



SMS Band Reporting Rate Pilot

Beau Jarvis-Child 2024

1 SUMMARY

Total population is one measure Fish & Game councils estimate to manage waterfowl. In the Auckland Waikato region, a banding program has been run since 2002, which relies on hunters reporting bands from harvested birds. To estimate the total population, we assume the ratio of birds shot with bands out of all banded birds is equal to the ratio of harvested birds out of the total population. Because not all bands are reported, we correct for non-reporting in our population estimates via a reporting rate which is estimated separately each year. Historically, this has involved asking a random selection of licence holders if they shot and reported a banded bird as part of the Game Bird Harvest Survey (GBHS). However, with few people shooting banded birds each year, our annual sample size for reporting rate is small, resulting in considerable uncertainty. This pilot explores multiTXT, a bulk SMS technology, to administer this survey to increase both sample size and response rate. We used multiTXT to send SMS messages to 5587 licence holders, resulting in a 66.7% response rate. We estimated that 9.3% of adult and junior whole-season licence holders shot a banded bird (95% confidence interval from 8.4% to 10.2%). Of these, 58.6% (95% confidence interval from 53.3% to 63.7%) reported submitting the band information. The estimated verified reporting rate was lower, at 52% (95% confidence interval from 46.7% to 57.2%). We recommend this approach be repeated to understand the year-to-year consistency of reporting rates. Following this it would be a worthwhile approach to be administered every 2-3 years.

INTRODUCTION

Total population size is an important population parameter in gamebird management. Auckland Waikato Fish & Game generates data to calculate the total annual population size of mallard (*Anas platyrhynchos*) and grey duck (*Anas superciliosa*) via a banding programme that has run since 2002. Whilst the two species are differentiated during the banding process, it is accepted that due to hybridisation, it is often difficult to do this from visual inspection alone and, for the purpose of this report, will be referred to as *grallards* (D. Klee, 2012 banding report).

Estimated population size (N_t) in year t is estimated as follows: “Assuming that a banded bird is just as likely to be harvested as a non-banded bird, then the ratio of band returns (adjusted for non-reporting rate) from that year cohort should be the same as the ratio of birds harvested to the total population.” It is calculated as:

$$N_t = \frac{b_t \rho_t H_t}{r_t}$$

Where N_t is the number of grallard in year t prior to the hunting season, b_t is the number of birds banded in year t , r_t is the number of bands returned from the b_t cohort in year t , ρ_t is the estimated reporting rate, and H_t is the number of mallards harvested in year t .

This report is focused on ρ_t ; the reporting rate.

Historically, reporting rates were estimated based on questions asked in the latter period(s) of the annual game bird harvest survey. Hunters are asked if they have shot a banded bird during the game bird season and, if so, if they had reported it. Because sample sizes were small, a 3-year average was previously used. The validity of aggregating across years notwithstanding, these estimates were still associated with reasonable uncertainty (Figure 1).

Estimates from the two most recent harvest surveys also suggest that the phone surveys have a non-response rate of around 54% (based on calling 458 licence holders). Non-response bias is relevant because we may expect that those less likely to report bands are also less likely to engage in the harvest survey.

