Gamebird Harvest Assessment Report

Beau Jarvis-Child 2024

1 SUMMARY

This report's primary objective is to estimate the mallard/grey harvest based on the Gamebird Harvest Survey (GBHS). As a secondary objective, the effect of season regulations on harvest and hunter activity is explored, and other estimates, such as survival rates, are presented.

A decrease in hours hunting waterfowl and grallard harvest coincides with more restrictive regulation making it difficult to determine if recent declines come as a result of fewer birds or more restrictive regulations, specifically season length. There is however evidence of a drop in harvest and more people shooting zero birds on opening weekend which we would not expect to come as a result of season length.

Estimates of cumulative harvest suggest trends are similar for short and long season when excluding opening weekend. If hunters are manipulating their behaviour to “make the most of” the shorter season, what we observe as “similar trends” may in fact represent a decline in hunter effort and harvest. Further work will investigate this by looking at neighbouring regions.

Bag limits have the most impact on opening weekend as they only restrict harvest for a small proportion of hunters during the rest of the season. Given that around 40% of harvest occurs on opening weekend, highly conservative bag limits, e.g. 2, could be very effective at reducing harvest – however, this would likely impact hunter satisfaction and compliance.

Grallard harvest per hunter per hour appears to cycle up and down between 1993 and 2024 which may be linked to climatic conditions. However the overall trend is downwards.

Survival estimates based on band return data show that survival is consistently lower for juvenile birds compared to adults while difference in sex are minimal. Further work is required to investigate if environmental factors or regulations are impacting survival.

2 SURVEY DESIGN

The Gamebird Harvest Survey is designed to estimate how many waterfowl are harvested each year. Due to recall bias (i.e., people forgetting), the dabbling duck hunting season is broken into survey periods depending on the season length to improve accuracy.[1] In each survey period, a random selection of at least 120 adult and junior full-season licence holders are phoned (i.e., the survey excludes children, day licence holders, landowner occupiers, and those who hunt without a licence). In period 1, randomly selected hunters are asked about the opening weekend harvest. In period 2 and onwards, randomly selected hunters are asked about their hunting in the preceding two weeks. We collect data from hunters regarding the regions they hunt in, how many birds they shot of each species during the survey period and the number of hours they hunted for. From this data, we can determine key metrics such as total harvest (necessary for population estimates), average hours spent hunting waterfowl (to gauge hunter engagement) and harvest per hunter per hour (an index of hunter success). It is worth mentioning that because a random selection of hunters are surveyed each period, estimates are first calculated at the period level (e.g., average opening weekend harvest) and then combined for whole season estimates. In some instances, daily estimates are calculated and aggregated. While this

[1] Barker, R. 1991. Nonresponse Bias in New Zealand Waterfowl Harvest Surveys. The Journal of Wildlife Management , Jan., 1991, Vol. 55, No. 1, pp. 126-131

benefits accuracy (i.e., reduces recall bias), it does mean that our ability to test whole-season effects is limited as we are often dealing with aggregated data[2].

The current report, based on the raw data, does not consider Auckland Waikato licence holders who hunt in other regions or hunters who come to our region to hunt. In the future, this will be possible if neighbouring regions are cooperative in sharing their raw data. However, a quick look at the summarised data indicates that the effect on estimates will likely be minimal, as those leaving and those coming in will more or less cancel each other out.

3 GRALLARD HARVEST

Trends from 1993-2024 indicate that grallard harvest is decreasing, which could be due to several factors, namely the number of hunters, hours hunted (hunter interest/season length), environmental conditions, population size and bag limits.

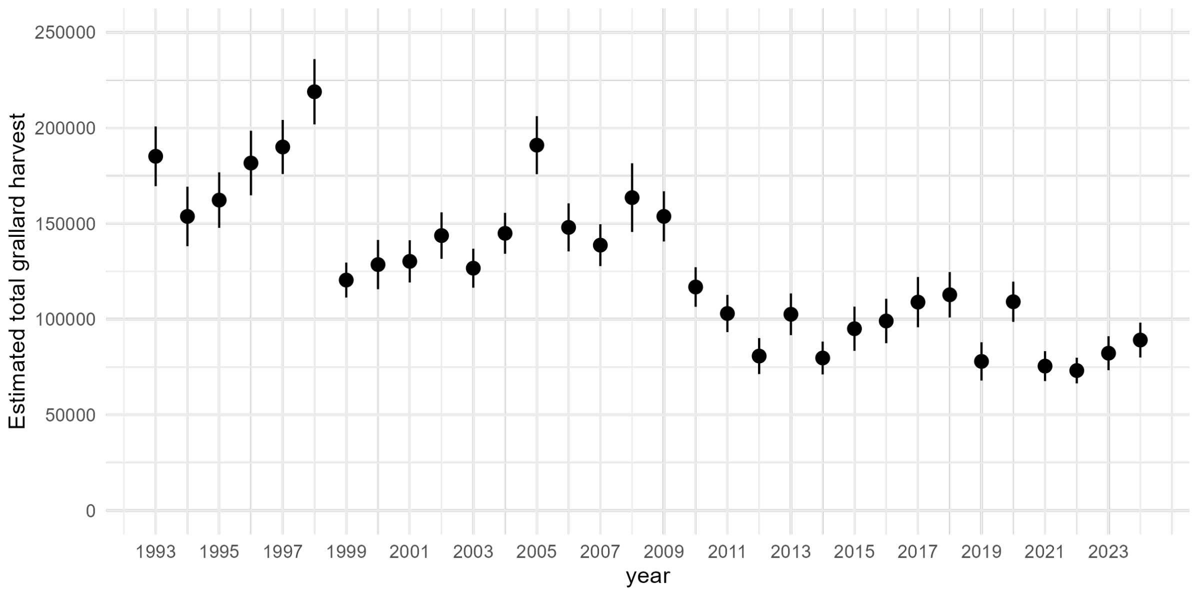

Figure 1: Total estimated grallard harvest from 1993-2024. Total harvest is calculated by multiplying the average junior and adult whole licence holder harvest by the number of adult and junior whole season licence holders each year. 95% confidence intervals are also included.

[2] Limitations include (1) loss of individual-level variation (e.g., modelling the effect on average harvest vs on harvest), (2) reduced statistical power (e.g., more challenging to detect differences with a smaller "aggregated" sample size), (3) limit on potential covariates (e.g., you could not include hunter age in a model with aggregated data), and (4) "Ecological fallacy" whereby relationships observed in aggregated data do not match those found at the individual level.

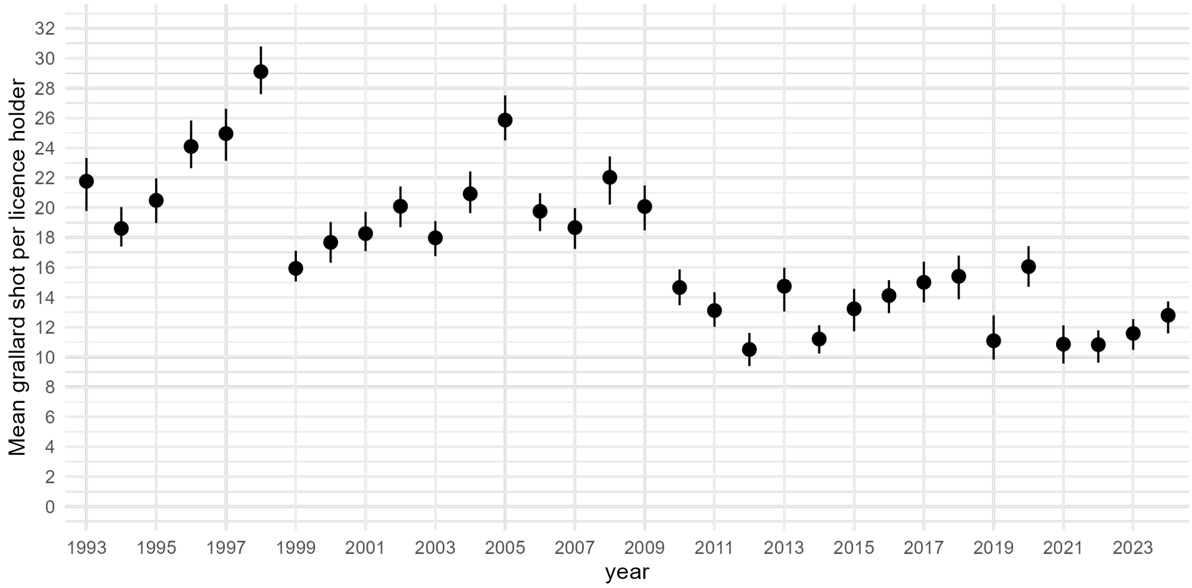

Figure 2: Estimated mean whole season grallard harvest per licence holder from 1993-2024. Annual averages are calculated as the sum of daily averages, and 95% quantile confidence intervals are generated from bootstrapping.

