any other monitoring for that matter, wax blocks should be placed within a maximum of 1 metre of that trap. It can be right beside the trap, affixed to a nearby tree/shrub, or wedged between rocks nearby.

Table 1: Maximum grid sizes and minimum number of blocks per hectare for *Rattus* spp. and mice during 'Control' and 'Eradication' project phases

Species	Maximum Grid Size	Minimum number of blocks per hectare CONTROL (See Figures 5 and 6 for example)	Minimum number of blocks per hectare ERADICATION (See Figure 7 for example)	Notes
Norway/Brown rat (*Rattus norvegicus*)	100m x 100m	4	6	*Can be reduced to 50x50m in high risk areas, such as seabird colonies, farms and urban areas*
Ship/black rat (*Rattus rattus*)	50m x 50m	9	15	*Can be reduced to 25x25m in high risk areas, such as seabird colonies, farms and urban areas*
Pacific rat/Kiore (*Rattus exulans)*	25m x 25m	25	45	*Can be reduced to 10x10m in high risk areas, such as seabird colonies, farms and urban areas*
Mice (*Mus musculus*)	20m x 20m	36	66	*We strongly recommend reducing this to 10x10m in built up areas, such as housing, lighthouses, industrial areas and farms.*

Whilst this guide is predominantly focusing on rodents, grid sizes for species such as hedgehogs, mustelids, possums, rabbits and to a lesser extent feral cats vary between 50m-250m depending on your project scope. An initial 100mx100m grid can capture all of these species due to their wider home ranges. These are minimum monitoring coverage guidelines, the more you put out the faster you are likely to detect your target species. For further information on specific species and monitoring block use, please contact WMIL directly (info@wmil.co.nz).

RECIPE

The standard recipe for creating wax blocks is below. Use this base recipe and then select a flavour using the additional instructions for other flavours in Figure 11. Ensure you buy unscented wax to avoid conflicting scent profiles in your blocks. You'll need to add in wax dyes if your essence or flavour doesn't create one. This is to make analysing bite marks easier as bite marks on clear/white wax are very hard to see!

If your checks are more than two days apart, or you have a native rodent or even cattle, sheep and/or dogs present, we strongly recommend using regular or large-sized silicon muffin trays. This is because both the target and non-target species can eat quite a volume of wax before you return thereby negating your monitoring.

Makes approximately 30 large or 60 small blocks.

Equipment:

- Standard 25 cm saucepan.
- Gas ring and gas bottle (or electric stove top).
- Silicon muffin tray (12 regular or 24 mini).
- Wooden spoon for mixing.
- Heatproof glass jug for pouring.
- Pure **UNSCENTED** paraffin wax pieces/pellet (or standard white candles).
- Flavours (peanut, aniseed, caramel, coconut, chocolate (cocoa powder), bacon, etc.).
- Wax dyes (to colour mixture if using flavouring essences) – avoid using food dyes.

Base Ingredients:

Pure paraffin wax pieces/pellets – enough to fill the saucepan 3⁄4 full, or 12 standard white candles.

Figure 8: Outside set up for making wax blocks (WMIL)

Base Instructions:

- Melt wax in pot (if using candles remove wicks once melted)
- Remove from heat before adding anything else and let it cool slightly (this avoids the water/alcohol-based flavourings/dyes causing the mixture to spit).
- Add flavour/wax dyes and stir thoroughly to mix.
- Carefully pour into the silicon tray using the heatproof jug.
- Let the wax blocks set overnight and then drill a hole in the centre of each block, using a battery-drill. We recommend placing a bucket underneath to collect the wasted wax for re-melting.
- **Do not pack into bags until completely set and cool**; preferably pack into bags the following day after melting. This prevents the wax from distorting in the bags while still warm.

Be careful as adding fats and essences can cause the wax to bubble and spit due to the higher fat and oil content so let your melted wax cool slightly before adding flavours.

Cocoa, peanut butter and aniseed are the most often used flavours. See Figure 11 for flavour specific recipe instructions. Examples of additional flavours that can be used are caramel, coconut, bacon essence, meat fat, chicken stock, fish sauce/stock, and beef stock. If your target species also seem to eat a certain flower or plant type, don't be afraid of trying to add these into your wax blocks too.

