Potential changes to canvasback closed season frequency due to introducing a liberal, 2-bird bag season.

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Introduction

The estimated canvasback population size for 2007 and the model-predicted population size for 2008 represent historical highs: The 2007 May survey estimate is 865,000 with a standard error of 86,000; the NAWMP population goal is 540,000. As a result, the Service Regulations Committee (SRC) set the 2007 canvasback harvest package to be a full season with a 2-bird bag limit. The 2-bird bag limit is a deviation from the existing Canvasback Harvest. The SRC indicated that no further deviations from the Strategy would be considered unless the Strategy was changed to allow for a 2-bird bag. The SRC also requested that the Population & Habitat Assessment Branch estimate the likely change in proportion of closed and restricted seasons that might result if a 2-bird were permanently included in the Canvasback Harvest Strategy. This assessment is being made available to the Flyways and SRC in order to inform debate over possible changes to the Strategy.

Canvasback harvest-management strategy

The Canvasback Harvest Strategy was adopted by the Service in 1994. The Strategy allows a full season (i.e., season length set by the mid-continent mallard AHM model) with a 1-bird bag, if the predicted canvasback population for the following spring exceeds 500,000. A restricted season-within-a-season (SWS) with a 1-bird bag is allowed, if the predicted number of canvasbacks does not exceed 500,000 for the AHM-determined season length, but does exceed 500,000 for a restricted season. The canvasback season is closed, if the predicted canvasback population size is less than 500,000 for a restricted season or if the mallard season is closed.

Methods

I simulated mid-continent mallard season length, canvasback population size, and canvasback season length for 1,000 20-year intervals using (1) the AHM mid-continent mallard model and 2007 model set, and (2) the current canvasback population model, which is used to predict canvasback population size in the following spring and to set the canvasback harvest package. (See the attached appendix for details of the model, relevant parameter values, and simulation details.) This simulation was repeated for three scenarios: (1) the current harvest strategy, (2) a harvest strategy allowing a 2-bird bag for a liberal season, if the predicted canvasback population size exceeds 900,000, and (3) a 2-bird bag liberal season strategy, if the predicted population exceeded 600,000. The 900,000 cut-off ensures that 2-bird seasons are allowed only in historically unusual circumstances, such as 2007, while the 600,000 cut-off allows a 2-bird season at a predicted population size just above the 1-bird cut-off.

For each 20-yr interval, I calculated the percentage of closed seasons, SWSs, full seasons, and 2-bird seasons. I then calculated the mean percentage for the 1,000 simulations. Comparisons between the percent closed and SWSs for the current strategy and for the two 2-bird bag strategies quantify the likely near-term impact of a 2-bird bag limit on the distribution of season lengths.

The canvasback population model used to predict the upcoming spring population size assumes exponential growth rather than density dependence and was not developed to simulate long-term dynamics. Because survival rates are high, the average growth of the population is also high and, when the model is simulated for a 20-yr interval, the canvasback population can grow well beyond reasonable biological limits. If simulated population sizes are unrealistically high, the percentage of closed and SWS seasons will be underestimated. Underestimation of closed season frequency may or may not affect the relative change in closed and SWS seasons due to the introduction of a 2-bird bag. To investigate, I modified the current population model to include an indirect density-dependence (see appendix for the modified model) and re-ran the simulations for the current strategy and 600,000 bird cut-off using the revised model.

Results

Adding a 2-bird bag limit for liberal seasons slightly increased the percentage of closed and restricted seasons (6% increase for both cut-offs, see Table 1). This increase was weighted more towards closed seasons when the cut-off for a 2-bird season was lower (increases of 4% closed, 2% restricted for 600,000, and 3% closed, 3% restricted for 900,000, see Table 1). Approximately one-third of the full seasons are estimated to be 2-bird seasons.

Results based on the density dependent canvasback model suggest that the current model underestimates the frequency of closed and SWSs (see Table 2). The density dependent model projects fewer 2-bird bag induced closed and restricted seasons (about 2% overall), which is likely due to the lower percentage of 2-bird seasons. Only one in nine full seasons is estimated to include a 2-bird limit under the density dependent model.

