BLUFF HILL MOTUPŌHUE
ENVIRONMENT TRUST

TRAPPING PERFORMANCE AND COSTS

BHMET Experiences with Manual, AT220 and A24 Traps

Abstract

For community conservation groups, predator control is an expensive undertaking. This report assesses the performance and cost of different trap options: manual traps; and two types of automatic (i.e. self-resetting and re-luring traps) – the AT220 from NZ Autotraps and the A24 from Goodnature.

David Swann
david@motupohue.nz

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Contents

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Executive Summary

Community Conservation groups spend a lot of time, money and energy on predator control. There are a bewildering range of trap options available – with an ever-increasing array of trapping technology available. With technology comes cost.

This report uses the Bluff Hill Motupōhue Environment Trust's experiences undertaking predator control on the 800 hectares of Bluff Hill Motupōhue to assess the performance and costs of three trap types:

- Manual Traps
- NZ Autotraps AT220 automatic traps
- Goodnature A24 automatic traps.

Using a year's worth of trapping data, this report assesses kill rates and costs to better understand trap options. The costs are broken down into operating costs (bait / lure costs plus people costs) and capital costs (the capital cost spread over five years). These costs are then used to assess a 'cost per kill' figure.

The results are summarised in the table below:

Summary	Manual Traps	AT220 Traps	A24 Traps 'As Is'	A24 Traps 'Fixed'*
Number of Traps	1,148	134	394	394
Total Cost / Trap / Year	$34.31	$144.62	$89.22	$55.17*
Operating Cost / Trap / Year	$22.95	$32.53	$59.22	$25.17*
Kills / Trap / Year	1.23	31.08	11.28	11.28
Cost / Kill	$27.90	$4.26	$7.91	$4.89*

*These figures are predicted based on Goodnature-recommended fixes to some issues identified with A24 traps.

Note that when people costs are measured (this report uses a people cost of $30 per hour), manual traps become a very expensive option. However, the capital costs of automatic traps are a major factor in the buying decision – there's nothing cheaper than a manual trap!

These figures are necessarily a snapshot of BHMET's specific situation – a conservation group that's been undertaking predator control since 2008, focused on a well-controlled 250Ha podocarp forest but with expansion over the last two years into previously uncontrolled areas.

Bluff Hill Motupōhue Environment Trust

The Bluff Hill Motupōhue Environment Trust (BHMET) was established in 2008 to restore native habitat on Bluff Hill / Motupōhue. Most of BHMET's mahi has been the control of invasive predators in order that our native manu can once again thrive on the hill.

Motupōhue is a 1,000-hectare peninsula in the extreme south of Te Waka o Aoraki. That area includes 200 Ha of the Bluff township (not considered in this report); 260 Ha of Department of Conservation and Invercargill City Council Scenic Reserves that protect a mature podocarp forest; 300 Ha of ICC Recreation Reserve and 240 Ha of low-producing farmland.

Trapping started in the DOC/ICC scenic reserve where manual traps were deployed 'by the book' on traplines cut 100m apart. Mustelids were controlled with a network of DOC200 traps across the remainder of the peninsula.

More recently, a Backyard Trapping Program was started in the township with a focus on rat control. 400 traps are deployed throughout Bluff (and are not considered in this report).

Thanks to Department of Conservation Jobs for Nature funding in 2021, the trust has been able to accelerate our mahi and trial the tools and techniques that will allow us to achieve a predator-free peninsula. The trust's goal is to be able to reintroduce kiwi and tieke into the predator-free ngahere by 2028.

Manual versus Automatic Traps

Between 2008 and 2019 all trapping on Motupōhue was done with manual traps with a focus on the 260 Ha of the scenic reserves – a mature podocarp forest. This trapping has been highly successful with predator numbers at very low rates.

The reduction in predator numbers has caused a dramatic increase in mouse numbers. Where rats are tracking at around 3.33%, mice are up at 46.5%. That causes a real challenge for manual traps because mice are eating the bait within 2 days. With an average rebait cycle of 21 days, that means manual traps are only baited for 10% of the time. When a manual trap kills (typically within 2 days of rebaiting), it remains inert for the remainder of the cycle.

The most important 'game changing' technology are the automated traps that reset and rebait automatically. BHMET has been using the Goodnature A24 trap for rats (with a bycatch of mice) since 2019 and has been using the NZ Autotraps AT220 traps for possums and rats (with a bycatch of mice) since 2021.

BHMET bought automatic traps for several reasons. The most important is that they are reputed to be more effective than manual traps. Automatic traps remain constantly baited. Automatic traps remain live continuously.

Automatic traps can also be more efficient. An AT220 only requires a battery charge and lure refresh every 100 cycles – typically 4-6 months. This is an important consideration for BHMET as we need to have a contingency plan for a post-Jobs for Nature reduction in staffing levels. Manual traps are considerably more labour intensive than automatic traps and the small Bluff community could never have enough volunteers to operate the scale of trap network required to control predators across the 1,000 hectares of Motupōhue. Our volunteer community of 20-30 volunteers is (just) large enough to maintain an automatic trap network across this area.