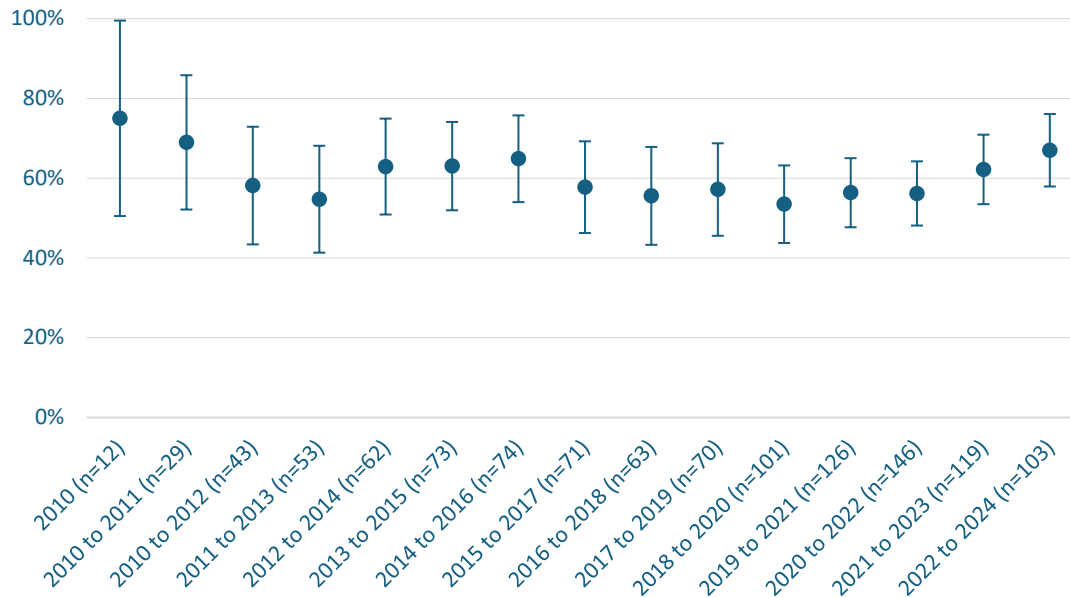


Figure 1: Estimated proportion of individuals who report bands calculated using a 3-year average of GBHS phone call data.

Uncertainty in estimates of reporting rate can have a significant effect on estimates of population size. For example, in 2024¹ the unverified reporting rate based on the harvest survey data (i.e., phone surveys) was 69%, resulting in a population estimate of 624k. However, there is considerable uncertainty in the reporting rate (95% confidence intervals spanned from 51% to 87% (see Figure 4)). The effect of variability on grallard population estimates is shown in Figure 2, where the upper limit of the estimated population confidence interval is 810k, and the lower limit is 432k—a difference of nearly 380k birds².

¹ Where $H_t = 82605$, $b_t = 3134$ and $r_t = 285$

² The results naturally improve when taking a 3-year average.

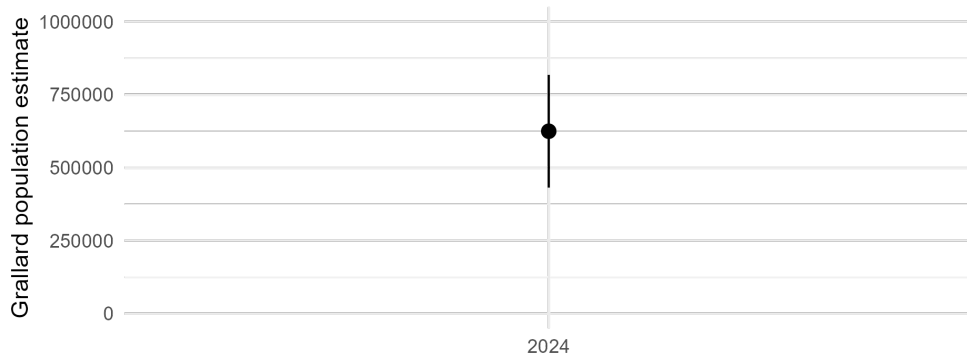


Figure 2: Estimated grallard population for 2024 demonstrating the effect of uncertainty in reporting rate estimates from GBHS phone call data. Reporting rate estimates for 2024 are taken from Figure 4. Note: the confidence intervals incorporate the uncertainty associated with our estimate of the reporting rate and the estimate of total gallard shot.

This report aims to improve on uncertainty and bias associated with these estimates by increasing both the number of people contacted (i.e., increase sample size) and improving survey non-response (i.e., the number of people who respond to the survey) via MultiTXT, an alternative method of collecting this data. The ability to easily send follow-up messages may also assist in generating a verified reporting rate.

MultiTXT is a messaging service operated by One NZ that allows bulk text (SMS) messages to be sent and received using a computer. Importantly, it may be programmed to respond automatically to keywords, and the messages can be exported into an Excel file.

2 METHODS

2.1 ONE NZ MULTITXT

Several providers offer bulk SMS technology for similar prices. One NZ was deemed the most suitable for this use case as it:

- (1) did not charge licence holders to respond (which could reduce response rates) and
- (2) offered automated (and immediate) responses to keywords, which was essential for increasing response rates on the follow-up question (see section 3.3 for more details).