There was a drop in average and total harvest (Figures 1 and 2) around 2009. Around the same time, hunting regulations were made more conservative – going from an 8-week season to 4 weeks and a 10-bird limit to 6 (see Appendix, Figures 15 and 16). Therefore, the question is whether harvest is lower because there are fewer ducks to shoot (and therefore less hunter effort) or because more restrictive regulations effectively reduce harvest.

While there is some evidence that season regulations may be impacting harvest (discussed later), it is worth considering whether harvest has been affected outside of what we might expect from regulations. For example, consider how the average opening weekend harvest has changed over time (Figure 3). Here, despite the years before 2009 and 2012-2021 having the same bag limits (shown in blue), on average, the more recent period has consistently lower harvest estimates, indicating that something other than bag limits has reduced harvest. Further evidence of this can be observed in Figure 4 which illustrates that the proportion of hunters shooting zero birds on the Saturday of opening weekend doubles on average after 2009.

There are several potential theories as to what may have caused this. Some may argue that this drop aligns with the hypothesis that the population decreased around 2009 due to back-to-back drought events. It has also been suggested that this drop in harvest may be a result of a decline in hunter effort. However, the trends do not seem to match, whereby the trend in mean hours hunting waterfowl on opening weekend shows more of a general decline as opposed to a drop around 2009 (See Appendix, Figure 18). In addition, it has been suggested that the survey implementation changed around this time (e.g., before 2009, the selection of surveyed hunters may not have been perfectly random, and some group totals were entered (D. Klee, personal communication))[3]. While we cannot determine randomisation by looking at the data, we can check for outliers (e.g., group counts), of which there is an insignificant amount.

[3] The structure of the survey also changed around this time (i.e., the format of the database). However, considerable time has been dedicated to investigating whether this may have resulted in some inconsistency with nothing found. It is reassuring to note that other regions also experienced this change but did not observe a change in their estimates (e.g., Southland).

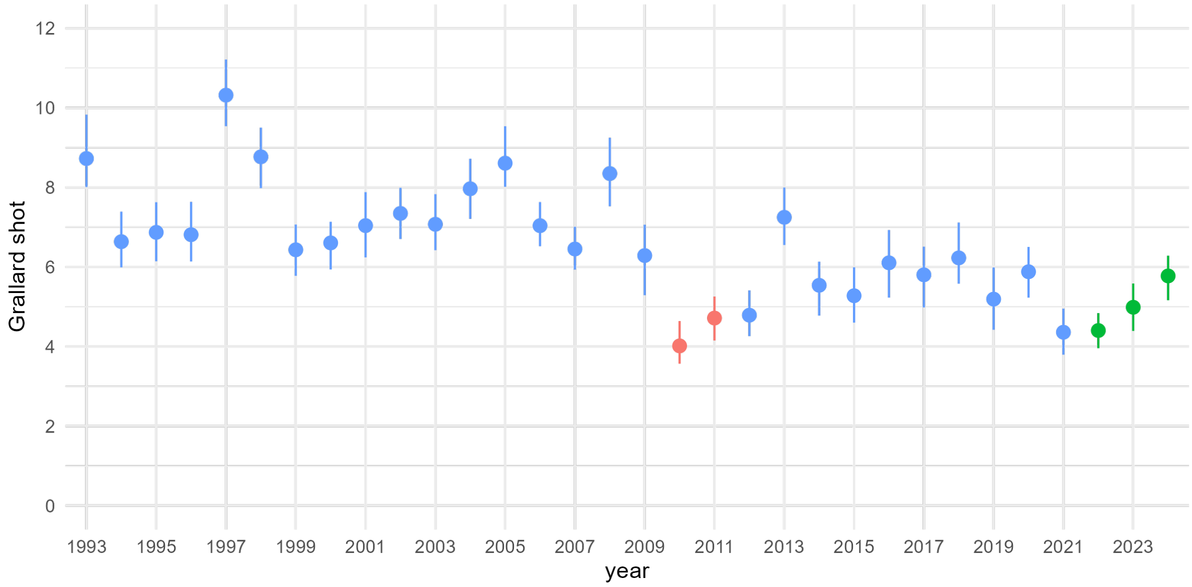

Figure 3: Estimated mean opening weekend grallard harvest per licence holder from 1993-2024. Years are coloured by mallard limit. Blue = 10, Green = 8, Orange = 6. Opening weekend averages are calculated as the sum of daily averages, and 95% quantile confidence intervals are generated from bootstrapping.

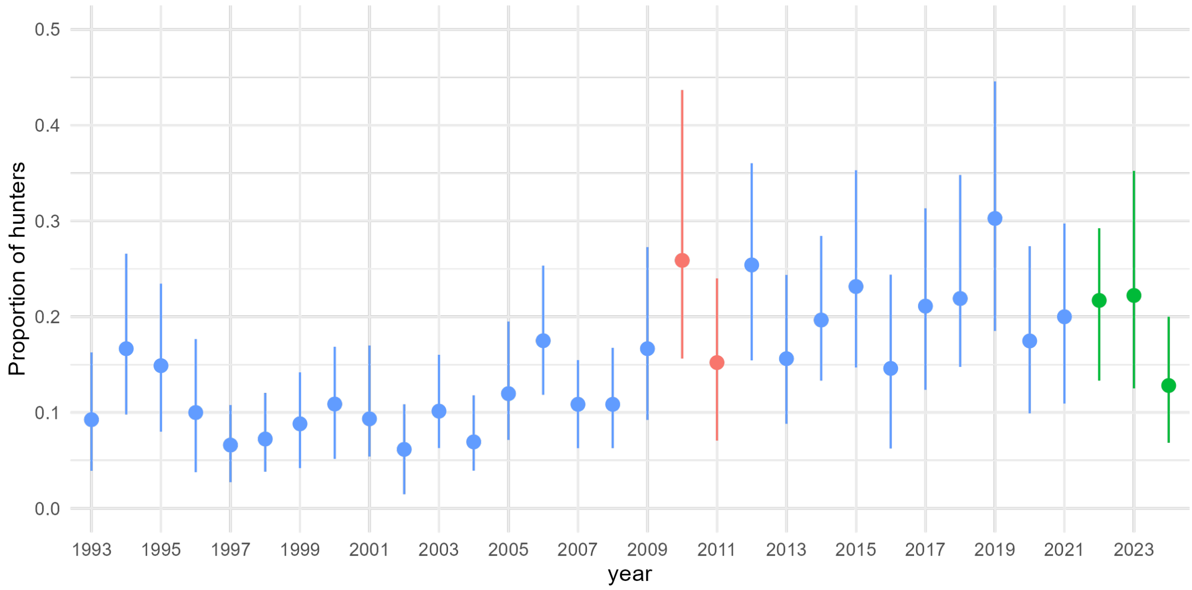

Figure 4: Proportion of hunters shooting zero grallards on the Saturday of opening weekend. Years are coloured by mallard limit. Blue = 10, Green = 8, Orange = 6. 95% quantile confidence intervals are generated from bootstrapping.