Often, the decision to purchase a trap is based on capital costs. This can seem like a simple decision: manual traps are an average of $39 each, A24s are $150 and AT220s are $500.

This report uses approximately a year of data collected from manual, A24 and AT220 traps to better understand the performance and cost differences. Are the automatic traps worth the dramatically higher capital costs?

It is important to note that this study is based only on BHMET's experiences on Motupōhue. Every trapping scenario will be different, particularly in terms of kill rates. That said, this report has been structured to help organisations understand how their situation might change these results.

Counting Kills

Counting kills is not the same as measuring success... success is measured by the absence of predators. When predators are absent, kills are absent! Monitoring is the only valid means of determining the absence of predators.

However, counting kills is important to determine how far along the predator control / elimination journey an organisation is. It is also a key measure of trap performance. A kill occurs where four things are present:

- A predator,
- A trap appropriate to the species of predator that is placed correctly,
- Bait in the trap that's appropriate to the target species,
- Appropriate trap maintenance,

Counting kills is a good way of identifying trapping quality issues.

Kills are easy to count with manual traps – the carcass is retained in the trap until it is counted. However, with automatic traps, carcasses drop out of the trap and are quickly removed by other predators. BHMET has been assessing automatic trap predation rates and we were surprised at the high proportion of carcasses being removed: over 80% of 'small' carcasses were removed from AT220 traps; about 20% of 'large' carcasses were removed.

In the absence of automatic trap sensors, automatic trap kill figures were being significantly under-counted. This affects BHMET's understanding of predator control progress and results in an under-valuing of expensive automatic traps.

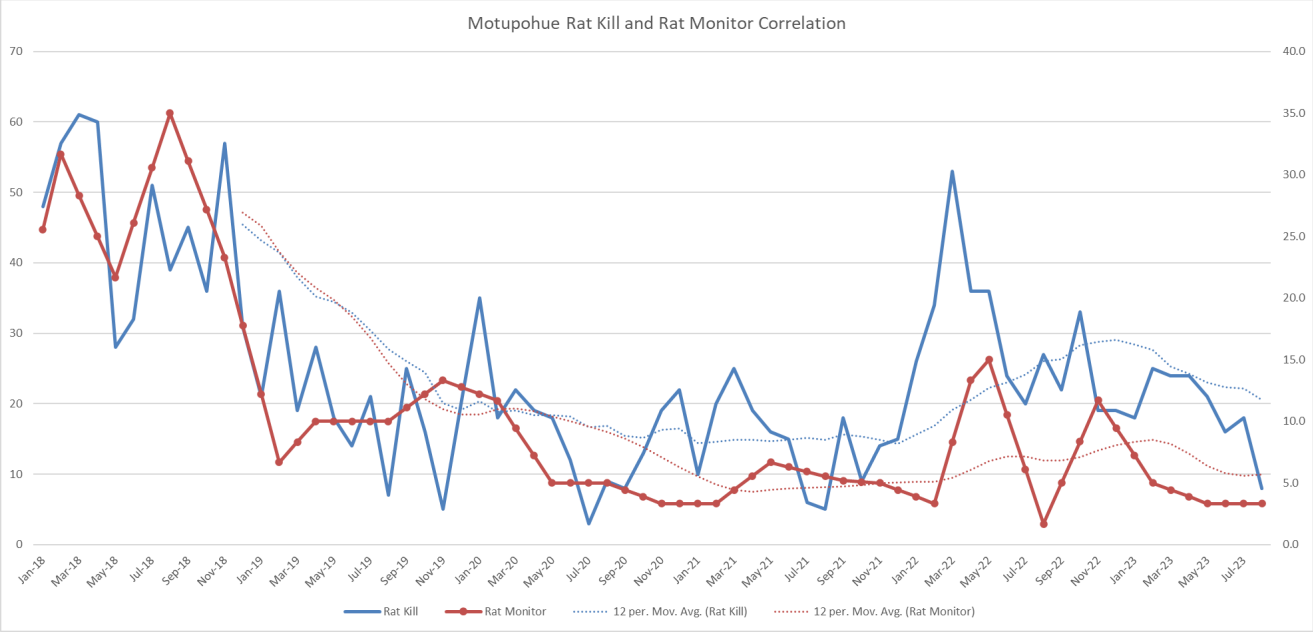
Trap sensors are expensive. BHMET can only afford to attach sensors to a proportion of our automatic traps. The figures from these sensors have been used to extrapolate kill figures across the automatic trap fleet.

Kills versus Monitoring

Environment Southland conduct rat (and mouse) monitoring every quarter. Four of the six monitoring lines are inside the DOC / ICC Scenic Reserves with the other two being just outside the Scenic Reserves. For the last two quarters (as at September 2023, the RTI has been measured at 3.33% for rats and 46.5% for mice.

BHMET has maintained a comparison between monitoring results and kill results to ensure that a correlation exists. Not only does this ensure that trap density and maintenance are correct, it also allows us to use kills as a proxy for monitoring on other parts of the hill. Monitoring is done quarterly, and kills are reported monthly so for the purposes of the analysis, monitoring results are extrapolated to monthly points using a 'straight line'.