2.2 SAMPLE FRAME AND SAMPLE SIZE

In 2024, Auckland Waikato had 6915 distinct adult and junior whole-season licence holders (i.e., excluding children and day licences). Not all licence holders have a recorded mobile number, which is necessary for multiTXT. Sometimes, people who have purchased licences for their friends or kids use their number, resulting in duplicates. After addressing these by selecting the oldest licence holder of the duplicates, there were 5729 licence holders in the sample frame³.

³ The sample frame could be improved by collecting more cell phone numbers and not allowing duplicate numbers when people purchase their licence.

The estimated sample size required to calculate the reporting rate with a 5% margin of error (and 95% confidence intervals) was close to 350. After correcting for the estimated proportion of people who shot a banded bird (13.5%, based on previous years) and the estimated survey response rate (50%, a conservative estimate based on the two most recent phone survey periods), the sample size was 7000. Based on this, we aimed to contact all the licence holders in the sample frame.

We informed licence holders about the upcoming SMS survey in the July edition of Auckland Waikato Both Barrels, gamebird digital newsletter to garner the best response rate. Prior to the survey being sent out, around 1300 people had viewed this newsletter.

2.3 QUESTIONNAIRE

The survey was designed to be as simple as possible with the hope that more people would participate. We also hoped that in asking people if they shot a banded bird separately from whether they reported it, people who had not reported a band would not be discouraged from responding.

The initial SMS read:

Hi #firstname#, Auckland Waikato Fish & Game here. We are interested to know if you shot a banded duck this season. Please reply (for free) "YES" or "NO".

If they responded "Yes" (or some variation of), the automated follow-up SMS read:

Great! Have you reported this band yet? If you have, please reply (for free) "I have". If not, or if you're unsure, please reply "Not yet".

If they did not respond or responded, "Not yet" (or anything other than "I have"), then no follow-up message was sent.

If an individual did not respond to the follow-up message after a period a second message was manually sent that read:

Hi #firstname#, Can you tell us if you have reported the band? Free text "I have" or "Not yet". Cheers, Beau from Fish&Game.

Additionally, when the names of those who responded "yes" could not be matched to the banding database, another message was sent which asked for more details to help verify the band:

Hi #firstname#, Fish & Game here. Thank you for responding that you shot and reported a band. However, we could not match your name to any reported bands this season. Is there a chance it was entered under a different name, or was it from a previous year/different region? Cheers!

2.4 CLEANING AND ANALYSIS

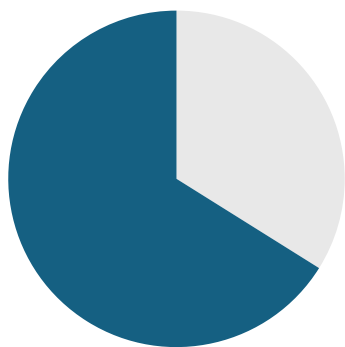
MultiTXT data (sent and received) was cleaned using R (statistical software). For each unique phone number, responses to "Did you shoot a banded bird?" and "Did you report it?" were coded first by searching for keywords ("yes" and "have", respectively) and then manually checked.

Around 11 people did not respond to the second follow-up message. We checked their names against the banding database to determine if they had reported the banded bird they said they had shot.

Proportions (and 95% confidence intervals) of people who shot a banded bird and those who reported a band after they shot a banded bird were calculated via logistic regression (with no additional covariates).

3 RESULTS

We attempted to survey all 5729 licence holders that we had a unique mobile number for. Of these, 5587 received the initial question due to “bad” numbers or failed deliveries. We received five reports of people being unable to respond to the initial question, which may indicate a wider issue impacting the response rate (i.e., more people may have responded, but we did not receive the message). However, it is impossible for us to tell if someone tried to respond and could not. While One NZ could not diagnose the issue (a test message the following day to those with the error was successful), it may have been due to a momentary outage in their provider⁴. Despite this, 3727 people (66.7%) responded to the multiTXT survey.



66.7% of the 5587 who received an SMS responded.

From these responses, we estimated that 9.36% of adult and junior licence holders shot a banded bird during the 2024 season (95% confidence interval from 8.45% to 10.32%). Figure 3 shows the previous annual estimates calculated from the phone surveys alongside the 2024 SMS estimate.

⁴ A potential solution may be to send batches of texts over a period of time, e.g., one day. In addition – an initial test run of 99 people garnered a response rate of 82%.