Figure 9: Pouring chocolate flavoured wax into silicone muffin trays (WMIL)

Figure 10: Peanut butter and cocoa wax blocks in silicon tray

Figure 11: Additional instructions for making different flavours of wax blocks.

CHOCOLATE

Additional Ingredients:

- 5 heaped tablespoons of pure cocoa powder

Additional Instructions:

Take pan off heat and add to melted wax. Do not use drinking chocolate as this contains milk powder and the mixture will split and burn.

COCONUT

Additional Ingredients:

- 5 teaspoons of coconut essence (or 1⁄2 block of creamed coconut or 5 heaped tablespoons of desiccated coconut)
- 1 heaped tablespoon of pure cocoa powder or pieces of wax dyes for colouring

Additional Instructions:

After melting wax and cocoa powder/wax dyes take off the heat and add coconut essence one spoonful at a time (taking care as the mixture will bubble and fizz). If using creamed coconut or desiccated coconut, add after wax melted (as the coconut can burn if left on the heat) and stir to combine. Pour carefully into the silicon tray using the jug.

PEANUT

Additional Ingredients:

- 1⁄2 jar of smooth peanut butter (or 2-5 teaspoons of peanut essence)
- Small pieces of wax dyes for colouring

Additional Instructions:

Take the pan off the heat once wax has melted and add peanut butter stirring thoroughly to mix. Alternatively take off the heat and add peanut essence one spoonful at a time (taking care as the mixture will bubble and fizz). If using the essence, add wax dyes (2 cm piece of each depending on colour you are trying to make) prior to taking off the heat and mix thoroughly. Pour carefully into the silicon tray using the jug.

Note:

If peanut butter is used, this wax does not store as long as the other types as it can spoil due to the fat/nut content but is very attractive to rodents.

ANISEED (OR OTHER FLAVOURS):

Additional Ingredients:

- 2-5 teaspoons of aniseed (or other flavour) essence
- Small pieces of wax dyes for colouring

Additional Instructions:

As above but add aniseed (or flavour) essence one spoonful at a time (taking care as the mixture will bubble and fizz) after wax is melted and off the heat. Pour carefully into the silicon tray using the jug.

(Note: aniseed is very attractive to black (ship) rats)

PLACING WAX BLOCKS

Wax blocks need to be staked firmly into the ground or fixed to tree branches within your grid. When placing your blocks in your project site, you need to "*think like a rat*" and place the monitoring where good habitat exists, i.e. where you think a rat would like to live or walk by. For example, do not place monitoring in the open without any cover, such as open fields or beaches, as rats like to run along features. Even under an 8-wire fence in an open field is better than out in the open. Placing them along rock walls or coastal features and under cover, such as on the edges of trees and shrubs, is better. If you have known rat runs, or buildings and other structures, such as ruins or sheds, place your wax blocks in and around these features as these are likely where rats are residing. Blocks can be firmly attached to trees using small pieces of wire threaded through the centre of the block. Additionally, wax blocks can be used as a bait type within traps. Note some wax block flavours will go rancid quicker than others such as peanut butter. Cocoa seems to last much longer, but it will be very site specific so try out what works at your project site. You can shave off the outer rim of your wax blocks to remove all marks and 'refresh' your block to use it again and make them last longer.

When working in areas of prime rat habitat, such as farms, rubbish dumps, seabird colonies, and estuaries, WMIL staff have often reduced the grid sizes used (as discussed above), mainly to target the rats more quickly and to detect any survivors from eradication efforts quicker.

