Appendix S1. Description of models of the effect of management on relative rat abundance.

Rats were monitored with tracking tunnels. Tunnels were deployed to represent the three control areas, 70 in Pikiariki, 80 in Waipapa South and 80 in Waipapa North. There were four surveys in most years, generally spread across the seasons.

To model the effect of management on rat abundance, we fitted models with both binomal and beta-binomial distributions and selected the best fit using AIC. To allow for temporal variation unrelated to management, we included year as a random effect and checked for autocorrelation between years.

In the first model of rat abundance, the response variable was the proportion of tunnels tracked in each survey, calculated separately for each management area. Area and season were included as fixed effects. We fitted models with each of two terms describing the time since toxins were deployed – count in days and count in months – as fixed effects. The latter had lower AIC and is the result presented in S3.

In the second model of rat abundance, the response variable was annual average rat tracking. This was calculated as the mean value of any surveys in a 12-month period starting 1st February for each control area. Control area and time toxins were available were included as fixed effects. The lowest AIC model included interactions between control area and pindone, and control area and diphacinone, but no interaction between control area and aerial 1080 (S5).

Appendix S2. Potential predictor variables for models of relative rat abundance at time of survey.

Variable	Value
sinceAny	Number of months since a toxin was deployed
sinceAnyd	Number of days since a toxin was deployed
Season	Season (Summer: DJF, Autumn: MAM, Winter: JJA, Spring:SON)
Site	Control area (Pikiariki, Waipapa South, Waipapa North)

Appendix S3. Results of the model of relative rat abundance at time of survey, the reference level is Pikiariki in Spring.

Predictors	*Odds Ratios*	*CI*	*p*
(Intercept)	0.11	0.08 – 0.17	**<0.001**
sinceAny	1.13	1.08 – 1.18	**<0.001**
Site [Waipapa South]	0.93	0.58 – 1.49	0.771
Site [Waipapa North]	1.98	1.19 – 3.31	**0.009**
Season [summer]	2.36	1.48 – 3.76	**<0.001**
Season [autumn]	0.87	0.62 – 1.22	0.420
Season [winter]	1.16	0.85 – 1.60	0.351
sinceAny X Season [summer]	0.99	0.94 – 1.05	0.727
sinceAny X Season [autumn]	0.93	0.87 – 0.99	**0.034**
sinceAny X Season [winter]	0.94	0.89 – 0.99	**0.030**
Random Effects			
σ^2	0.32		
$\tau_{00\ Year}$	0.16		
ICC	0.11		
$N_{\ Year}$	13		
Observations	123		

Appendix S4. Potential explanatory variables for models of annual average rat tracking.

Variable	Value
Aerial 1080	Factor indicating occurrence of a 1080 operation in the year
Pindone	Proportion of the year pindone was available in bait stations
Diphacinone	Proportion of the year diphacinone was available in bait stations
Site	Control area (Pikiariki, Waipapa South, Waipapa North)

Appendix S5. Results of the model of annual average rat tracking.

Predictors	*Odds Ratios*	*CI*	*p*
(Intercept)	0.36	0.25 – 0.52	**<0.001**
Pindone	0.30	0.05 – 1.84	0.195
Diphacinone	0.52	0.17 – 1.53	0.232
Site [Waipapa South]	1.68	1.07 – 2.63	**0.024**
Site [Waipapa North]	1.19	0.74 – 1.91	0.468
Aerial 1080	0.53	0.33 – 0.87	**0.011**
Pindone x Site [Waipapa South]	0.32	0.04 – 2.59	0.285
Pindone x Site [Waipapa North]	4.97	0.59 – 41.74	0.139
Diphacinone x Site [Waipapa South]	0.53	0.15 – 1.91	0.331
Diphacinone x Site [Waipapa North]	3.70	0.52 – 26.37	0.192
Random Effects			
σ^2	1.20		
$\tau_{00\ Year}$	0.06		
ICC	0.05		
N_{Year}	13		
Observations	37		

Appendix S6. Anticoagulant toxin regime and toxin residue test results for guano and dead bats, during years guano collected from Pikiariki was tested, from August 2012 to May 2016 and August 2017 to May 2020. Orange = diphacinone present in bait stations; Blue = pindone present in bait stations; Black = toxin residues detected in communal guano; Grey = no toxin residues detected in communal guano. November 2012 to April 2014; data from Dennis (2019).