4 Hours spent hunting waterfowl

How long people spend hunting gives us a good indication of social trends in waterfowl hunting and the effect of season regulations. By reducing season length, we effectively try to reduce the time spent hunting (and, in turn, reduce harvest). The average amount of hours spent hunting waterfowl has remained relatively stable over time, with a drop around 2009 corresponding to a hypothesised drop in population and more restrictive regulations (Figure 6). Specifically, before 2010, people spent, on average, 32 hours a season hunting, whereas, after 2009, hunters spent 24 hours a season hunting (Figure 6).

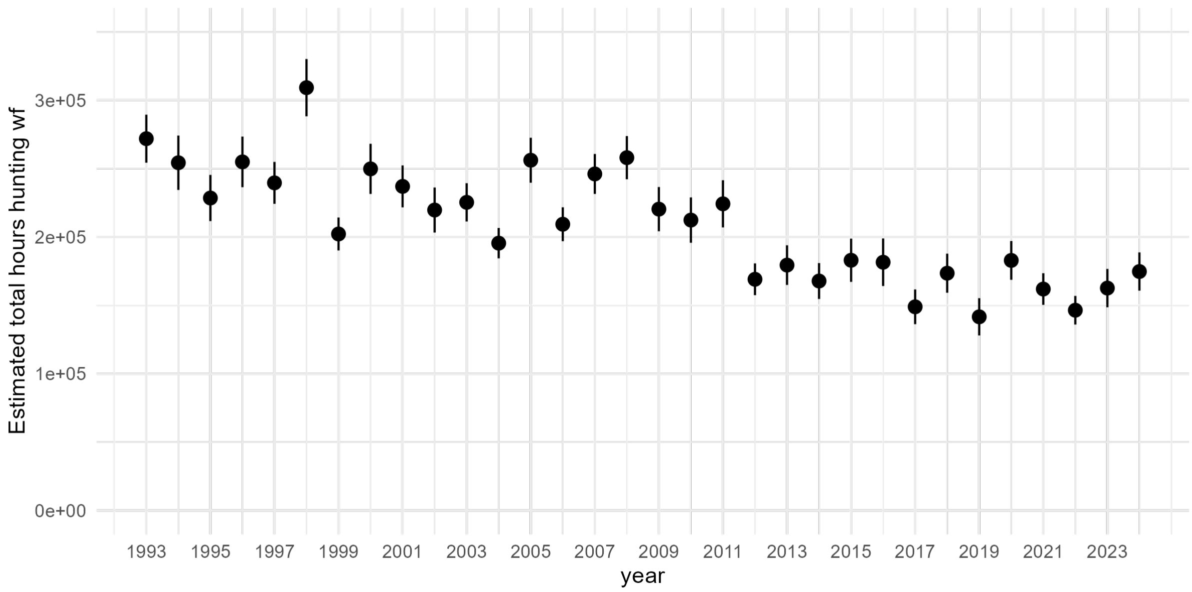

Figure 5: Total estimated hours hunting waterfowl from 1993-2024. Total hours hunting waterfowl is calculated by multiplying the average junior and adult whole licence holder seasonal hours by the number of adult and junior whole season licence holders.

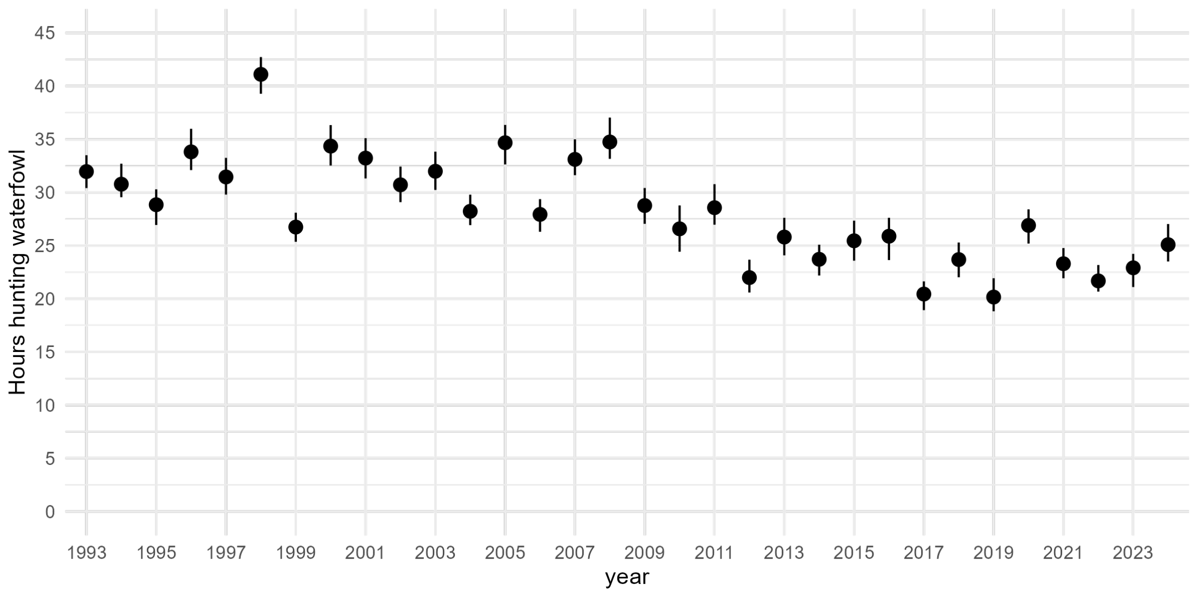

Figure 6: Average estimated hours hunting waterfowl per licence holder from 1993-2024. Annual averages are calculated as the sum of daily averages, and 95% quantile confidence intervals are generated from bootstrapping (one thousand iterations).

5 SEASON LENGTH

Figure 7 illustrates the cumulative mean daily grallard harvest and Figure 9 shows the cumulative mean daily hours spent hunting waterfowl between 1993 and 2024. Because the length of time people spend hunting and the number of birds they shoot are naturally linked, they follow similar patterns. Figure 7 shows that most of the harvest occurs on opening weekends and subsequent weekends, while the average harvest on weekdays is lower. Similarly, most of the hours spent hunting waterfowl occur on opening weekend and the subsequent weekends (Figure 9).

Comparing the cumulative mean harvest and hours hunting at day 30 between long and short seasons, it is apparent that, on average, our cumulative estimates are lower for shorter seasons, indicating that something other than season length has led to a reduction in harvest (Figure 7 and 9)[4].

Interestingly, when the opening weekend is excluded (Figure 8), the average harvest on day 30 (excluding outliers of 1995, 1998, and 2005) looks very similar when comparing long and short seasons, and even without removing the outliers, there is no statistically significant difference (p = 0.134). Similar patterns are found in cumulative hours hunting waterfowl.

Two things could be happening here. One hypothesis is that shorter seasons reduce the cumulative time spent hunting waterfowl after the opening weekend and consequently reduce the cumulative harvest. In other words, the line representing cumulative estimates of shorter seasons follows a similar trend/trajectory to longer seasons but is cut short by the early finish (Figures 8 and 10). In this scenario, we expect hunters to not manipulate their behaviour regarding how much they hunt depending on season length.

Another hypothesis is that, on average, hunter effort and subsequent harvest have decreased in recent years, potentially due to a drop in population. This drop in population size corresponds with a reduction in season length that influences hunters to manipulate their behaviour to hunt more (i.e., make the most of the shorter season). In other words, hours hunted and harvest have decreased in recent years, but it appears to be similar because it is condensed into the shorter season. In this scenario, one would consider season length to be less effective at influencing overall harvest.