Figure 12: Checking wax blocks on the Shiant Islands, Scotland (WMIL)

ANALYSING WAX BLOCKS

Generally, the below rules can be used to get an initial gauge on what has been eating the wax:

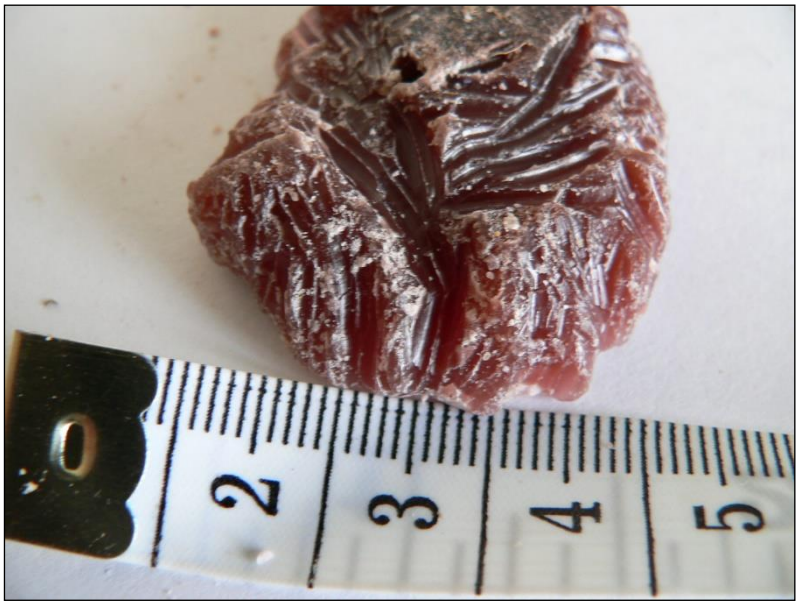
- **Rat** – Two parallel marks, each tooth mark approximately 1mm wide, messy eaters.
- **Mice** – Small parallel marks, each tooth mark approximately 0.5mm.
- **Rabbit** – Four parallel marks (very similar to rats) from top incisors and two large parallel marks from bottom teeth).
- **Hedgehog** – Two canines quite close together. Usually a crushed edge with blunt incisor marks on one edge, sharp canines on the other.
- **Possum** – Half-circle moon shaped teeth marks. Usually a large chunk is taken.
- **Bird** – Deep gouges start at a point and triangular.
- **Cats** – Two canines at a reasonable distance apart (depending on size of cat).
- **Shrew** – Very small teeth marks resembling very fine razor cuts. Sometimes hard to detect.
- **Iguana** – Often confused with rats. Multiple parallel marks, which depend on the species encountered.

Other species such as shrew or iguana can be location specific and are listed here to encapsulate the international work WMIL does, and the usability of this document for global groups. There are additional publications and guides for the identification of chews and teeth-marks from rodents. Valuable additional resources include the following:

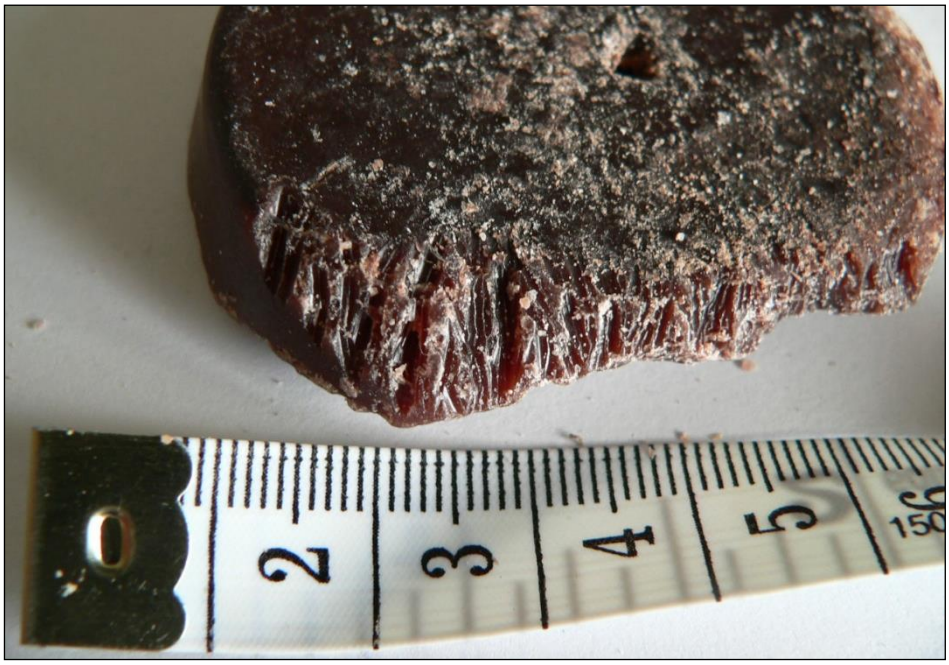
- **DOC (2019) –** *A Practical Guide to Trapping*
- **Cunningham & Moor (1996) –** *Guide to the identification and collection of New Zealand rodents*
- **Pest Detective (2020) –** *Bite Marks Information Page*
- **Landcare Research/Manaaki Whenua –** *Chewcards: A Guide to the interpretation of animal tooth impressions*

