
U.S. Fish and Wildlife Service
Adaptive
Harvest
Management
2003 Duck Hunting Season
Flyway Meetings
February - March, 2003

Outline

•**News items:**
- *AHM Task Force
- *2003 mallard predictions

•**Short-term issues:**
- *regulatory schedule for 2003
- *framework-date extensions
- *regulatory constraints
- *species' impacts

•**Near-term issues:**
- *midcontinent mallards
- *pintails
- *western mallards
- *black duck / eastern mallards
- *multi-stock AHM

•**Longer-term issues:**
- *hunter participation / satisfaction
- *review / criteria for regulatory alternatives

•New items: (1) status of AHM Task Force and (2) predictions for this year's mallard status & regulations

•Short-term: (1) AHM regulatory schedule and (2) "carry-over" issues from last year (regulatory constraints are those recommended by the Miss. Fly and include e.g., 1-step changes in regulations between years)

•Near-term: (1) the possibility of more revisions to the models for midcontinent mallards; (2) modeling efforts for pintails & western mallards; (3) the development of black duck AHM and its relationship to eastern mallard AHM; and (4) development of a conceptual framework for multi-stock harvest mgmt

•Longer-term: (1) desirability/feasibility of accounting explicitly for hunter participation/satisfaction in AHM; and (2) development of guidelines for the regulatory alternatives

News: *AHM Task Force*

- **Convened by Brent Manning, IAFWA, in December 2002**

- **Membership:**
  - ***Wayne MacCallum, Atlantic Flyway**
  - ***Roy Grimes, Mississippi Flyway**
  - ***John Cooper, Central Flyway**
  - ***Don Childress, Pacific Flyway**
  - ***Ken Babcock, Ducks Unlimited**
  - ***Rollie Sparrowe, Wildlife Management Institute**
  - ***Ken Williams, U.S. Geological Survey**
  - ***Ralph Morgenweck, U.S. Fish & Wildlife Service**
  - ***Dave Case, facilitator**

- **Mission: to foster understanding and support for continued strategic development and implementation of AHM**

- **Will make non-binding recommendations on AHM policy to IAFWA**

•The Task Force serves under the auspices of IAFWA, *not* the Fish & Wildlife Service

•Brent Manning appointed members based on their ability to contribute to the group's mission

•Task Force is interesting in strengthening support for AHM and helping facilitate discussion & agreement on its strategic direction

•Task Force will not duplicate existing administrative roles and functions, and will make its non-binding recommendations directly through IAFWA

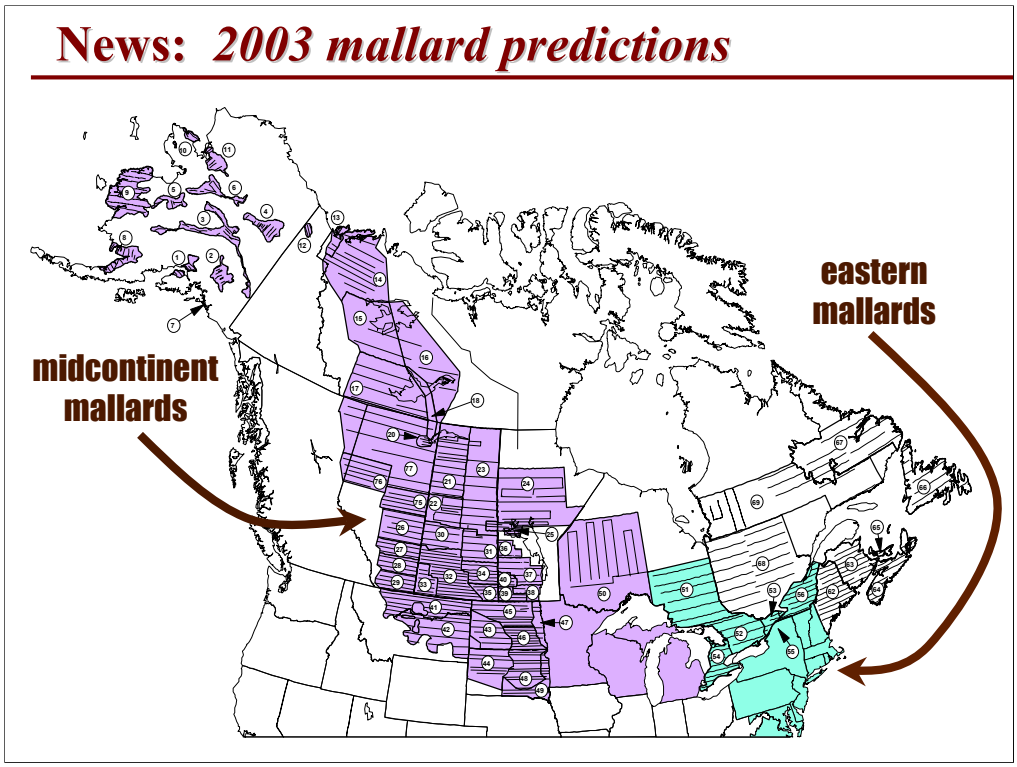
News: *AHM Task Force*

- **Tasks:**
  - ***harvest-management objectives (are harvest and population goals sufficient?)**
  - ***set of regulatory alternatives (how many? specifications? criteria for change?)**
  - ***management scale (how to account for variability in duck harvest potential?)**
  - ***communications (target audiences? key messages? products?)**

