Assignment of Mallards Breeding in Alaska to the Western Mallard Stock: *Expected Effects on Hunting Regulations and Management Performance in the Central and Mississippi Flyways*

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Background.--Since the advent of Adaptive Harvest Management (AHM), mallards breeding in Alaska have been assigned to the mid-continent stock. Recently however, Alaska mallards were reassigned to a western stock, which also includes birds breeding in California and Oregon (http://www.fws.gov/migratorybirds/mgmt/ahm/special-topics.htm). The purpose of this report is to demonstrate the expected effects of that reassignment on hunting regulations and management performance in the Central and Mississippi Flyways, whose regulations will continue to be based on the status of the mid-continent mallard stock.

Key elements of the models for mid-continent mallards had to be re-parameterized with the removal of Alaskan birds. In particular, the mean variance in predicted population size, bias-correction factors for estimated survival and recruitment rates, and model weights had to be re-calculated. The changes in these values were uniformly small, and would not be expected to significantly affect regulatory policies. However, the AHM framework for mid-continent mallards also includes a closed-season constraint and an objective function that incorporates the North American Waterfowl Management Plan (NAWMP) population goal, both of which were formulated when Alaska mallards were originally assigned to the mid-continent stock. Thus, these components need to be re-scaled to reflect the exclusion of Alaska mallards. Unlike changes in model parameter values, re-scaling of the closed-season constraint and the population goal can have significant effects on the expected regulations in the Central and Mississippi Flyways.

Methods.--As a basis for comparing the effects of re-scaling the population goal and the closed-season constraint, we used the mid-continent mallard models (and associated weights) as defined prior to the hunting season in 2007. These models included Alaska mallards as part of the mid-continent stock. The closed-season constraint was defined such that closed seasons would not be considered whenever breeding-population size was ≥5.5 million. This figure was derived from the record-low breeding population in the traditional survey area (4.96 million in 1985), adjusted upward for the mean proportion of birds breeding in the Great Lakes states (11%). The management objective for mid-continent mallards is to maximize long-term cumulative harvest (H), except when the breeding-population is expected to fall below the NAWMP goal. The objective is more formally defined as a desire to maximize the temporal sum of vH, where:

$$v = 1 \quad \text{if } E\left[N_{t+1}\right] \geq goal, \quad \text{and}$$
$$v = \left(\frac{E\left[N_{t+1}\right]}{goal} \right)^{a=1} \quad \text{otherwise.} \qquad (1)$$

This proportional valuation of harvest has the effect of inducing more restrictive regulations than necessary for maximizing sustainable harvest (under current model weights), with the explicit intention of keeping the population closer to the NAWMP goal than it would be otherwise. The population goal for mid-continent mallards has been 8.8 million, based on the NAWMP goal of 8.2 million (the 1970-79 average) in the traditional survey area and a goal of 0.6 million in the Great Lakes states.

After correcting model-parameter values as described previously, we derived optimal regulatory policies and simulated their performance for a mid-continent mallard AHM framework that excluded Alaska mallards. The population goal was defined as 8.5 million, based on the 1970-79 average of mallards in the traditional survey area minus Alaska (7.9 million), plus a goal of 0.6 million in the Great Lakes states. The goal of 8.5 million was retained throughout all analyses because the original NAWMP goal has a formal and institutionalized definition. We also examined various levels of population thresholds for the closed-season constraint.

Results and Discussion.—The following tables provide results from the simulation of optimal policies that were derived under the conditions described. All analyses are conditioned on the current set of regulatory alternatives.

Baseline:

- Models: 2007 mid-continent mallards (including Alaska)
- Objective function: *goal* = 8.8 million
- Closed-season constraint: Bpop ≥ 5.5 million

Metric	mean	sd
BPOP	7.453	1.812
Harvest	1.196	0.722
Harvest rate	0.086	0.042
Regulation	Frequency (%)	
C	10.2	
R	36.3	
M	7.0	
L	46.5	
Δ Regulations*	Frequency (%)	
No change	62.8	
1 step	21.1	
2 steps	15.8	
3 steps	0.3	

* changes in regulations between successive years

Scenario 1 (initially proposed in December 2007):

- Models: revised models (and weights) for mid-continent mallards excluding Alaska
- Objective function: *goal* = 8.5 million
- Closed-season constraint: Bpop ≥ 5.25 million (the 1985 mallard population in the traditional survey area minus Alaska, and inflated to account for the average proportion of mallards in the Great Lakes states)

Metric	mean	sd
BPOP	6.796	1.768
Harvest	1.067	1.067
Harvest rate	0.083	0.0457
Regulation	Frequency (%)	
C	17.0	
R	28.2	
M	9.0	
L	45.8	
Δ Regulations	Frequency (%)	
No change	57.3	
1 step	26.0	
2 steps	15.8	
3 steps	0.9	

Scenario 2:

- Models: revised models (and weights) for mid-continent mallards excluding Alaska
- Objective function: *goal* = 8.5 million
- Closed-season constraint: Bpop ≥ 5.00 million

Metric	mean	sd
BPOP	6.773	1.7903
Harvest	1.068	0.679
Harvest rate	0.084	0.044
Regulation	Frequency (%)	
C	13.3	
R	34.1	
M	8.1	
L	44.6	
Δ Regulations	Frequency (%)	
No change	59.4	
1 step	24.6	
2 steps	15.8	
3 steps	0.3	

Scenario 3:

- Models: revised models (and weights) for mid-continent mallards excluding Alaska
- Objective function: *goal* = 8.5 million
- Closed-season constraint: Bpop ≥ 4.75 million

Metric	mean	sd
BPOP	6.738	1.807
Harvest	1.070	0.665
Harvest rate	0.085	0.042
Regulation	Frequency (%)	
C	10.6	
R	37.6	
M	7.8	
L	44.0	
Δ Regulations	Frequency (%)	
No change	61.7	
1 step	22.4	
2 steps	15.8	
3 steps	0.0	

Scenario 4

- Models: revised models (and weights) for mid-continent mallards excluding Alaska
- Objective function: *goal* = 8.5 million
- Closed-season constraint: Bpop ≥ 4.50 million

Metric	mean	sd
BPOP	5.821	1.860
Harvest	1.135	0.563
Harvest rate	0.105	0.042
Regulation	Frequency (%)	
C	12.9	
R	3.8	
M	3.1	
L	80.2	
Δ Regulations	Frequency (%)	
No change	80.1	
1 step	6.6	
2 steps	5.8	
3 steps	7.6	

As expected under Scenarios 1-4 average breeding-population size and harvest are expected to be lower than under the Baseline condition, reflecting the exclusion of Alaska mallards from the mid-continent stock. Comparing the scenario originally proposed for mid-continent mallards excluding Alaska (Scenario 1: *goal* = 8.5 million, and closed-season constraint for *BPOP* ≥ 5.25 million) with the current mid-continent mallard AHM protocol (Baseline) suggests a slight increase in the expected frequency of closed seasons (Fig. 1). Lowering the closed-season constraint to *BPOP* ≥ 4.75 million (Scenario 3) was sufficient to produce a mean harvest rate, frequency of regulatory alternatives, and annual changes in

regulatory alternatives similar to the Baseline condition. Dropping the closed-season constraint further to 4.5 million produced a regulatory policy equivalent to one for maximizing long-term cumulative harvest (no harvest devaluation to maintain population closer to NAWMP goal).

The reader is reminded that these projections are based on current model weights, and annual changes in these weights will change the associated forecasts. Therefore, all of the forecasts in this report must be viewed with caution, and only large differences in performance metrics should be considered noteworthy.