We highly recommend having a printed guide, so for example this guide, and an additional one from the above list, as an ID guide on teeth marks on wax for rats, mice, rabbits, stoats, birds, etc. so that your group have a learning tool immediately available to hand. Additionally, keeping a range of wax blocks with rat teeth marks as a physical reference can be immensely useful, so that team members can refresh their ID skills as the number of rats are reduced through control and non-target species interference increases. It can be remarkable how people forget what rat teeth marks look like after a few weeks without any rats! We therefore recommend having comparison blocks in the collection of all the key species in your area to be able to check again if a strange piece of wax comes in from a team member during a check. The following pictures give a good overview of the marks left by various species groups that will likely interact with your wax blocks.

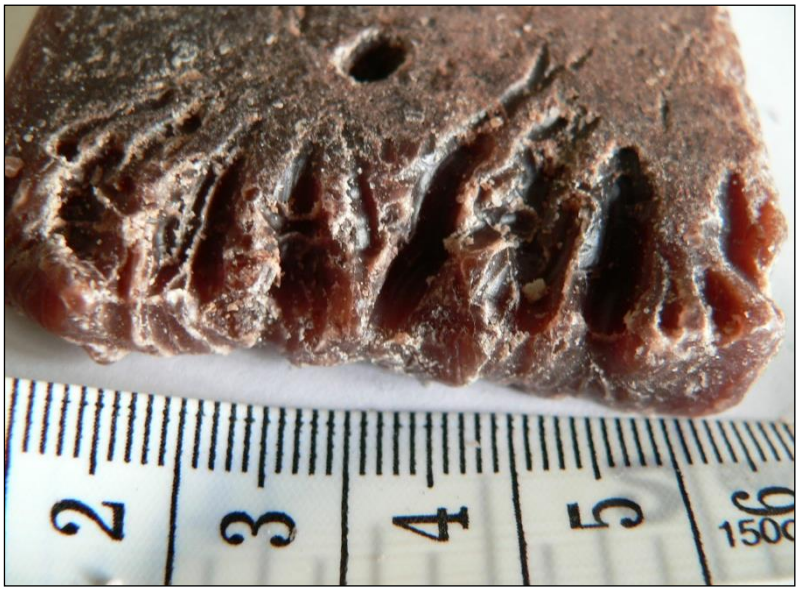
EXAMPLES OF RAT TEETH MARKS ON CHOCOLATE WAX

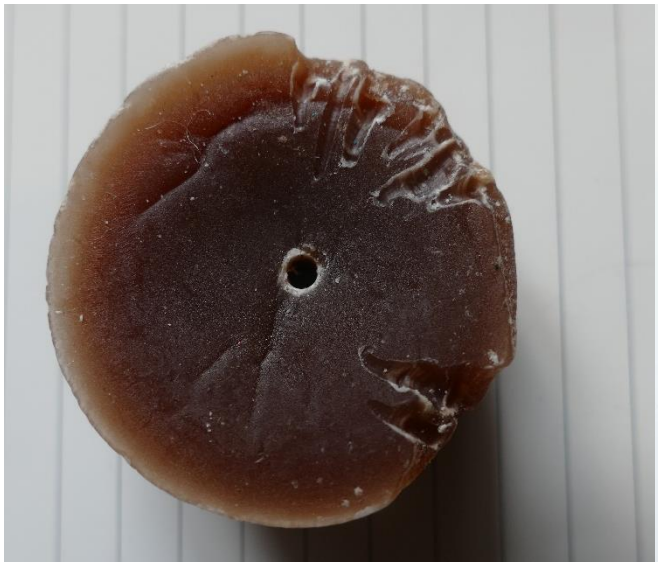


EXAMPLES OF MICE TEETH MARKS ON CHOCOLATE WAX

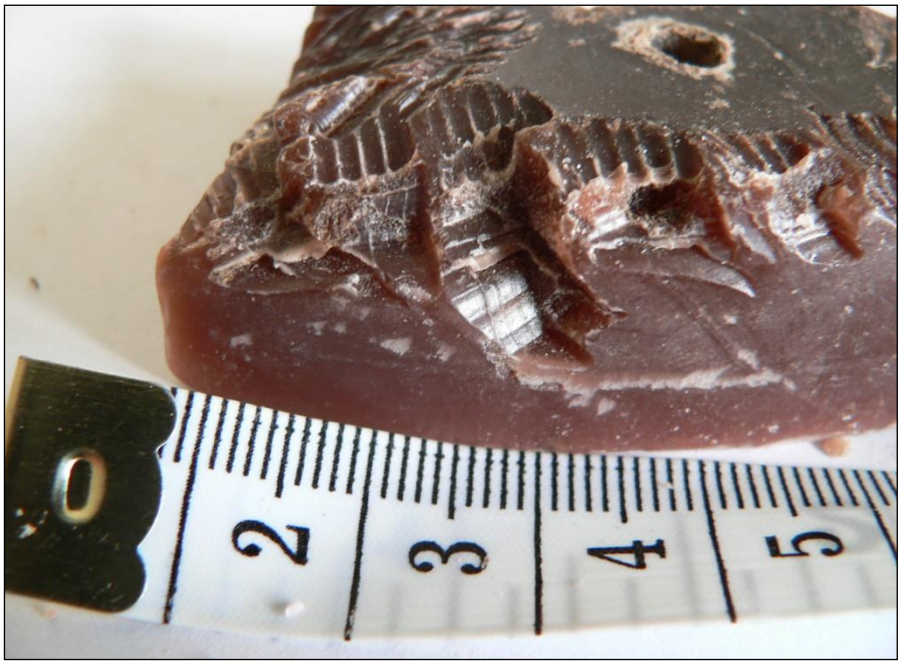


EXAMPLES OF BIRD MARKS ON CHOCOLATE WAX

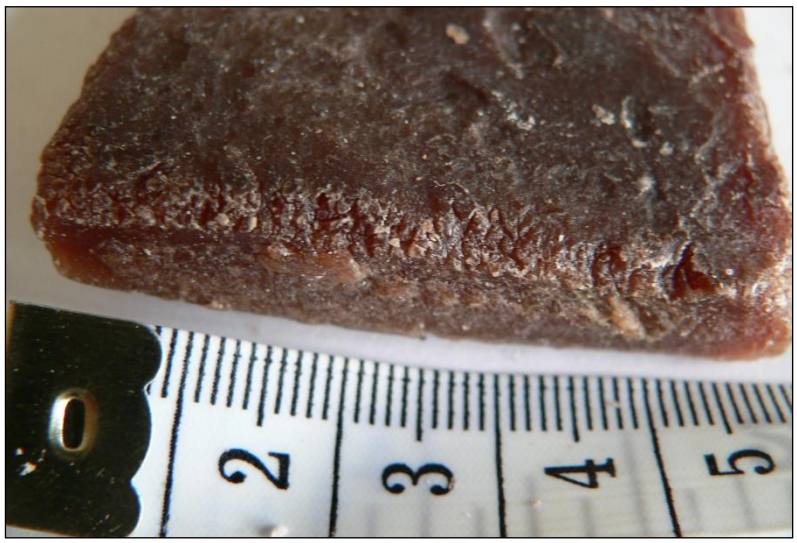




EXAMPLES OF RABBIT TEETH MARKS ON CHOCOLATE WAX



EXAMPLES OF SHREW TEETH MARKS ON CHOCOLATE WAX (ST. AGNES, ISLES OF SCILLY, UK)



EXAMPLES OF IGUANA TEETHMARKS (CARIBBEAN; Photos: Lydia Titterton, RSPB)

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