The results over the last 60 months show a good correlation and are shown in the graph below:



That analysis shows good trend correlation, but it should be noted that the vertical axes have different scales – kill numbers on the left-hand axis, RTI % on the right-hand axis. To check absolute figures, a bit more maths is required.

Motupōhue monitoring is based on 60 monitoring stations spread across 10 monitoring lines. An RTI of 3.33% means that rat footprints were found in just two out of the 60 monitoring stations over one night. If that directly correlated to trap kills, that would suggest that across the fleet of 463 rat traps in the scenic reserves, we should kill 3.33% rats PER NIGHT – i.e. 15 per night. On first sight, that's not a credible figure. However, manual traps are inert for 90% of the time... and so in a month, we would expect to have 15 x 30 x 0.1 kills – which is about 46 rats per month.

The actual manual trap kills in the scenic reserves are around 17 per month. The difference is accounted for because trap interaction rates are lower than monitoring station interaction rates, and because mice are being caught in rat traps (rendering the rat traps inert).

People Costs

For an all-volunteer group, it could be argued that the people costs are irrelevant. With that argument, the lure plus capital cost of manual traps is extremely low.

'Cost' is merely a method of measuring a finite resource – and volunteers are a finite resource. A finite number of people must remove a large number of predators from the largest possible area in the shortest possible time. Those predator numbers are being steadily replenished by breeding. If the number of kills isn't exceeding the replenishment rate, trapping is failing and the area needs to shrink.

If the number of kills equals the replenishment rate, predators are 'under control' but that control must continue for all time. Any pause or reduction of predator control will see predator numbers increase again.

If the only aim is predator control, the time frame doesn't matter. If the aim is predator elimination, then the time frame is critical because the costs of getting the last 5% of predators is about the same as the costs of getting the first 95% of predators. At that point, trapping effectiveness really matters – and the only way of measuring trapping effectiveness is to measure people costs.

Trap Density

An important trapping consideration is trap density. Different predator species have different home ranges and trap density must match the home range of the target species – a failure to achieve this would mean that pockets of predators remain in the area.

Predator Free NZ recommends two 'devices' per hectare for combined rat, possum, and stoat control but notes that one should be a trap and one a bait station.

BHMET's average trap density is just over 2 per hectare with an additional 478 bait stations.

Toxins

BHMET has used toxins in the past to control surges in rat population, but this has not been required in the last three years. The use of toxins is not considered in this report; toxins should always be considered as a cost-effective means of controlling high predator densities.

Report Structure

This document compares the performance and cost of the three types of trap being considered:

- Manual Traps
- NZ Autotraps AT220 traps (see https://nzautotraps.com/products/at220-autotrap for trap details
- Goodnature A24 traps (see https://goodnature.co.nz/ for trap details.

For each trap type, the following performance and cost factors were considered:

Factor	Explanation
Bait / Power Costs	The annual cost of keeping the trap attractive to predators and remaining lethal – excluding the people cost. This is the cost of bait/lure plus the costs of powering automatic traps.
People Costs	What does it cost for the people needed to keep the trap baited? This report uses a standard cost of $30 per hour across all trap types. The visit time at each trap is just the 'time at trap'. It does not include the time to walk to a trap.
Operating Costs	This is the bait / power costs plus people costs.
Capital Costs	A standard 'trap life' of five years has been used to divide the capital cost into annual amounts. It could be argued that 10 years is a more realistic lifespan for a trap but 5 years would typically be used for financial depreciation calculations for a trap purchase.
Cost / Trap / Year	How much does each trap cost per year – the operating plus capital costs
Kills / Trap / Year	Across the trap fleet, what is the average kill / trap / year. Note that for automatic traps, I've used triggers / trap / year rather than carcass counts per trap / year. See below for explanation.
Cost / Kill	How much is each kill costing?

The report then considers how the performance and cost of each trap type could potentially be improved.

Manual Traps

BHMET operates 1,148 manual traps across Motupōhue. This does not include almost 400 rat traps that are part of the separate Back Yard Trapping program and nor does it include leg hold traps. The traps are deployed across about 800 hectares of the peninsula (the township isn't included). The densest area of manual trapping is in the 260Ha scenic reserves where 700 traps are deployed – a density of 2.7 traps per hectare.

The traps are broken down as follows:

Trap Inventory	Quantity	Cost Each	Totals per Types
DOC 150	1	$110	$110
DOC 200	223	$120	$26,760
DOC 250	26	$200	$5,200
Flipping Timmy	62	$75	$4,650
Possum Master*	135	$65	$8,775
Rat trap	529	$20	$10,580
SA Cat	30	$60	$1,800
Timms	12	$70	$840
Trapinator	130	$50	$6,500
TOTALS	**1,148**		**$65,215**
		Average Trap Capital Cost	**$56.81**
		Annualised Trap Capital Cost	**$11.36**

*Note that our Possum Master traps are currently being retired to be replaced with the NAWAC-approved Flipping Timmy trap.