Unfortunately, it is challenging to determine which of these two scenarios is the case without experimental intervention. Trends in opening weekend harvest may offer some clues, which would lend weight to the latter hypothesis; however, this is inconclusive. Future efforts will consider how neighbouring regions' hours hunted and harvest have changed over this period. Of particular interest is the Northland F&G Council, which has not reduced its season length like ours. In addition, we may be able to determine if hunters are manipulating their behaviour by investigating the number of days hunted (comparing long and short seasons).

Lastly it is worth noting that for shorter seasons, there seems to be a greater emphasis on closing weekends – which may boost hours hunted post-opening weekends to be slightly greater than what you would expect from a longer season (Figure 9). Another key takeaway from this is to think of seasons

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[4] Opening weekend harvest is briefly discussed with respect to Figure 3.

as numbers of weekends rather than weeks, as most of the harvest occurs then. With this in mind, our current “four-week season” may be better thought of as a five-weekend season.

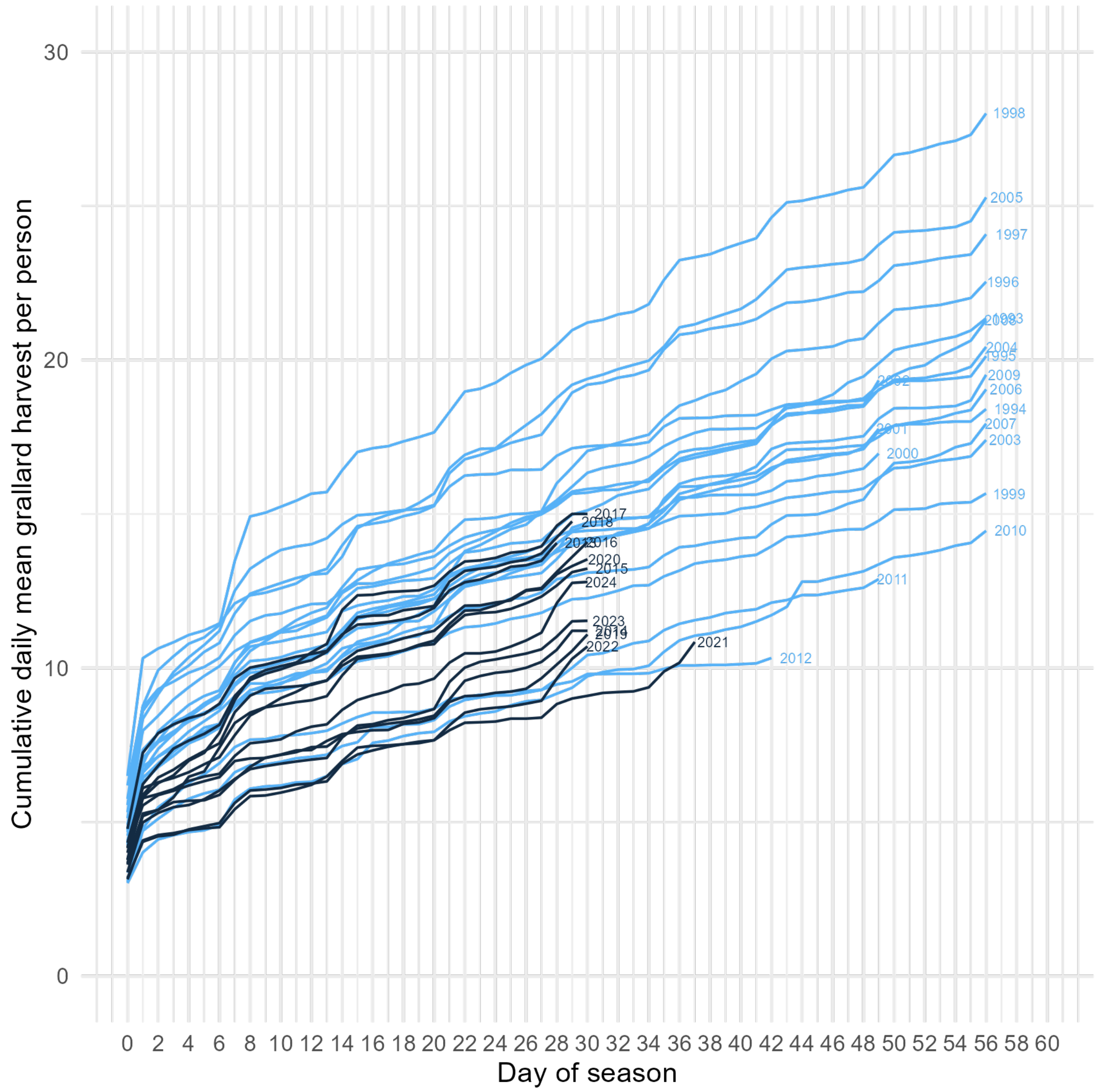

Figure 7: Cumulative daily mean harvest per licence holder from 1993-2024. Years with seasons greater than 40 days are coloured in light blue to illustrate differences between longer and shorter seasons. Where each year’s line ends correspond to the average grallard per person per season (as shown in Figure 2).

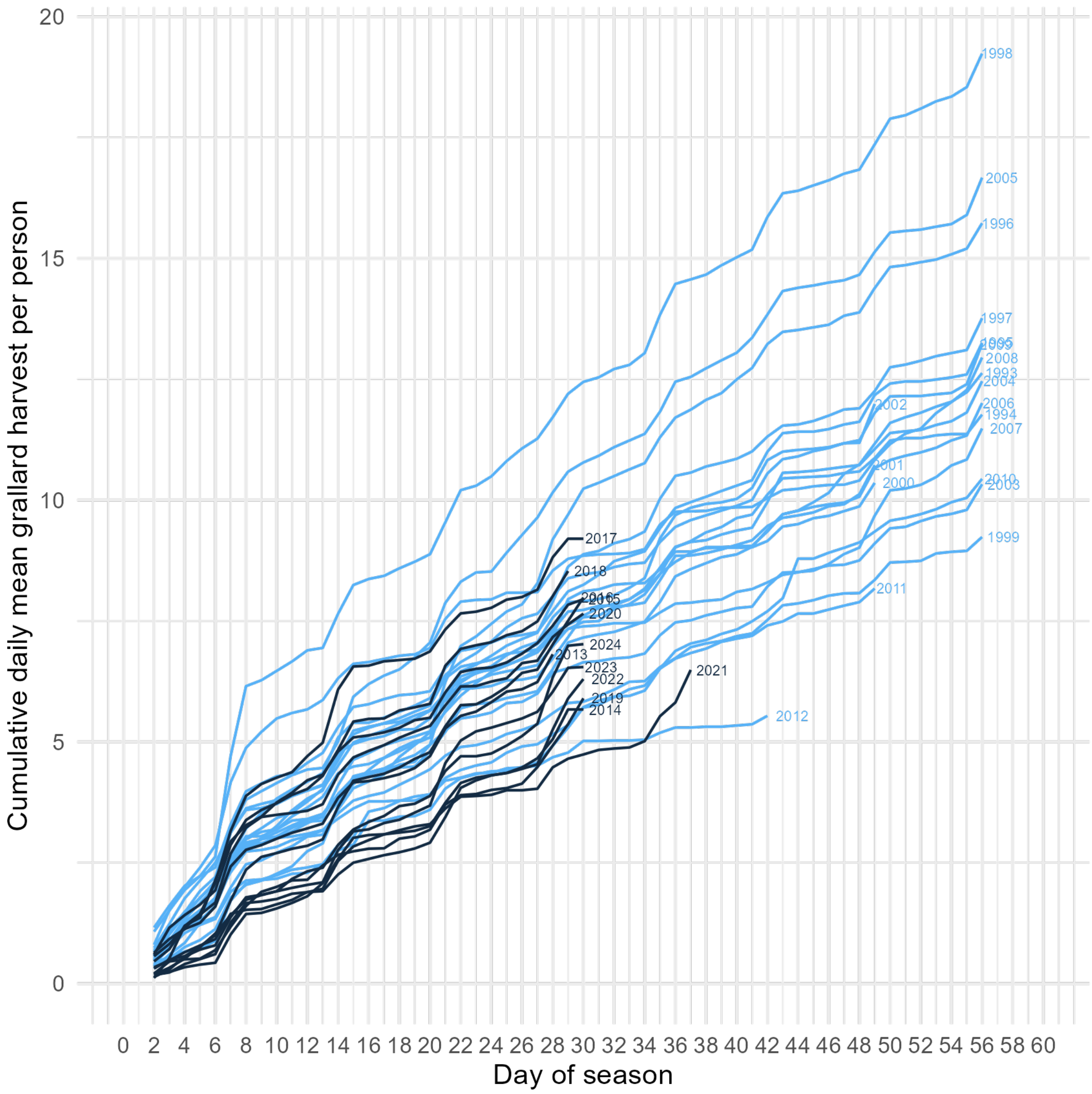

Figure 8: Cumulative daily mean harvest per licence holder from 1993-2024, excluding opening weekend. Years with seasons greater than 40 days are coloured in light blue to illustrate differences between longer and shorter seasons.