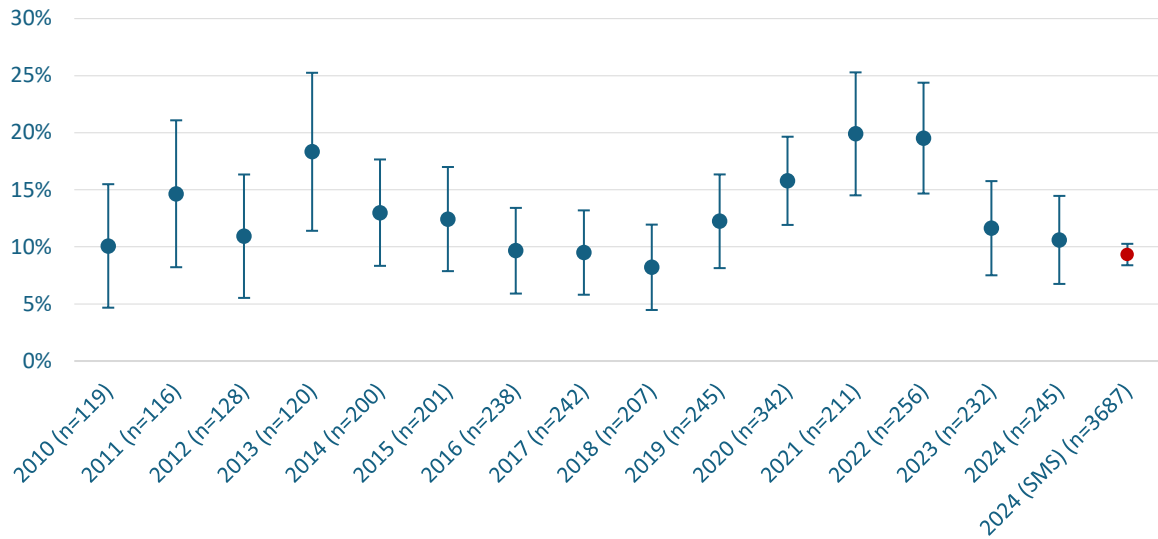


Figure 3: Estimated proportion of individuals who reported shooting a banded duck, calculated from GBHS phone calls (blue) and SMS survey (red) (95% CI).

Of the 346 individuals who reported shooting a banded bird, 58.6% (95% confidence interval from 53.3% to 63.7%) reported submitting the band information. Figure 4 shows the annual estimates of the reporting rate from 2010 to 2024 based on the gamebird harvest survey data (blue dots) and the 2024 SMS estimate (red dot).

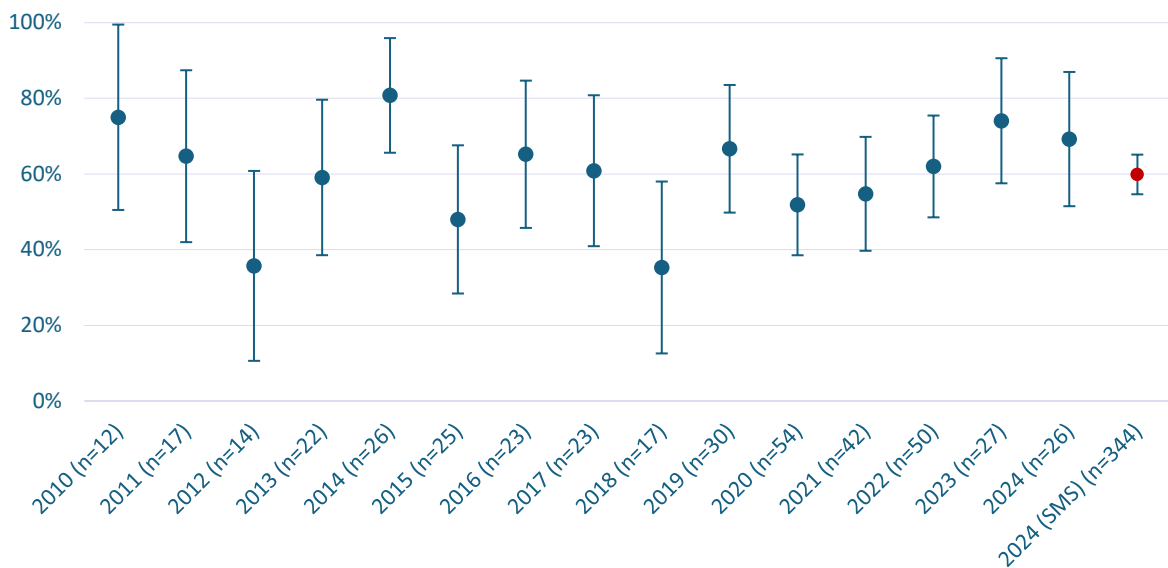


Figure 4: Estimated proportion of individuals who said they reported a band after reporting that they shot a banded bird, calculated from GBHS phone calls (blue) and SMS survey (red) (95% CI).