We aim for 26 re-bait visits a year. We achieve an average of 17.3 visits a year – one visit every 21 days. Motupōhue has very high mouse numbers and most bait disappears within 2 days. So, on average our manual traps are inert for 90% of the cycle. This was a major rationale for the use of automatic traps.

For this analysis, we use an average visit time of 2 minutes. This does not include the time taken to walk to the trap. The bait cost of 6c per trap per visit is based on dividing the total annual bait spend by the total number of trap visits.

Manual traps are unpleasant to operate. Since the kill invariably occurs at the start of the cycle, the trapper has to deal with a rotted carcass. But once predator control has become effective (as is the case on Motupōhue) they're also boring. At an average kill rate of 0.1 kills per trap per month, a typical trap line with 30 traps will only see two kills on each visit. Whilst this is a sign of trapping success, it can be challenging to maintain trapper enthusiasm!

To overcome these issues, 300 of the larger traps are fitted with Celium VHF sensors. These allow the remote monitoring of manual traps to allow fast clearance and 'gamify' the trapping experience. Note that the costs ($150 per sensor) are not included in this analysis.

Manual Trap Performance

Our fleet of manual traps killed a total of 1,412 predators between 1 Sep 22 and 31 Aug 23 with a breakdown as follows:

Bird	Cat	Ferret	Hedgehog	Mouse	Possum	Rabbit	Rat	Stoat	Weasel
17	20	4	76	425	112	8	643	88	19

This count is unambiguous – carcasses are held in the trap and even if a predator scavenges the carcass, enough remains to identify the species.

Note the high mouse count. Mice are not a target species, and the traps are calibrated to try to avoid mice kills. That's always challenging, particularly with rat traps.

The overall performance statistics are:

Manual Trap Performance	
Manual Trap Total #	1,148
Kills / Year	1,412
Kills / Trap / Year	1.23

The majority of BHMET's manual traps are in the DOC and ICC scenic reserves. This is a well-controlled area with low predator numbers. The low overall kill rate has been normal for the trust over the last five year until Jobs for Nature funding allowed for an expansion of trapping operations.

Manual Trap Costs

People costs are the most important factor in manual trap operations. Even though the visit time per trap visit is low, the visit frequency needs to be high – ideally once a fortnight, in practice, an average of once every 21 days.

Since the bait is typically removed within two days, the trap is rendered ineffective which then compounds the high people cost by increasing the cost per kill.

The manual trap cost statistics are:

Manual Trap Costs	Lure Cost	People Cost	Operating Cost	Capital Cost	Total Cost
Per Unit	$0.09	$30.00			
Fleet Annual Totals	$2,127.00	$24,220.81	$26,347.81	$13,043	$39,390.81
Per trap costs	$1.85	$21.10	$22.95	$11.36	$34.31
Per kill costs	$1.51	$17.15	$18.66	$9.24	$27.90

Different Scenarios

BHMET's manual traps are deployed in very different trapping environments. The results above are for the whole fleet. It is useful to identify specific scenarios across the hill.

Weekly Visits

Increasing the frequency of trap visits will inevitably improve performance as is clearly demonstrated on one of our scenic reserve trap lines where a volunteer has managed an incredible once-a-week visit frequency through the year. Her diligence has double the catch rate on her line – from a fleet-wide average of 0.84 per trap per year to 1.76 kills per trap per year. That's an impressive achievement in a low-predator environment:

Line B1 Performance	
Manual Trap Total #	42
Kills / Year	74
Kills / Trap / Year	1.76

But, on that line, the cost per trap has almost than doubled to $64.59 per year and the cost per kill has actually increased – from $27.90 to $36.66.

B1 Trap Costs	Lure Cost	People Cost	Operating Cost	Capital Cost	Total Cost
Line Annual Costs	$191.79	$2,184.00	$2,375.79	$337.00	$2,712.79
Per Trap Costs	$4.57	$52.00	$56.57	$8.02	$64.59
Per Kill Costs	$2.59	$29.51	$32.11	$4.55	$36.66

Higher Predator Numbers

Most of BHMET's manual traps are in the DOC and ICC scenic reserves which have an extremely low (RTI of 3.33% as at September 2023) predator population (with the exception of mice which track at 46.67%). That clearly has an impact on trapping effectiveness – if there are low predator numbers, there will be low kill numbers.

To explore the impact of this, the results across higher predator areas were analysed. The trap inventory and results were extracted for the traps deployed on the ICC recreation reserves and the Awarua areas.

In these areas, BHMET has used a network of DOC 200 and DOC 250 traps along with some limited possum traps. There has been no rat control.

Note that this area also has a higher proportion of traps with Celium VHF sensors which has increased the average visit frequency slightly.

The kills per trap per year are only 40% higher than those in the Scenic Reserves:

Higher Predators	
Manual Trap Total #	288
Kills / Year	502
Kills / Trap / Year	1.74

BHMET had anticipated higher kill rates. Our hypotheses for the lower-than-expected rates are:

- Food is not as abundant in the expansion areas – the podocarp forest of the scenic reserves would always be a more attractive food source.
- BHMET has deployed a much higher proportion of automatic traps into the expansion areas – these seem to quickly reduce predator numbers, which would lessen kill rates on the manual traps.
- The manual traps in the expansion area are much better at avoiding mouse bycatch – there are far fewer snap-E and T-Rex traps.