- **Organizational meeting - January 16, 2003 in Herndon, VA; next meetings planned for late February and at NAWNRC**

- **Key messages:**
  - ***affirmation of AHM success**
  - ***work is long-term in nature, requiring "several years"**
  - ***but, short-term issues can affect perceptions and support for AHM (framework extensions, regulatory constraints, other species impacts)**

- Task Force will focus on policy issues that involve value judgments and on communication that fosters understanding and facilitates discussion
- First meeting of the Task Force was in January; primarily organizational in nature
- Task Force is interested in affirming the success of AHM to date and taking the time necessary to make substantive improvements
- In the short-term, the Task Force is interested in facilitating discussions and fostering agreement on some issues that are affecting perceptions & support for AHM



•Mallard predictions that were provided at January SRC meeting; based on current mallard models and associated weights

News: *2003 mallard predictions*

Eastern	Bpop		
	N	SD(N)	Reg.
2002 (observed)	1.005	0.064	L
2003 (predicted)	0.933	0.136	L

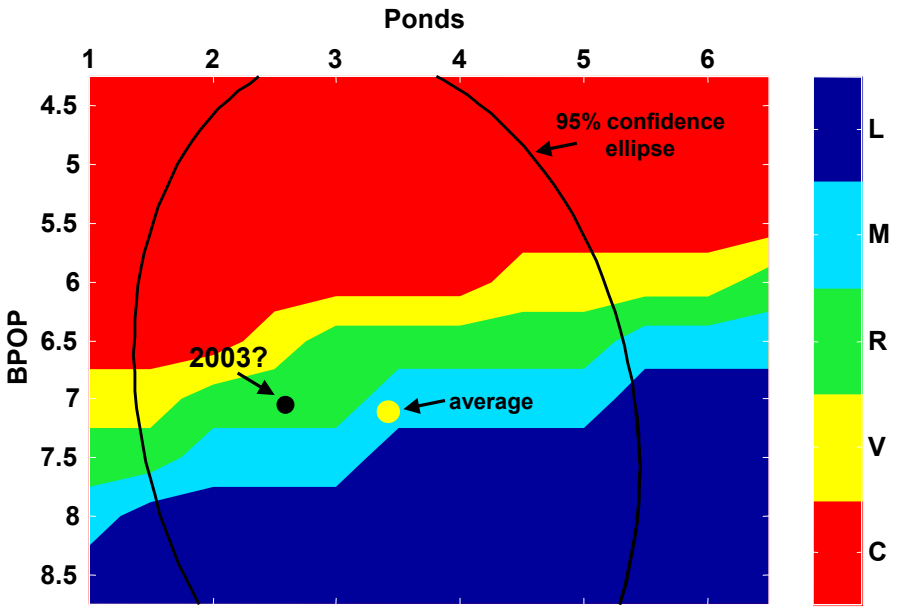
Midcontinent	Bpop		Ponds		
	N	SD(N)	N	SD(N)	Reg.
2002 (observed)	8.533	0.258	1.439	0.105	L
2003 (predicted)	7.101	1.197	2.620	1.121	R

•The eastern mallard population is expected to decline by 7%, but the population likely still will be high enough to support the liberal alternative in the Atlantic Flyway

•The midcontinent population (including the Lake states) is expected to decline by 17%; the model projects in increase in Canadian pond numbers, but this is based on normal precipitation

•Based on last year's decision table (which could change based on updated model weights this spring), the forecast is for the restrictive regulatory alternative