3.1 VERIFYING REPORTED BANDS

We know from previous years that what people say is not always true. We checked the names of those who reported submitting band information against our database of reported bands. First, 130 of the 206 individuals could be easily verified by matching first and last names to the banding database (including other North Island regions). A further 28 are verified manually by checking last names and

consulting the licencing database (e.g., checking addresses). For example, an adult may report via SMS they shot and reported a band; however, the band is reported under their child’s name. Naturally, this only works if they share a surname. Sometimes, a submitted band may be reported on more than once. For example, a father and son shoot together; the father shoots a banded bird, and the son submits it. However, when responding to the SMS survey, they both report shooting and reporting a band. Assuming they share a surname and similar address – we can remove such duplicates (in this case, n=3).

Thirty-eight individuals (21%) could not be verified against the database of reported bands. These may be instances where the band in question has been reported (e.g., it has been reported under a family member's name whose name differs from theirs). There is also the possibility that they have not reported a band (e.g., they misread the question and have only reported bands in previous seasons).

A follow-up SMS was sent to these individuals to address this, and 25 (66%) responded. Of these, 12 (48%) provided alternate names and were verified, 10 (40%) could not be verified (e.g., duplicates), and 3 (12%) were removed as errors.

The verified reporting rate can be calculated under two assumptions:

- (1) individuals who could not be verified did shoot a banded bird, and
- (2) individuals who could not be verified did not shoot a banded bird.

Under the first assumption, the verified reporting rate was 49.7% (95% confidence interval from 44.4% to 54.9%). Under the second assumption, the verified reporting rate was 54.4% (95% confidence interval from 49.2% to 59.6%).

Since nearly 50% of the individuals who responded to the SMS asking for more details could be verified, the true verified reporting rate is likely somewhere in the middle: 52.0% (95% confidence interval from 46.7% to 57.2%).

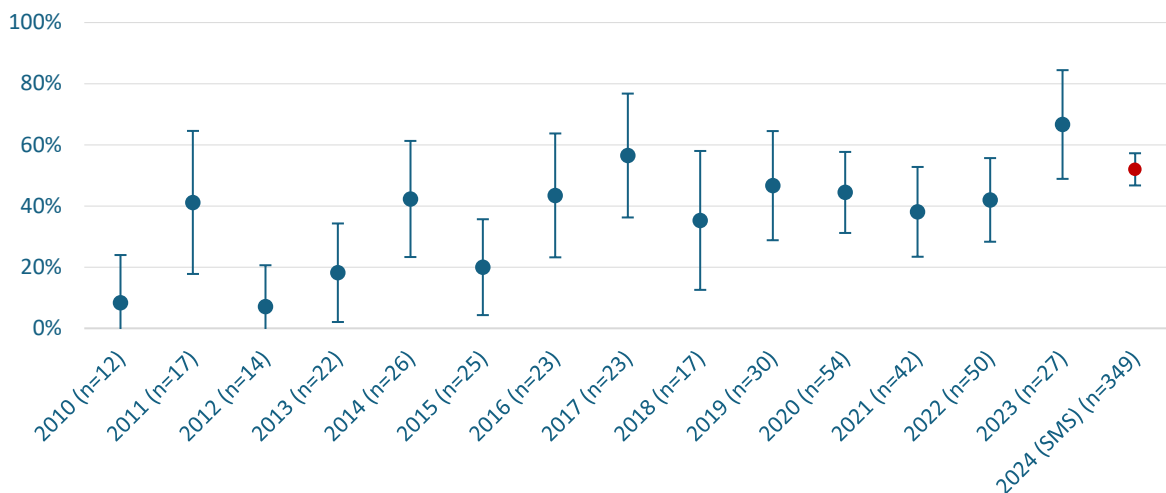


Figure 5: Verified reporting rate over time (i.e. the number of bands that could be verified against the database out of the number of individuals that reported shooting a banded bird based on GBHS phone calls (blue) and SMS survey (red) (95% CI).