This area saw a slightly higher visit frequency (every 16.59 days on average) coupled with a higher average trap capital cost so the per trap costs were higher. The higher kill rate does reduce the cost per kill but still not down to the level of automatic traps (see below).

Higher Predators	Lure Cost	People Cost	Operating Cost	Capital Cost	Total Cost
Line Annual Costs	$556.41	$ 6,336.00	$6,892.41	$3,883.00	$10,775.41
Per Trap Costs	$1.93	$22.00	$23.93	$13.48	$37.41
Per Kill Costs	$1.11	$12.62	$13.73	$7.74	$21.46

AT220 Traps

AT220 automatic traps have become an important component of our trapping on Motupōhue. The trust operates a fleet of 134 AT220 traps deployed across about 450 hectares of the peninsula. That's a trap density of 1 per 3.36 hectares.

The average deployment time for these traps has been 9 months at the time of this analysis (as at 1 September 2023.

The entire fleet of AT220s is fitted with Celium VHF sensors which were fitted to allow BHMET to monitor trap performance. Of these, only 100 have provided reliable results. Note that the costs of the sensors are not included in this analysis.

We are now confident that AT220s last six months before needing battery and lure refresh. And in that time, we know from carcass counts that they are considerably more effective than manual traps.

The relure / rebattery process takes around 6 minutes that includes the time to clean the trap eyes. All of BHMET's AT220 traps use the 500ml lure bottle – with lure costing $24 per litre. Our trappers carry charged batteries with them to do an immediate swap out. The costs of the spare batteries are not factored into this analysis.

AT220 Trap Performance

Both the AT220 computer and the Celium node can identify the difference between a 'large' and 'small' predator. The carcass counts for AT220 traps from 1 Sep 22 to 31 Aug 23 are used to try and estimate likely species breakdowns. This may be a risky proposition for small predators since mice tend to explode when the AT220 is triggered making counting challenging. Therefore, the ratio of mice to rats is likely to be understated.

			Small					**Large**		
			Bird	**Rat**	**Mouse**	**Weasel**	**TOTALS**	**Possum**	**Cat**	**TOTALS**
Carcass Counts			6	352	316	1	**675**	203	4	**207**
Trigger Counts			31	1803	1618	5	**3457**	694	14	**708**

Note that the bird bycatch are almost all Tauhou / Waxeyes which feed from the AT220 lure cup just before dawn – before the daytime safe mode operates.

The overall performance of the AT220 looks like this:

AT220 Trap Performance	
Total AT220	134
Small Kills / Year	3,457

Large Kills / Year	708
Total Kills / Year	4,165
Kills / Trap / Year	31.08

The key figure is the kills per trap per year – a very high figure.

AT220 Costs

AT220s are the most expensive trap BHMET uses – retailing at $495 each (excl GST) but with considerable discount for bulk purchases down to $395 each. In this section of the analysis, we have used the pessimistic figure of $495 – in the 'Improvement Potential' section, we use the optimistic figure of $395. That's still the highest cost of any trap that BHMET uses.

However, the operating costs are proving very attractive. The traps are proving capable of staying in the field for 6 months on one battery and one 500ml lure... whilst killing on average 15 predators in that time. The lure costs are extremely low at just $12 per 500l refill.

AT220 Costs	Lure Cost	People Cost	Operating Cost	Capital Cost	Total Cost
Per Unit	$24/L	$30/hr		$99/trap/yr	
Fleet Annual Totals	$ 3,487.25	$ 871.81	$ 4,359.06	$ 13,266.00	$ 17,625.06
Per trap costs	$ 26.02	$ 6.51	$ 32.53	$ 99.00	$ 131.53
Per kill costs	$ 0.84	$ 0.21	$ 1.05	$ 3.19	$ 4.23

Because of the high capital cost, the cost per trap is the highest at $131.53 per year. But, because the kill rate is so high, the per kill costs are the lowest at just $4.23. Note that by buying the traps in bulk, a lower capital cost per trap is achievable. The cost table for the lower bulk cost is included in the 'Improvement Potential' section below.

A24 Traps

BHMET has been using Goodnature A24 traps since 2019. Our initial deployment was 60 A24s on the Foveaux Walkway. These first traps performed well – we had digital counters fitted on these traps and we were replacing lure and gas every six months. In hindsight, that was too long between servicing – it was likely that the traps were inert for the latter part of the period.

We then bought another 350 A24s in July 2022. The original intention was to fit all of these with Celium nodes so that we could keep track of kills. Unfortunately, for many reasons, we were only able to fit about 100 traps with Celium nodes. However, that has given us enough data to extrapolate likely kill rates across our fleet of A24 traps.

We have had approximately 400 A24 traps deployed on Motupōhue with the average deployment time being around 9 months. That's enough time for us to assess performance and costs.