	Piki	Waipapa Sth	Waipapa Nth	Guano	No. dead bats tested	No. dead bats residues
Aug-12						
Sept-12						
Oct-12						
Nov-12						
Dec-12						
Jan-13					2	1
Feb-13						
Mar-13						
Apr-13						
May-13						
Jun-13						
Jul-13						
Aug-13						
Sept-13						
Oct-13						
Nov-13						
Dec-13						
Jan-14						
Feb-14						
Mar-14						
Apr-14					1	1
May-14						
Jun-14						
Jul-14						
Aug-14						
Sept-14						
Oct-14						
Nov-14						
Dec-14						
Jan-15					1	1
Feb-15					1	1
Mar-15					2	2
Apr-15					1	1
May-15						
Jun-15						
Jul-15						
Aug-15						
Sept-15						
Oct-15						
Nov-15						
Dec-15						
Jan-16						
Feb-16						
Mar-16						
Apr-16						
May-16						

	Piki	Waipapa Sth	Waipapa Nth	Guano	No. dead bats tested	No. dead bats residues
Aug-17						
Sept-17						
Oct-17						
Nov-17						
Dec-17						
Jan-18						
Feb-18						
Mar-18					1	1
Apr-18						
May-18						
Jun-18						
Jul-18						
Aug-18						
Sept-18						
Oct-18						
Nov-18						
Dec-18						
Jan-19					1	1
Feb-19						
Mar-19					1	0
Apr-19						
May-19						
Jun-19						
Jul-19						
Aug-19						
Sept-19						
Oct-19						
Nov-19						
Dec-19						
Jan-20					1	0
Feb-20					3	0
Mar-20						
Apr-20						
May-20						

Appendix S7. Summary of captured and logged PIT-tagged female lesser short-tailed bats, between January and March each year from 2011 to 2024.

Year	No of females	Recapture (%)	Adults	Juveniles
2011/12	21		11	10
2012/13	194	62	191	3
2013/14	278	85	241	37
2014/15	355	87	349	6
2015/16	419	88	336	83
2016/17	401	77	383	18
2017/18	405	89	365	40
2018/19	444	84	396	48
2019/20	487	86	474	13
2020/21	454	75	433	21
2021/22	383	86	383	0
2022/23	449	83	403	46
2023/24	530	85	517	13
Total captures	**4820**			
No of individuals	**1229**			

Appendix S8. All models that were run as part of the analysis to describe apparent survival in adult and juvenile female lesser short-tailed bats, 2012–2024.

S= survival model, npar= number of parameters. AIC= Akaikes Information Criterium, Δ AIC = difference in AIC between the top model and the model tested, weight = support for the model (0-1), Age (adult or juvenile), time = year, pindone = duration of pindone available, diphac = duration of diphacinone available, aerial = 1080 aerial operation, afteraerial = the influence of 1080 the year after.

model	S	npar	AIC	Δ AIC	weight
1	~age * year	38	3907.50	0	0.90114396
2	~age+ year	27	3911.92	4.4211	0.09880172
3	~age + pindone + rats * afteraerial	20	3929.30	21.797	0.00001666
4	~age + aerial + rats * afteraerial	20	3931.25	23.7443	0.00000629
5	~age + pindone + aerial + rats * afteraerial	21	3931.25	23.7469	0.00000628
6	~age + diphac + pindone + rats * afteraerial	21	3931.30	23.7964	0.00000613
7	~age + pindone + afteraerial	18	3932.07	24.563	0.00000418
8	~age + diphac + pindone + aerial + rats * afteraerial	22	3933.25	25.7462	0.00000231
9	~age + pindone + aerial + afteraerial	19	3933.99	26.491	0.00000159
10	~age * yr_trend	18	3934.00	26.4966	0.00000159
11	~age + diphac + pindone + afteraerial	19	3934.06	26.5591	0.00000154
12	~age + pindone + afteraerial + rats	19	3934.06	26.5614	0.00000154
13	~age + afteraerial + rats * pindone	20	3935.22	27.7185	0.00000086
14	~age + aerial + afteraerial	18	3935.64	28.1387	0.00000070
15	~age + diphac + pindone + aerial + afteraerial	20	3935.99	28.491	0.00000059
16	~age + pindone + aerial + afteraerial + rats	20	3935.99	28.491	0.00000059
17	~age + diphac + pindone + afteraerial + rats	20	3936.06	28.5575	0.00000057
18	~age + aerial + afteraerial + rats * pindone	21	3937.06	29.56	0.00000034
19	~age + diphac + afteraerial + rats * pindone	21	3937.22	29.7182	0.00000032

