Summaries of recent research reports on waterfowl abundance

"Prowse, T. (2023).

Conservation and Sustainable-Harvest Models for Game Duck Species."

What is this report about? This study develops a computer model of duck population abundance and simulates various levels of hunting-harvest. The report was commissioned under the Sustainable Hunting Action Plan 2021-2024, by the Department of Jobs, Skills, Industry and Regions (DJSIR) to inform setting sustainable game duck harvests in Victoria. The sustainability performance of the modelled population was defined as to maximise the cumulative harvest over a 50-year period, under the constraint that populations were maintained above some minimum population threshold (defined arbitrarily at 20 % of carrying capacity).

This study provides confidence, that duck hunting can continue with recommended levels (limits, quotas, etc.) of annual harvest that will allow game duck populations to persist over the long term such that populations will not fall below 20% of the carrying capacity, even in years when environmental conditions are poor.

How does it do that? Four species are modelled, two representing highly mobile species (Black duck and Grey teal), and two representing less highly mobile species (Chestnut teal and Australian wood duck), for which there is sufficient known biological data to build population models. The study first estimates "carrying capacity" for game ducks in Victoria, and other subregions of southern Australia (Northern Basin, Lake Eyre Basin and South Australia). Carrying capacity is not really defined in the report, but generally means the average population-size that can be maintained by the landscape and its resources. This process depends upon the following data:

1. the population estimates for duck species in Victoria from 2020-2023 (e.g., Ramsey and Fanson 2023)
2. the Eastern Australian Waterbird Survey data for the Victorian and southern NSW survey bands which are relative abundances estimated for a proportion of the landscape,
3. the population estimates for duck species in the NSW Riverina from 2017-2023 (e.g., Dundas *et* al, 2020; McLeod et al 2020)
4. a meteorological index of *water in the landscape,* the Standardised Precipitation-Evapotranspiration Index (SPEI) which is based on differences between wetting and drying weather-data.

The statistical relationships between 'water in the landscape' and duck relative-abundances are used to create correction-factors to extrapolate relative-abundance to absolute abundance. These correction-factors are used to develop the baseline model which describes the impact of environmental variability (i.e., water in the landscape) on game duck carrying capacity in the four subregions. Future predicted drying effects of climate change were also factored-in.

The model uses the published information on duck biology from other studies, such as population growth rates, annual survival rates, clutch-size and dispersal rates among sub-regions, to simulate

the life-history and abundance of each species over a 100-year period. Environmental variability was simulated by each modelled year using the input of SPEI randomly sampled from the historic record. Weak density dependence in the population is mediated through clutch-size and dispersal.

The model is run for the first 50-years to allow populations to stabilise around carrying capacity and dispersal among sub-regions; and then for the second 50-years harvest mortality from hunting is simulated, including associated losses through wounding (23% of harvest).

Harvest was simulated at fixed percentages of each subregion's population. For Victoria, harvest rates were varied (10 to 50%), and for South Australia and the Northern Basin harvest was fixed at 5%.

What does the report find? Key results are:

"*Simulation results for Grey Teal and Wood Duck suggested that long-term mean population size and expected minimum population size (for Victoria and all the simulated sub-regions) could be maintained above 20 % of carrying capacity for up to (and including) 30 % proportional harvests*." In such scenarios, note that the mean population size for Victoria would be around 40% of carrying capacity.

Results for Black Duck and Chestnut Teal suggest a more precautionary approach, …a harvest quota of 10 to 20 % is recommended for these species." With a 10% harvest quota all populations can be maintained above 20% of carrying capacity with a mean population size of 75—80%, and 60—65% carrying capacity for Black ducks and Chestnut teal, respectively.

So how do these recommended quotas compare with current harvest estimates? The Game Management Authority estimates duck hunter harvest after each season; and since 2021 has estimated Victoria's duck population each year before the hunting season with helicopter and ground-based counts (

Table 1). Analysis shows that harvest has been less than the suggested 10-20% of population size for 9 out of the 10 cases of game duck species, for which we have full data. Population estimates for Pink-eared ducks should become a priority, but given the low harvest estimates it seems unlikely to be an overharvested species.

In 2022 hunters in Victoria had a 12-week season, with bag limit of 4 whereas, in 2021 there was a short hunting season (3-weeks and a restricted bag limit), yet this harvest could have been maintained for a 10-week season *pro-rata* and even the Pacific black duck harvest would have only been 20% of the population harvested.

In 2023 hunters were restricted to a 5-week season, with bag limit of 4, but participation was high with more hunting days per hunter than historical levels. Moloney and Flesch *(2023),* speculate that hunters may have been motivated to greater participation in the belief that 2023 could be the final Victorian duck hunting season given the Parliamentary inquiry into native game bird hunting arrangements.

Table 1. Estimates of November-December game duck population size in Victoria (Ramsey and Fanson 2021; Ramsey and Fanson 2022; Fanson 2023) *and game duck harvest the following hunting season in Victoria* (Moloney and Flesch 2022; Moloney and Flesch 2023) *in comparison to recommended harvest quota for sustainable hunting* (Prowse 2023). *Species in bold text were featured in the population models.*

Year	Species	Estimated population, Victoria	Estimated harvest, Victoria	Harvest as % of population	In quota?
2021	**'teal' Grey and Chestnut combined**	**981,600**	**16,430**	**1.7**	✓
	Australian Wood duck	**680,900**	**14,301**	**2.1**	✓
	Australian Shelduck	406,700	1,643	0.4	✓
	Pacific black duck	**327,600**	**19,534**	**6.0**	✓
	Hardhead	55,300	61	0.1	✓
	Pink-eared duck	n/a	304	n/a	?
2022	**Grey teal**	**616,000**	**47,506**	**7.7**	✓
	Chestnut teal	**62,700**	**26,044**	**41.0**	×
	Australian wood duck	**1,248,200**	**68,632**	**5.5**	✓
	Australian shelduck	509,900	20,567	4.0	✓
	Pacific black duck	**440,600**	**98,700**	**2.2**	✓
	Pink-eared duck	n/a	1,118	n/a	?
2023	**Pacific Black Duck**	**574,400**	**144,995**	**25.2**	×
	Grey Teal	**460,200**	**91,206**	**19.8**	✓
	Australian Wood Duck	**1,140,100**	**58,457**	**5.1**	✓
	Chestnut Teal	**30,100**	**14,155**	**47.0**	×
	Pink-eared Duck	n/a	7,269	n/a	?
	Australian shelduck	205,300	2,831	1.4	✓

In conclusion: Waterfowl managers and duck hunters should be quite comfortable with the recommended quotas of 10-20% of the game duck population. This study confirms that levels of duck harvesting 2021 - 2022 – 2023, in most cases in Victoria, are sustainable for populations in Victoria and across the broader region. The public should be made aware that Victorian hunters are generally harvesting less than the recommended sustainable quotas. Waterfowl managers and the broader public should be reassured that the science suggests considerable margin for error, whereby harvest could be safely increased, at least for some species. Such a safety-margin is perhaps useful given some of the uncertainties (e.g., dispersal rates, wounding loss, climate change, etc) which provide fruitful areas to target further research.

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