The re-lure / re-gas process takes around 6 minutes including the time taken to clean the trap. This report uses a bulk price of $5 per gas canister and $10 per lure. However, it has since been determined that the traps can be fitted with a 'basket' to allow any chosen lure to be used. The cost summary will therefore use 'standard' lure costs alongside the reduced costs of using manual trap lures.

A24 Trap Performance

Measuring automatic trap performance is more challenging. Carcasses are quickly predated. We rely on our Celium nodes to provide an estimate of total kill rates and then use carcass species counts to calculate the ratio of different species.

Our fleet of 394 A24 traps has produced the following results:

Kill Types	Bird	Hedgehog	Mouse	Rat	Total
Carcass Count	2	4	249	39	294
Trigger Count	30	60	3,764	590	4,444

Mouse RTI figures on the hill are up at 46.67% while rat RTIs are down at 3.33%. So the estimated ratio of mice to rats at 6.37:1 seems higher than the anticipated RTI ratio of 14:1.

It should be noted that there's a different ratio of mice to rats for the manual traps: 0.66:1. That's because many manual traps are calibrated to prevent mice from triggering the trap. In most cases, a mouse will trigger an A24 although BHMET has a lot of trail cam footage showing mice accessing the trap without triggering it – a small mouse can get past the trigger without disturbing it.

The overall performance is therefore:

A24 Trap Performance	
A24 Trap Total #	394
Kills per year	4,444
Kills / Trap / Year	11.28

The kills per trap per year figure is a significant improvement over manual traps but lower than the AT220. This is confirmed by watching trap interaction rates on trail cams – the trap interaction rate is lower than expected and there are many examples where birds and small mice have gone up into the trap without it triggering.

A24 Costs

There are two aspects of A24 cost that have been problematic for BHMET.

- We've used the standard Goodnature gas and lure which are expensive - $5 for gas and $10 for lure.
- The time between re-gas / lure is too short – just 4 months on average with only 4 kills in that time. This seems to be getting worse with four recent trap lines requiring re-gassing after less than two months.

However, after conversations with Goodnature, these solutions have been proposed:

- A lure basket is available which fits into the lure socket and allows any lure to be used. This would potentially reduce the lure cost dramatically. The additional analysis below uses the figure of $0.25 per rebait – higher than the manual trap cost because more lure is needed but that will be offset by the need for fewer rebaits.
- BHMET might have had a bad batch of gas canisters which can leak from around the cylinder top. Goodnature have supplied a new batch of cylinders.

- BHMET might have some traps which contain a manufacturing defect that causes a slow, leaky retraction of the kill bolt. This is easy to test, and Goodnature will replace any traps with these faults.

From the analysis based on data from the last year, the A24 operating costs are the highest at $59.22 per trap per year with the gas and lure being the main component of this. The total cost per trap per year is $89.22.

A24 Costs	Gas/Lure Cost	People Cost	Operating Cost	Capital Cost	Total Cost / yr
Per Unit	$15.00 each	$30/hr		$30/trap/yr	
Fleet Annual Totals	$ 19,444.13	$ 3,888.83	$ 23,332.96	$ 11,820.00	$ 35,152.96
Per trap costs	$ 49.35	$ 9.87	$ 59.22	$ 30.00	$ 89.22
Per kill costs	$ 4.38	$ 0.88	$ 5.25	$ 2.66	$ 7.91

Note that the cost per trap does fall when bought in bulk – down to $130 each. That brings the costs down further – reflected in the 'improvement potential' section below.

Over the last year, the per kill costs have been almost twice as high as the AT220. If the issues identified in conversation with Goodnature are fixed, we would expect to see a reduction in costs – see below for the revised cost table.

Improvement Potential

This report is based on the trap performance 'as is'. This section now explores the potential for improvement in performance and cost for each trap type.

Manual Traps

Manual traps will remain the mainstay of most community conservation groups. So it's important to understand ways of improving the effectiveness of manual traps.

Long-life Lures

One way of potentially increasing the effectiveness is to use long-life baits to increase the kill rate without needing to increase the visit rate. In theory, having a permanently available bait should increase kill rates by 10x... because the trap is attractive for 100% of the visit cycle rather than the 10% at present.

This still has to be modified since once a kill occurs, the trap is rendered inert for the remainder of the cycle. As a result, the more realistic performance increase is 5x (since the distribution of kills across the cycle would result in half the traps being inert on average).

If that was the case (and our trials of long-life baits does not support this theory), then the cost per kill would have the potential to fall as low as $7.20. This is about the same as the A24 and more than the AT220.

BHMET has trialled the use of plastic Nara lures and the clay Poauku lures, but the results are inconclusive. They certainly haven't resulted in a 5x improvement in kill rates. They are still used but as secondary lures to back up more traditional lures.

BHMET makes extensive use of flour and icing sugar 'blaze' to make our traps more attractive to predators. Blaze only lasts 3-4 days (less in rain) before being eaten by mice and insects. Blaze is an

important means of increasing trap interaction rates and we hypothesise that the absence of blaze for much of the trap cycle contributes to the underperformance of long-life lures.