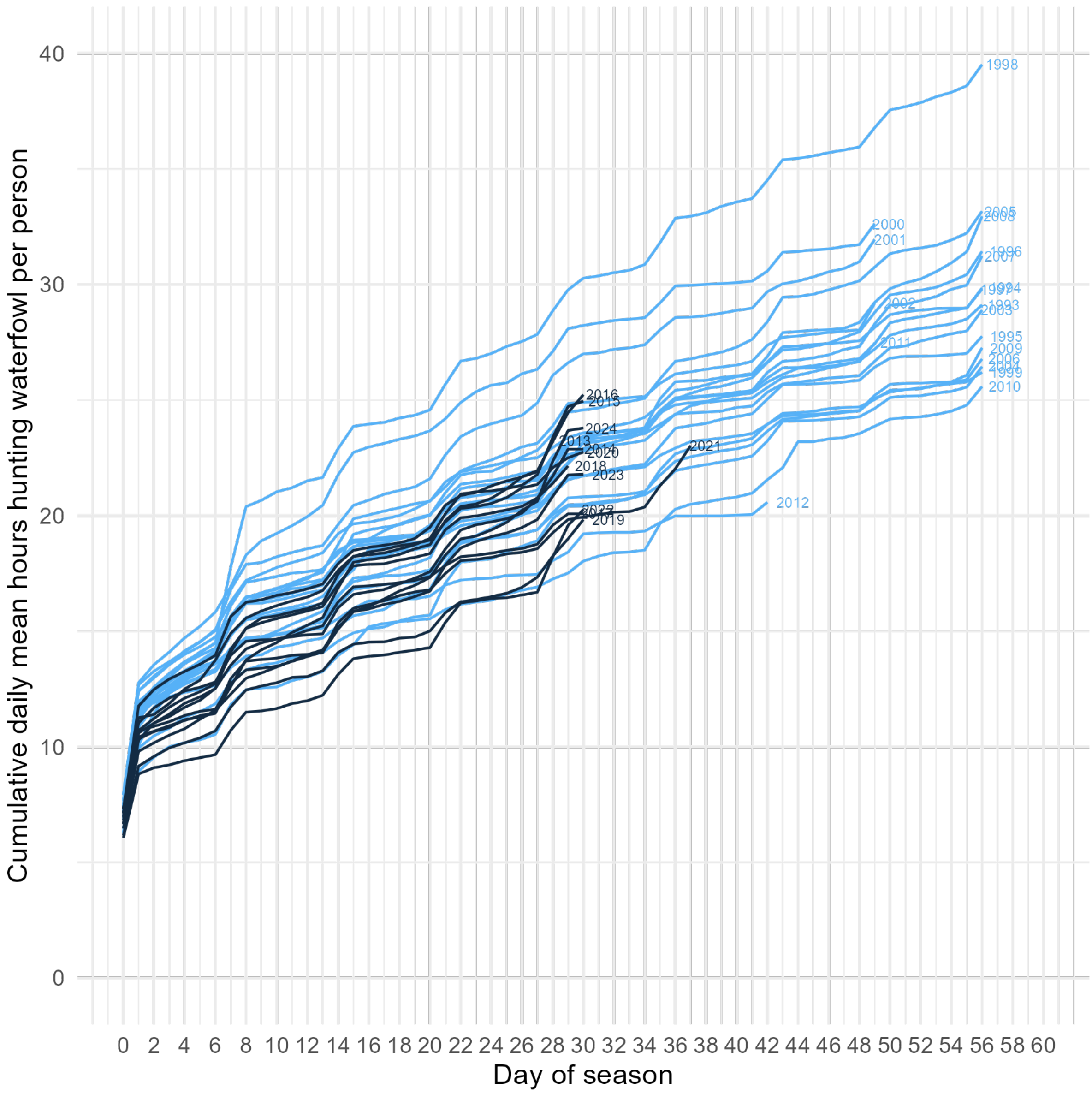

Figure 9: Cumulative daily mean hours spent hunting waterfowl per licence holder from 1993-2024. Years with seasons greater than 40 days are coloured in light blue to illustrate differences between longer and shorter seasons. Where each year's line ends correspond to the average hours per person per season (as shown in Figure 7).