Table 1: Percent of 20 years in strategy based on the current canvasback population model. Mean (standard deviation) for n = 1,000 simulations. The distribution of mallard seasons were 7% closed (sd = 11%), 30% restricted (7%), 6% moderate (6%), and 57% liberal (22%).

	Closed	SWS	Full	2-bird
Current strategy	14 (15)	5 (9)	82 (20)	
2-birds at 600K	17 (14)	8 (11)	51 (23)	24 (25)
2-birds at 900K	18 (15)	7 (11)	50 (18)	24 (25)

Table 2: Percent of 20 years in strategy based on the canvasback population model modified to incorporate density-dependence. Mean (standard deviation) for n = 1,000 simulations.

	Closed	SWS	Full	2-bird
Current strategy	29 (13)	24 (13)	47 (13)	

2-birds at 600K	31 (13)	24 (13)	39 (13)	5 (4)

Appendix: Model and simulation details

The models and simulation approach used here follow the work of Dubovsky & Johnson (2003, *An Assessment of the U.S. Fish and Wildlife Service's Canvasback Harvest-Management Strategy and an Alternative Proposed by the Flyway Councils*).

The current canvasback model predicts next spring's May canvasback population size, N_{t+1}, to be

$$N_{t+1} = s_w \cdot \left[s_s \cdot N_t + s_s \cdot N_t \cdot A_t - H_t / (1 - CLR) \right],$$

where

N_t = May canvasback population size, year t,

A_t = Fall age ratio, year t,

= $0.75 \cdot (-0.063 - 0.148 \cdot P_t)$,

with P_t = millions of May ponds in prairie Canada, year t; 0.75 is a bias adjustment factor,

H_t = Harvest, year t,

s_s = summer survival = 0.936,

s_s = winter survival = 0.926,

CLR = crippling loss rate = 0.3.

The AHM model with the 2007 model set (see Runge et al. 2002. *A Revised Protocol for the Adaptive Harvest Management of Mid-continent Mallards* and U.S.F.W.S. 2007. *Adaptive Harvest Management: 2007 Hunting Season*) was used to simulate mallard population dynamics and Canadian prairie ponds (P_t), and to set the overall season length. The canvasback model was used to simulate canvasback population dynamics and set canvasback season lengths with the following harvest estimates:

- 7,000 closed season,
- 69,491 restricted season (30 days, Atlantic & Mississippi flyways/39 days Central flyway/60 days, Pacific flyway),
- 102,776 moderate season (45/60/107),
- 129,626 liberal season (60/74/107),
- 157,362 2-bird bag liberal season (assumes a 31% increase in harvest in the Atlantic flyway and 22% in the other flyways, Paul Padding, unpublished harvest data).

The harvest estimates are calculated from flyway-specific average harvest/day between 1994-2000, and assume a Canadian harvest of 7,733 for restricted seasons, 10,722 for moderate and liberal seasons, and an Alaskan harvest of 350 birds. Harvests are also adjusted for framework extensions with Atlantic flyway harvests increased by 11%, Central flyway by 9%, and Pacific flyway by 3%.

The 2007 estimates – 865,000 canvasbacks, 9 million mid-continent mallards, and 5 million Canadian prairie ponds – were used as initial conditions for the simulations. The results did not differ when the objective values and historical mean number of ponds were used instead.

The canvasback model was modified to include indirect density-dependence with

$$N_{t+1} = s_w \cdot \left[s_s \cdot N_t + J_t - H_t / (1 - CLR)\right],$$

where

J_t = Juveniles in fall, year t,

= $0.75 \cdot (-2.14 + 70.77 \cdot P_t)$,

with P_t = millions of May ponds in prairie Canada, year t, and a 0.75 bias adjustment factor.

By predicting fall juveniles, and not fall age ratio, using Canadian ponds, the model insures that production will not exceed pond capacity in years when May canvasback numbers high and pond numbers are low. The juvenile-pond regression relationship was fit using harvest-based age ratios, May canvasback population estimates, and Canadian prairie pond estimates from 1974-2006.