Trap Sensors

BHMET has placed Celium nodes on about half of our major traps (i.e. DOC, possum and cat traps) outside the scenic reserves. This provides a near real-time notification of a trap trigger.

This improves trap performance because traps get cleared within a few days of a kill occurring. This is important because it's the well-placed traps that kill... and by getting these back in action quickly, we improve the chances of another kill.

Trap sensors are expensive – each Celium node is at least $150. That brings the capital cost of a major manual trap up to over $200 – about the same cost as an A24 plus 'Smart Cap'.

A24 Traps

BHMET's A24 traps have not performing 'as advertised'. The traps are degassing and running out of lure far too quickly. That said, according to Celium trigger records, they are killing at a far higher rate than manual traps.

After a positive conversation with Goodnature, the fixes identified above have been proposed. If these fixes work (and BHMET will test this rigorously over the coming year, we might anticipate performance figures based on the following adjusted figures:

Revised Lure Cost	$0.25 per visit
Increased period between regas	20% improvement

That would lead to the following cost table (which includes the reduction in trap cost when bought in bulk to $130:

A24 Corrected Costs	**Gas/Lure Cost**	**People Cost**	**Operating Cost**	**Capital Cost**	**Total Cost/Yr**
Per Unit	$5.25 each	$30/hr		$26/trap/yr	
Fleet Annual Totals	$ 6,805.45	$ 3,111.06	$ 9,916.51	$ 11,820.00	$ 21,736.51
Per trap costs	$ 17.27	$ 7.90	$ 25.17	$ 26.00	$ 51.17
Per kill costs	$ 1.53	$ 0.70	$ 2.23	$ 2.66	$ 4.89

If those anticipated figures are correct, then the costs per kill are at the same level as the AT220. BHMET will be continuing to monitor A24 results against this new expectation.

Lure

The standard A24 lure is a complex and expensive system. It comprises of a double pouch, the lower pouch full of lure and the upper pouch empty. In the top of the upper pouch is a type 675 button battery which uses a rare-earth magnet to short across a resistor on deployment. This generates gas which inflates the upper pouch, squeezing the lure out at a steady rate over a several-month period.

BHMET's recent experience is that lure lasts only 4 months at most. In some cases, lure is gone after just 2 months. We don't understand why some traps lose their lure so quickly. One hypothesis is that if the trap leaks gas and stop firing, mice get in above the trigger and eat the lure.

The lure pouch is non-recyclable. To avoid putting the battery and magnet into landfill, BHMET cuts apart old lure pouches to remove the battery and magnet for recycling.

A lure pouch costs $11.90 retail – a bulk cost of $10 has been used for this analysis.

In subsequent conversations with Goodnature, the alternative of using a bait basket to allow any lure to be used has been suggested. BHMET will be experimenting with this approach. One limitation is that the standard lure drips continuously to act as a pre-feed under the trap. The lure basket won't allow this to happen so one possibility is that there will be a reduction in trap kill rates.

Gas

The A24 trap is powered by a small carbon dioxide canister. This is supplied by Goodnature who do not permit the use of generic refills – this would void the trap warranty.

According to Goodnature, a single gas canister should be capable of powering the trap for six months or 24 triggers.

BHMET's experience is that traps have lost all their gas after four months – just four triggers. More alarmingly, recently, that period has dropped down to two months. BHMET has tried diagnosing the problem without success. A s noted above, it appears that BHMET had received a bad batch of gas canisters so hopefully this issue will be resolved.

The CO2 canister retails for $7.50 – a bulk cost of $5 has been used for this analysis. It should be noted that generic gas canisters can be bought online for just $2.50.

BHMET is not persuaded by Goodnature's arguments for not allowing the use of generic gas canisters. The claim on the Goodnature website is that generic canisters might contain petrochemical residues (that would damage the rubber seals in the trap) and that Goodnature canisters are capped with dry silicone which lubricate the trap seals. Neither seem particularly compelling rationales.

'Smart Cap'

Goodnature has a 'Smart Cap' solution for monitoring triggers on A24 Traps. It uses Bluetooth to transfer trigger information to a nearby smartphone.

Although this is far cheaper than the Celium node, it is a short-range solution that necessitates a trap visit in order to download the data. Using the Celium node permits a real-time understanding of trigger data without the need for a trap visit.

Unfortunately, the 'Smart Cap' requires the organisation to set up a Goodnature *Dashboard* user, line, and trap management system that operates in parallel to Trap.NZ. This is unacceptable since it doubles the administrative overhead of trap management. Few trapping organisations will use a single trap type – all trap types must be able to interoperate fully with Trap.NZ's system.

There is no system to transfer data from the Goodnature Dashboard into Trap.NZ – that requires the download and upload of a CSV file. Again, this is an unacceptable limitation.

AT220 Traps

The AT220 traps have performed well on Motupōhue. The only issue that the trust has had to deal with is that the lure feed tube was being nibbled by mice during daytime safe mode. We added a stainless-steel tube around the bottom of the rubber feed tube, and this has solved the problem.