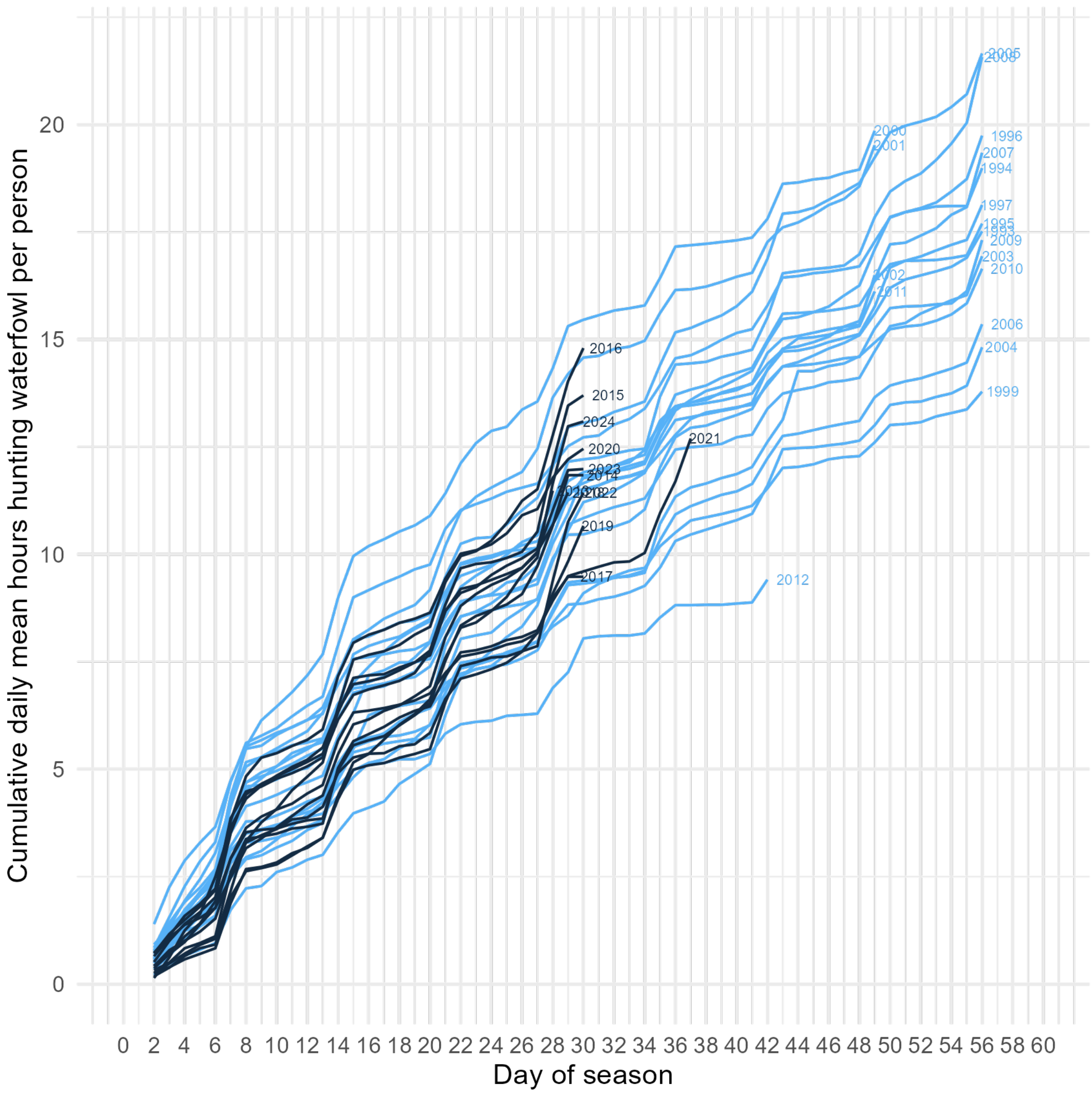

Figure 10: Cumulative daily mean hours spent hunting waterfowl per licence holder from 1993-2024, excluding opening weekend. Years with seasons greater than 40 days are coloured in light blue to illustrate differences between longer and shorter seasons.

6 BAG LIMITS

On average, just under 30% of the days hunted between 1993 and 2024 resulted in a hunter shooting zero grallard. With historic bag limits varying from 6 to 10, bag limits appear to only impact the top hunters. Because patterns in harvest vary between opening weekend and the rest of the season (Figures 11 and 12), the effect of bag limits will be considered for each.

For opening weekend, in years where limits of 6 and 8 birds were set, hunters, on average, shot more than 5 birds a day 23.5% of the time. For years with a limit of 10, this was 32% of the time. In comparison, for days outside of opening weekend, years with a limit of 6, 8 and 10 saw, hunters, on average, shoot more than 5 birds a day 8%, 9.7% and 11% of the time, respectively. Put another way, unless we reduce bag limits below 6, we are likely only able to manipulate around 25% of hunters on opening day and 10% of the hunters post-opening weekend.

As shown in Figures 11 and 12, as bag limits increase, fewer people make the limit, meaning that the effect of bag limits gets weaker the more liberal they are. For example, hunters who shoot over 5 birds a day on opening weekend will, on average, shoot one less bird a day with a limit of 8 compared to 10 (Table 1).

This may be best represented with a scenario based on previous year's data. Let's say there are 7000 hunters in 2025. 93% hunt the Saturday of opening weekend and 73% the Sunday. On Saturday, 30% shoot more than 5 birds, while on Sunday, 20% will. Using the averages shown in Table 1, we expect the opening weekend harvest for those who shoot over 5 birds under a 6, 8, and 10-bird limit to be around 18,000, 22,000, and 25,000, respectively. When compared to the total estimated harvest, this is not considerable. Naturally, much lower bag limits will impact total harvest (assuming compliance); however, it is necessary to consider this impact on hunter satisfaction. It is worth reiterating a few points:

1. that hunter satisfaction is generally higher when the limit is attainable[5].
2. that low bag limits are a useful means to communicate to hunters that the population is low.

Table 1: Average grallard shot per day by hunters that shoot more than 5 birds a day for opening weekend and the days following opening weekend under different bag limit restrictions (based on data from 1993 to 2024).

Limit	Mean grallard shot per day (OW)	Mean grallard shot per day (after OW)
6	6.11	6.07
8	7.47	7.2
10	8.43	7.76

[5] Unpublished work by M. Garrick

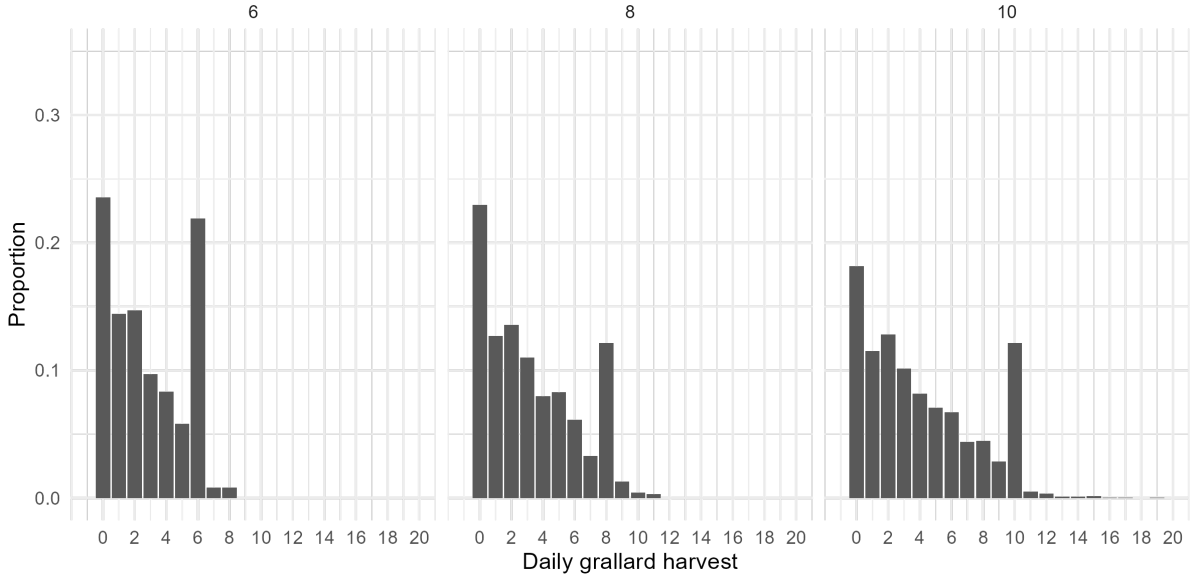

Figure 11: Distribution of daily grallard harvest under three bag limits (6 – left, 8 – centre, 10 – right) for opening weekend days 1993-2024.

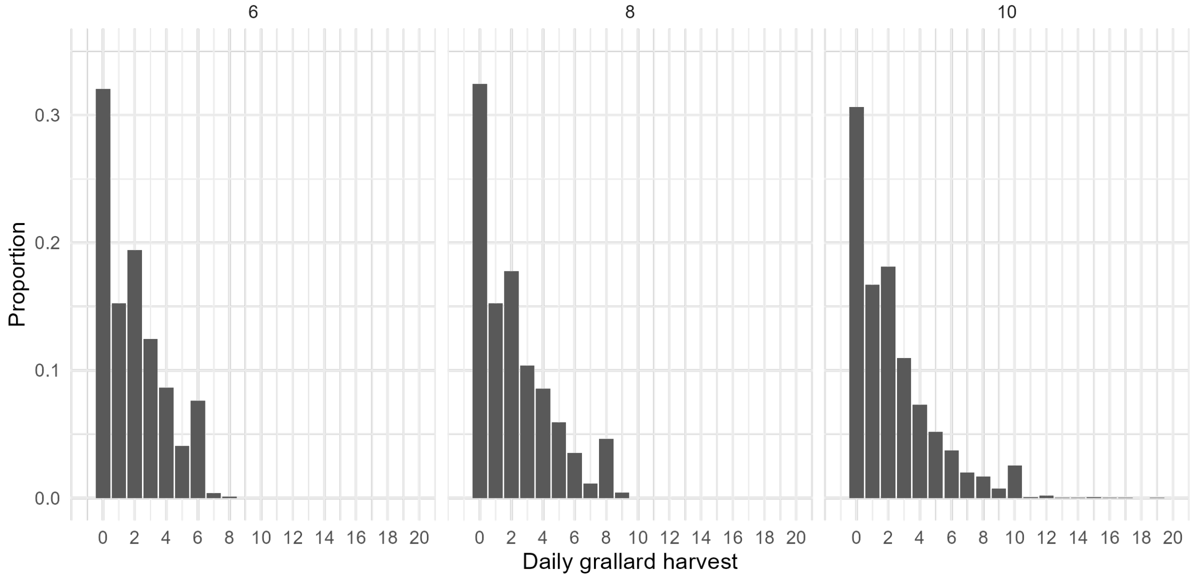

Figure 12: Distribution of daily grallard harvest under three bag limits (6 – left, 8 – centre, 10 – right) ***excluding*** *opening weekend days 1993-2024.*