20	~age + diphac + aerial + afteraerial	19	3937.38	29.8741	0.00000029
21	~age+ aerial + afteraerial + rats	19	3937.38	29.8769	0.00000029
22	~age + pindone + afteraerial + rats * diphac	21	3937.87	30.3693	0.00000023
23	~age + diphac + pindone + aerial + afteraerial + rats	21	3937.99	30.491	0.00000022
24	~age + diphac + rats * afteraerial	20	3938.78	31.2822	0.00000015
25	~age + diphac + aerial + afteraerial + rats * pindone	22	3939.05	31.5465	0.00000013
26	~age + pindone + rats	18	3939.10	31.5975	0.00000012
27	~age + aerial + afteraerial + rats * diphac	21	3939.30	31.7967	0.00000011
28	~age + diphac + aerial + rats * afteraerial	21	3939.59	32.087	0.00000010
29	~age + pindone + aerial + afteraerial + rats * diphac	22	3939.75	32.243	0.00000009
30	~age + afteraerial	17	3939.93	32.4326	0.00000008
31	~age+ diphac + aerial + afteraerial + rats	20	3940.25	32.7525	0.00000007
32	~age + diphac + pindone + rats	19	3941.04	33.5342	0.00000005
33	~age + pindone + aerial + rats	19	3941.08	33.5767	0.00000005
34	~age + afteraerial + rats	18	3941.69	34.1911	0.00000003
35	~age + diphac + afteraerial	18	3941.80	34.301	0.00000003
36	~age + pindone + rats * diphac	20	3942.17	34.6669	0.00000003
37	~age + aerial + rats * pindone	20	3942.23	34.7291	0.00000003
38	~age + diphac + rats * pindone	20	3942.28	34.7743	0.00000003
39	~age + pindone + rats * aerial	20	3942.93	35.423	0.00000002
40	~age + diphac + pindone	18	3943.00	35.502	0.00000002
41	~age + diphac + pindone + aerial + rats	20	3943.03	35.5261	0.00000002
42	~age + afteraerial + rats * diphac	20	3943.47	35.9672	0.00000001
43	~age + diphac + afteraerial + rats	19	3943.57	36.0689	0.00000001
44	~age + pindone + aerial + rats * diphac	21	3944.08	36.5773	0.00000001
45	~age + diphac + aerial + rats * pindone	21	3944.22	36.7153	0.00000001
46	~age + pindone	17	3944.23	36.7244	0.00000001
47	~age + diphac + pindone + rats * aerial	21	3944.89	37.3831	0.00000001
48	~age + pindone + aerial	18	3945.67	38.1664	0.00000000
49	~age + diphac + pindone + aerial	19	3947.25	39.7521	0.00000000
50	~age + rats	17	3948.15	40.6484	0.00000000
51	~age + aerial + rats	18	3948.54	41.0417	0.00000000
52	~age + aerial	17	3949.68	42.1728	0.00000000
53	~age + diphac + rats	18	3949.79	42.2887	0.00000000
54	~age + diphac + aerial + rats	19	3949.90	42.3956	0.00000000
55	~age + diphac + aerial	18	3950.79	43.2885	0.00000000
56	~age + aerial + rats * diphac	20	3951.04	43.5427	0.00000000
57	~age + diphac + rats * aerial	20	3951.90	44.3955	0.00000000
58	~age + diphac	17	3951.93	44.4291	0.00000000
59	~time	26	4064.90	157.3987	0.00000000

Appendix S9. Session capture numbers for Schnabel population estimate 2024

Date	Recaptures	Unmarked	Recapture rate
22/01/2024	0	85	
23/01/2024	2	64	0.03
24/01/2024	47	217	0.18
25/01/2024	25	113	0.18
26/01/2024	10	11	0.48
29/01/2024	13	19	0.41
30/01/2024	114	134	0.46
31/01/2024	46	49	0.48
1/02/2024	23	75	0.23