3.2 DISCREPANCY BETWEEN SAID REPORTED AND REPORTED.

Technically, the current method measures the proportion of individuals who report bands when we are really interested in the proportion of bands that are reported. Assuming that the average number

of bands people don't report is equal to the number of reported bands, our estimates are unbiased. However, if, for example, individuals who collect more bands are more likely to report them (or if people give their bands to their friends to report), then a higher proportion of bands are being reported than people are reporting bands.

The SMS survey provides a unique opportunity to test this assumption as the text reminded some individuals who subsequently submitted their bands. Assuming they would have otherwise not submitted their bands, we can treat these individuals as a sample of those who "would not have submitted bands". From this, we can compare the mean number of bands that people submitted on their own accord to the mean number of bands for people who had to be reminded.

Individuals who reported bands on their own accord (i.e., submitted before the SMS survey started) submitted on average 1.31 bands (95% CI from 1.23 to 1.38), while those who were reminded by the SMS survey submitted 1.53 bands on average (95% CI from 1.2 to 1.86). No statistically significant difference was found ($p=0.21$)⁵. While this is worth investigating further, if possible, it is not immediately concerning.

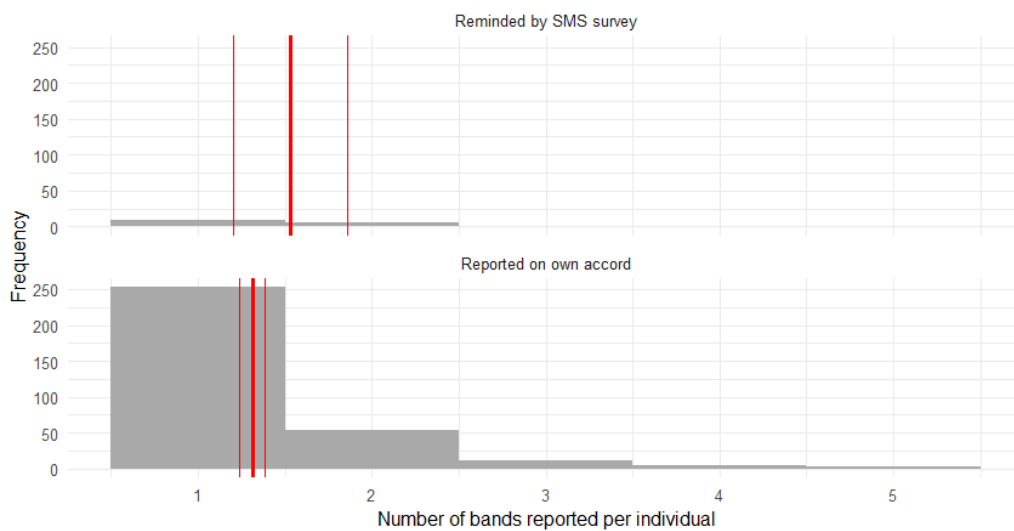


Figure 6: The distribution of bands reported per individual in the 2024 season comparing those who reported bands before and after the SMS survey started. Means are shown in red, with corresponding 95% confidence intervals.

3.3 ADJUSTED REPORTING RATE FOR 2024

The estimated verified reporting rate for 2024 was 52%. However, 16 individuals, potentially reminded by the SMS survey, subsequently sent in their band information. These were excluded from the analysis as they are not "natural" reporting. When included, the reporting rate for 2024 increases to 56.7%. This is mainly useful to know if we wish to extrapolate these estimates to other years that did not have an SMS survey. In other words, in 2024, we estimate a reporting rate of 56.7% given the presence of an SMS survey and 52% without one.

Figure 7 below shows the estimates of grallard population in 2024 based on the verified reporting rate and corresponding variability. Compared with Figure 2, the estimate of the grallard population has much smaller confidence intervals.

⁵ With a small sample size of "reminded by SMS", more evidence is required to test this assumption fully.