7 GRALLARD PER HOUR

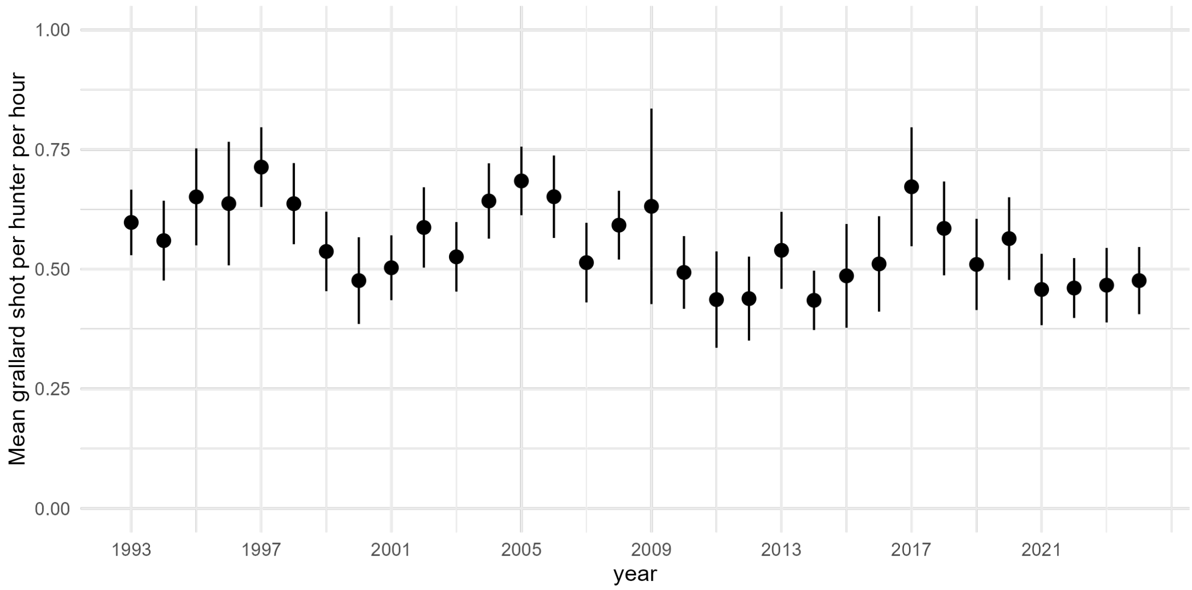

Figure 13: Estimates of average grallard harvest per hunter per hour from 1993 to 2024 with 95% confidence intervals.

Grallard per hunter per hour seems to cycle up and down from 1993 to 2024. On the whole this cycle is trending downwards. This decline may be partly due to a decrease in hunter effort, but the fluctuations from year to year (and decrease in recent years) are likely due to population size - driven by climatic conditions. Grallard per hunter per hour positively correlates with our estimates of the total grallard population, with the relationship between grallard per hour and population size being statistically significant ($p < 0.001$)[6].

8 SURVIVAL RATES

Survival rates are calculated from banding data and represent the proportion of the population that survives from one year to the next. Over the last 20 years, survival rates for juveniles have remained consistently low for both males and females at around 0.4. For adult males, survival rates have been consistent at around 0.6, while for adult females, survival has dropped below 0.5 since 2019.

Survival rates may remain stable while the population hypothetically collapses because duckling survival is the single most important variable governing population growth[7] which is not captured in our survival estimates. Environmental effects and season regulation can be included in predictors of the Burnham live-dead model, but further work is required to explore this fully. Initial results suggest that Autumn rainfall may have the largest effect on survival outside of differences in sex and age class, while the effect of season regulations is small at best. However, it is worth reiterating that we would

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[6] This may come as a result of both estimates being generate from the same harvest data.

[7] J. Sheppard (2017). Breeding Ecology and Productivity of Mallards and Mallard-grey Duck Hybrids in New Zealand.

expect this, particularly for season length, if the drop to a four-week season coincided with the drop in the grallard population.

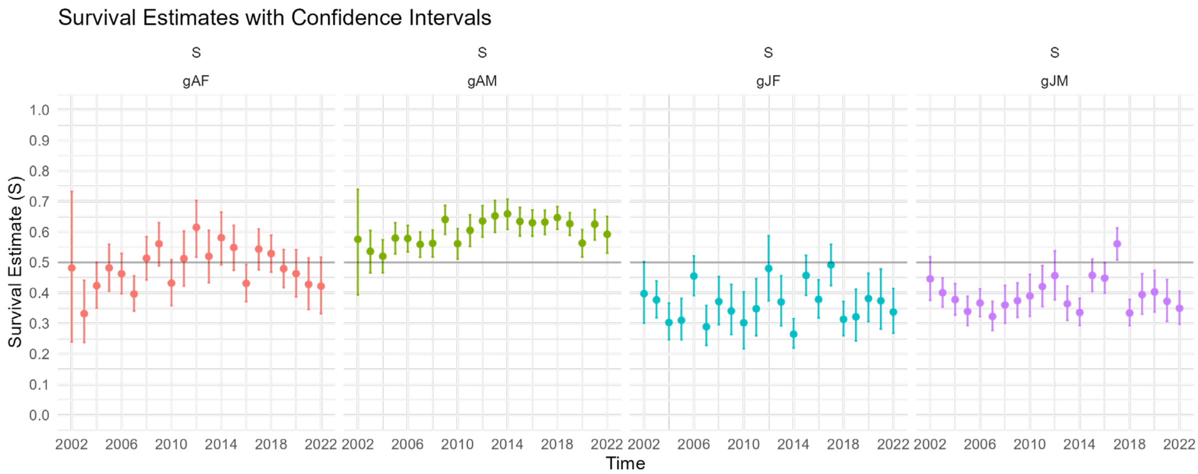

Figure 14: Estimates of survival (S) from 2002 to 2022 based on a Burnham live–dead model. AF (orange) = Adult females, AM (Green) = adult males, JF (blue) = juvenile females, JM (purple) = juvenile males. Survival estimates are distinct in terms of age, sex, and time combination. They are calculated in a model that assumes the other parameters (F, p and r) vary only by sex and age.

9 APPENDIX

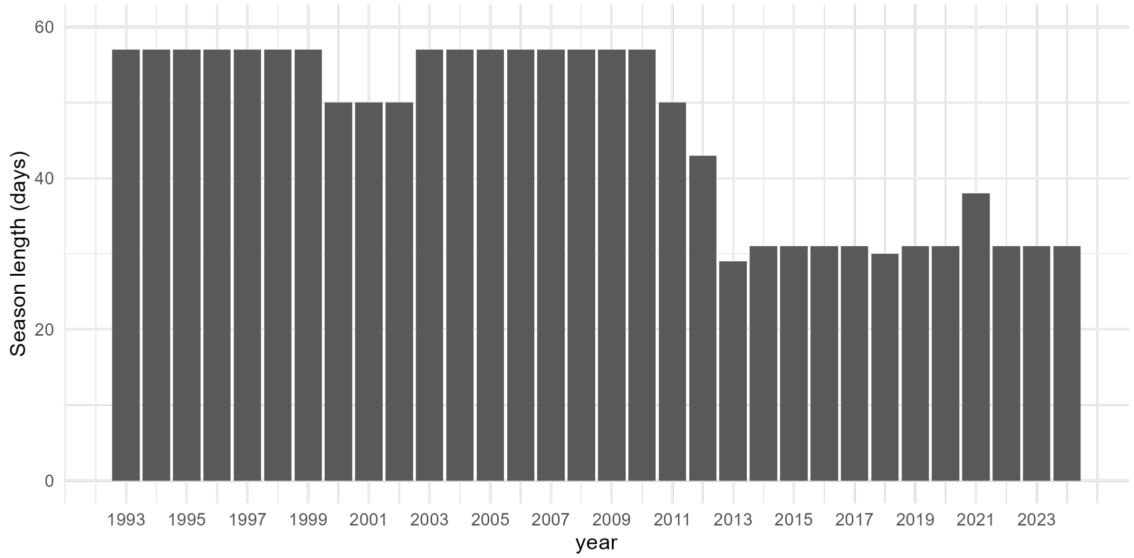

Figure 15: Auckland Waikato season length (days) 1993-2024.