Bulk Trap Costs

As indicated above, the costs of AT220 traps fall quite sharply when bought in bulk: from $495 each down to $395 each. That changes the cost table considerably. The 'bulk price' cost table looks like this:

AT220 Costs	Lure Cost	People Cost	Operating Cost	Capital Cost	Total Cost
Per Unit	$24/L	$30/hr		$90.80/trap/yr	
Fleet Totals	$ 3,487.25	$ 871.81	$ 4,359.06	$12,167.20	$ 16,526.26
Per trap costs	$ 26.02	$ 6.51	$ 32.53	$90.80	$ 123.33
Per kill costs	$ 0.84	$ 0.21	$ 1.05	$ 2.92	$ 3.97

Lure

The mayo lure drips into a bait cup high up in the trap. This area of the trap gets extremely messy, particularly when mouse components end up exploding into the bait cup. Cleaning the trap in-situ is challenging and potentially dangerous if safety protocols aren't scrupulously observed.

AT220 Battery

If a battery fully discharges, the AT220 is left in a dangerous state – the trap is set with no means to trigger the trap. BHMET requires that all trappers carry spare charged batteries so that a trap can be made safe.

It would be preferable if the trap triggered once a battery reaches a level too low to support reset. Although this introduces new hazards involved with a trap triggering without warning, BHMET believes that this is the lesser of two evils.

Recording Triggers

The AT220 has a computer that controls the trap operation and records the number of triggers and trap status. This data is accessed using a short-range wi-fi connection which requires a trap visit. BHMET is working with Autotraps NZ and Encounter Solutions to develop a wired connection between the computer and the Celium node to monitor trap status remotely. Other remote monitoring solutions are available for the AT220.

Connection to Trap.NZ

When an appropriate sensor is attached to the trap (BHMET uses the Celium node), data can be transferred to Trap.NZ. Unfortunately, once in Trap.NZ, there are no tools available to make use of the data – for example, being able to convert 'trigger' events into kills using adjustable species ratios.

Conclusions

As is so often the case, the choice of trapping technique is going to involve a compromise.

Summary	Manual Traps	AT220 Traps 'As Is'	AT220 Traps 'Bulk'	A24 Traps 'As Is'	A24 Traps 'Fixed'
Total Cost / Trap / Year	$34.31	$131.53	$111.53	$89.22	$55.17
Operating Cost / Trap / Year	$22.95	$32.53	$32.53	$59.22	$25.17
Kills / Trap / Year	1.23	31.08	31.08	11.28	11.28
Cost / Kill	$27.90	$4.23	$3.97	$7.91	$4.89

Manual traps are the cheapest in terms of capital costs and operating costs. But by far the most expensive in terms of cost per kill.

That's rather like setting up a trucking company that only factors in the cost of buying vehicles and ignores the cost of operating vehicles: bikes would be chosen. But the cost per kg per km will be astronomical.

AT220 traps are the most expensive in terms of capital costs, in the middle for operating costs but the lowest cost per kill. They're killing machines and have been largely trouble-free for BHMET.

If we were to continue the transport analogy, the AT220 is the *Dreamliner* of the trapping world – eye-wateringly expensive to buy, very efficient in terms of cost per km but carrying a lot of paying passengers. Profitable for the airline!

The A24s are halfway in terms of capital costs and cost per kill but their operating costs per trap were very high. It is hoped that the fixes recommended by Goodnature will address the consumable cost issue.

The choice will depend on your circumstances. Many volunteer organisations regard the cost of labour as zero. That's a mistake for many reasons and will always prevent a transition to trapping effectiveness. If cost is the only factor and the biggest cost (people) is regarded as 'free', then manual traps are the inevitable answer.

If someone is going to buy traps for you, get them to buy AT220s! Your trapping operation will be far better off buying 10 AT220s ($5,000) than a mix of 128 manual traps ($5,000)... those 10 AT220s will kill 310 predators in a year compared to 108 predators killed by the manual traps. That will cost you $325.30 per year versus $2,863.26 for manual traps.

If your capital costs are going to have to come out of your operating budget, your choice is a little tougher. The key here is that you don't have to buy all the AT220s in one go. Buy one every 6 months... and watch the impact on predators.

One important proviso. BHMET wouldn't have been able to compare manual, A24 and AT220 traps without the use of the Celium network. Having a means of keeping track of kills is essential if you want to measure the efficiency and effectiveness of *your* trapping infrastructure. If you do not keep track of automatic trap kills, then the only way of measuring trap performance is by monitoring – and this is a significantly trailing indicator.

Both A24 and AT220 traps have means of measuring triggers. The AT220 computer keeps a log of all triggers and can upload those to a nearby device using wifi. That's included in the $500 price. The A24 has an optional 'Smart Cap' that records triggers and can upload them to a nearby device using Bluetooth. This costs $55 and requires the organisation to set up a user management system.

BHMET uses the Celium network to monitor manual, A24 and AT220 traps in one system that's connected to Trap.NZ. Each node costs $150 and is complicated to deploy and operate but it's been a game-changer for BHMET. BHMET is working with Encounter Solutions to develop a wired connection between the AT220 trap and the Celium node in order to be able to monitor trap status in real time.

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