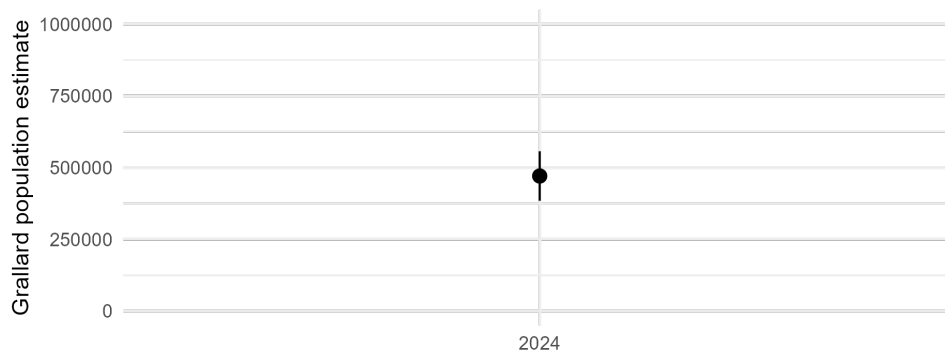


Figure 7: Estimated grallard population for 2024, demonstrating the effect of improved reporting rate estimates on confidence intervals due to the SMS survey. Reporting rate estimates for 2024 are taken from Figure 4 (red dot). Note: the confidence interval incorporates the uncertainty associated with our estimate of the reporting rate and the estimate of total grallard shot.

4 APPENDIX

4.1 ASSOCIATED COST

One NZ multiTXT relies on three associated costs: a \$180 one-off set-up fee, a \$20 monthly fee (which is only necessary to pay for the one month the survey is being administered), and an outbound SMS fee at around 11c per SMS. In total, 6368 outbound SMS were sent with an associated cost of \$812, bringing the total cost to just over \$1000. This was slightly higher than anticipated⁶ – but the additional follow-up texts to verify bands were deemed worthwhile. One NZ still seems like the best option, and I had no issues with their software or support.

Realistically, this was probably a couple of weeks' work. In hindsight, there are many ways that this survey could be streamlined to reduce working hours. For example, manually checking the surnames and addresses of unverified bands to see if they had submitted them under their child's name is probably not as efficient as following up with all those whose bands could not be verified. Regardless, verifying bands will always be by far the most time-intensive process. However, if this were to be replicated in future years, one might expect that the associated time would be reduced given that the code has been written, etc.

4.2 LEARNINGS

Most people responded within the first day or two. However, some responded up to 26 days after sending the first SMS. Knowing this, waiting 3-4 weeks before even looking at the data would be worthwhile as it would eliminate the repetition of processes such as cleaning data and verifying bands. For example, the process could be structured as follows:

1. Send initial SMS to all users (with messages staggered over a day to hopefully avoid issues with them being unable to respond due to network issues).
2. Wait 3-4 weeks and download the data.

⁶ GST excluded pricing worth noting..

3. Clean data and match names to the banding database (remember to include nearby regions).
4. Identify unverified bands and send a follow-up message. When asking about verified bands, it may be worthwhile asking for them to confirm whether they shot a banded bird this year.
5. Wait one week.
6. Download data from the follow-up message.
7. Manually verify the remaining bands.
8. Analysis data and write report.

The main issue with verifying bands is that one must assume that the band has not been reported until proven otherwise. Because getting proof is time-consuming and, at times, difficult, there remains the risk that unverified bands are misidentified.

Further research is required to test whether and how much reporting rates fluctuate year to year. Assuming they do not change dramatically, one could compromise by administering the survey every 2 or 3 years and interpolating the reporting rates in years without an SMS survey.

4.3 RECOMMENDATIONS

Overall, the multiTXT pilot was a success. We estimated the band reporting rate with a higher response rate and smaller margins of error. In addition, we verified many of the bands, which helped us better understand the true reporting rate and the discrepancy between people saying they reported a band and the bands that were actually reported. In Auckland Waikato, monitoring reporting rates using a multiTXT survey of all licence holders every 2-3 years would be worthwhile if it is found that reporting rates do not fluctuate significantly from year to year.

A nationwide SMS survey of reporting rates would allow all regions with banding programmes to get more accurate estimates with lower uncertainty. This would enable Fish & Game councils to better manage waterfowl in their region via less biased estimates of the total population. A nationwide survey also allows for comparisons in reporting rates between regions, which may help us to understand the factors that influence reporting rates.