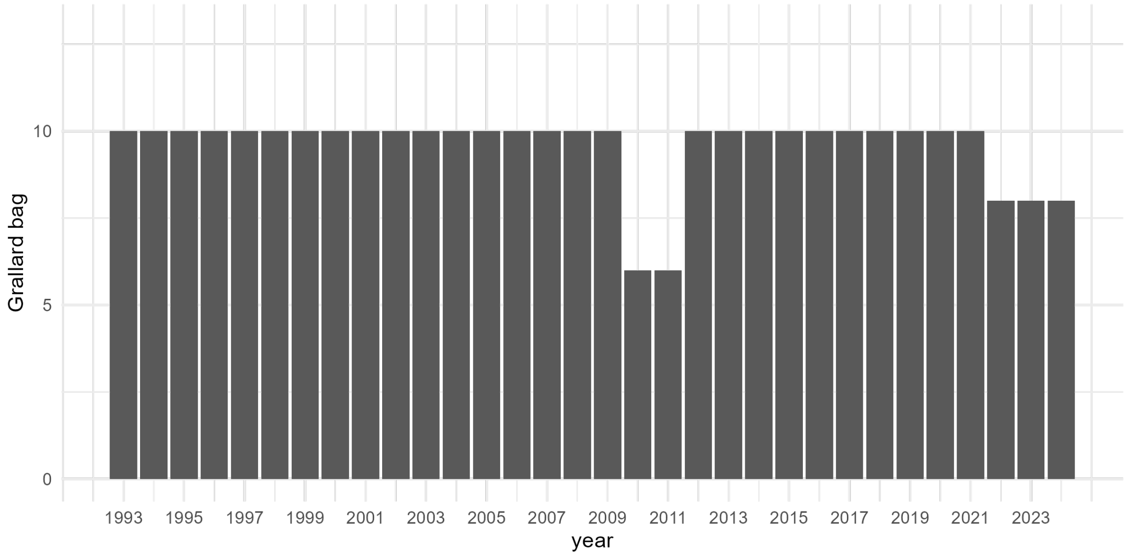

Figure 16: Auckland Waikato grallad bag limit 1993-2024.

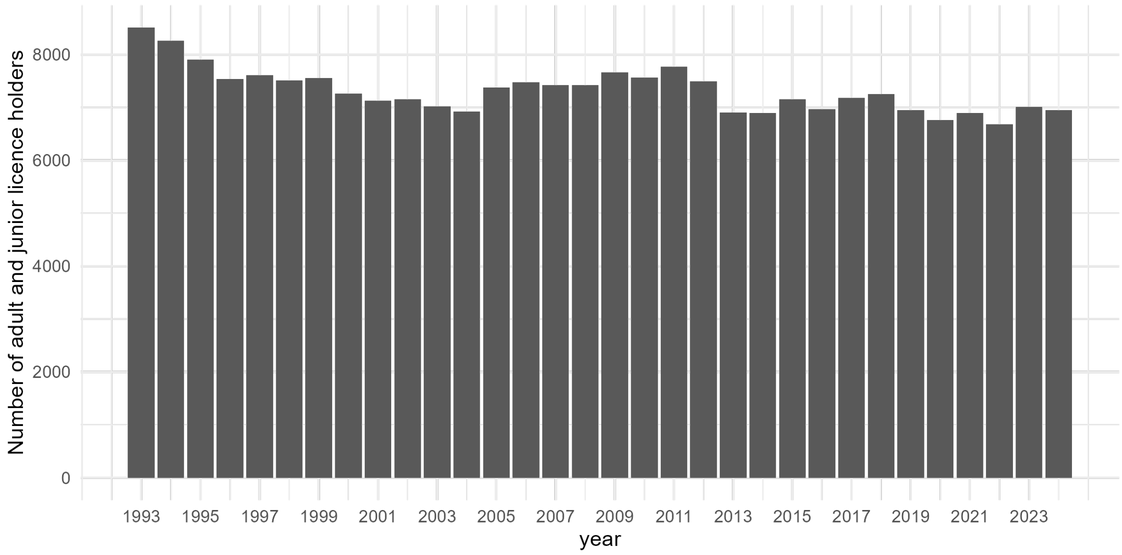

Figure 17: Auckland Waikato adult and junior full-season licence holders 1993-2024. Note that for 1995, the number of licence holders is unknown, and the average of the two surrounding years is imputed.

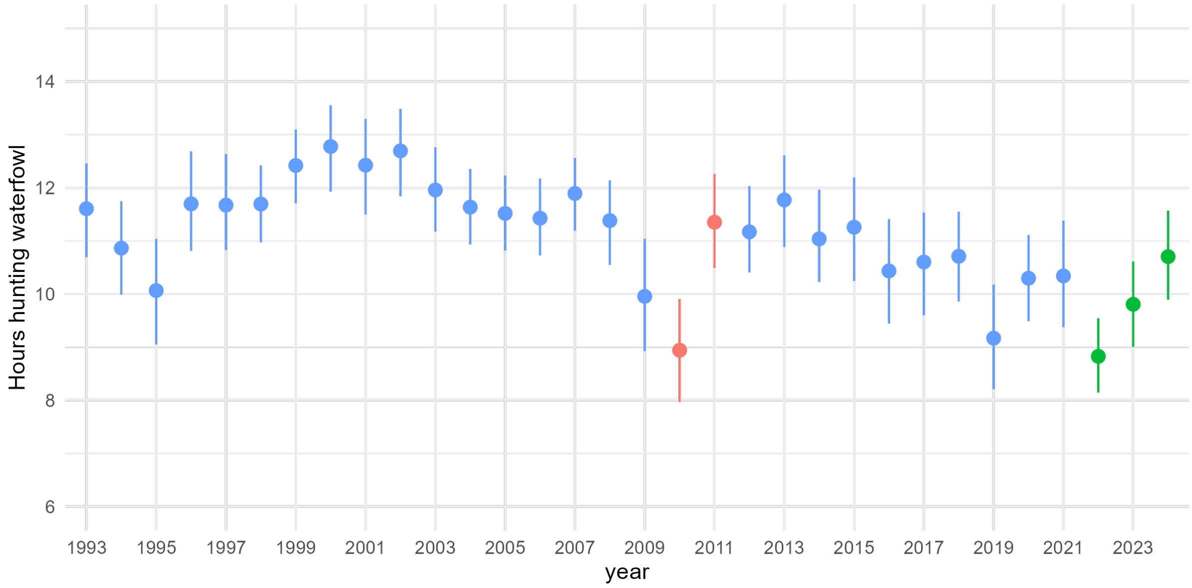

Figure 18: Estimated mean opening weekend grallard hours hunting waterfowl per licence holder from 1993-2024. Years are coloured by mallard limit. Blue = 10, Green = 8, Orange = 6. Opening weekend averages are calculated as the sum of daily averages, and 95% quantile confidence intervals are generated from bootstrapping.