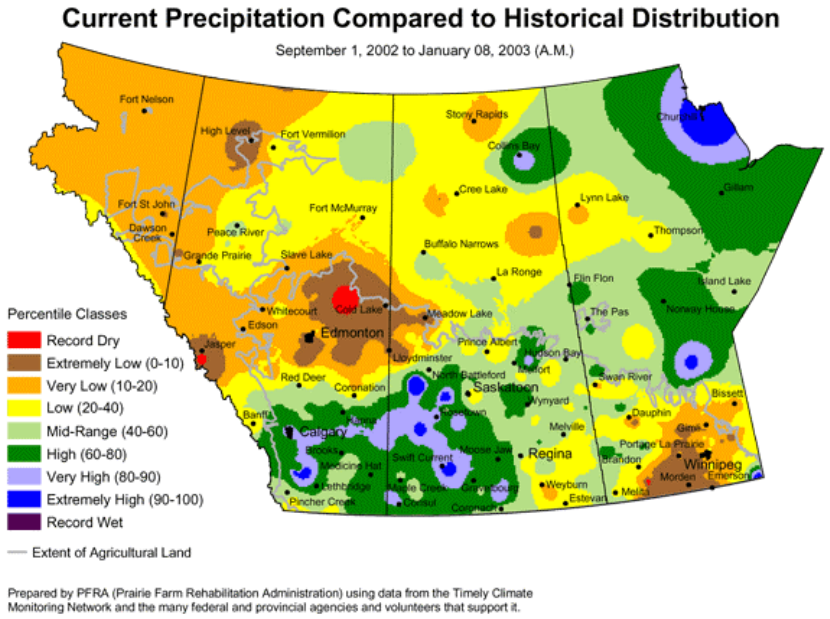
News: *2003 mallard predictions*



•The ellipse represents resource conditions expected in 95% of all years, and provides a sense of the relative frequency of the 5 regulatory levels

•Black dot is forecast this year based on model predictions (mallard models have a track record of 6% error on average)

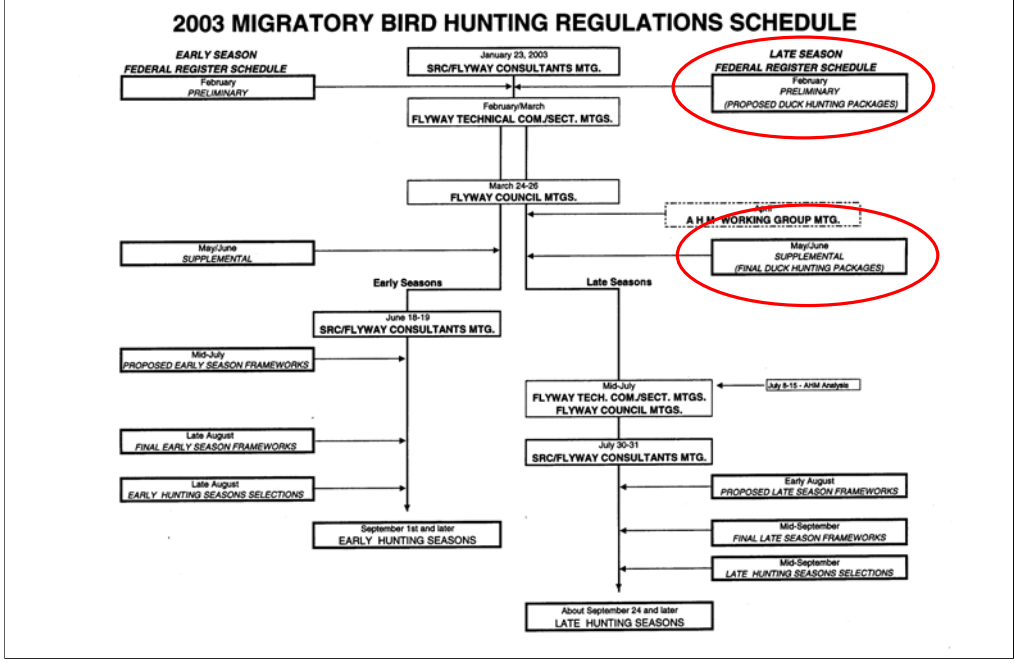
News: *2003 mallard predictions*



•However, the projection of pond numbers is highly uncertain, and precipitation in Prairie Canada since last summer has been a mixed bag

•Unfortunately, the 3-month forecast for Prairie Canada is warmer and drier than normal

Short-term issues: *regulatory schedule*



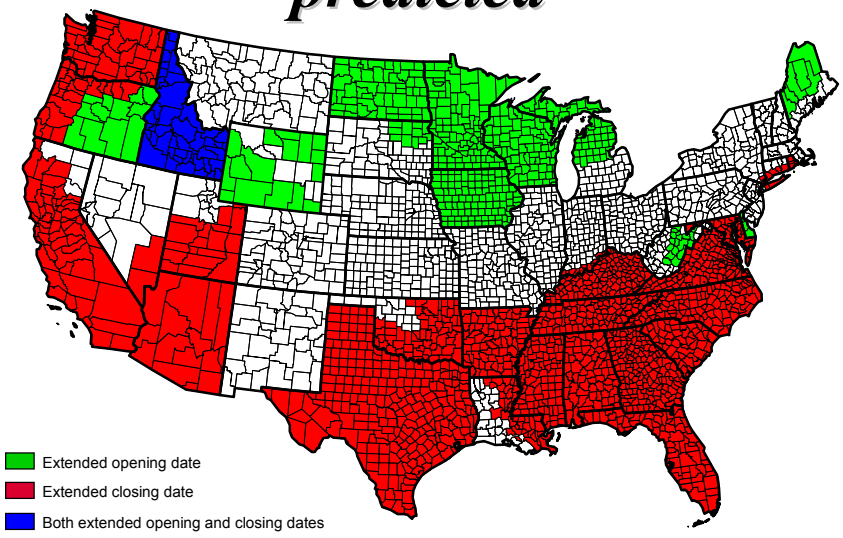
•Formally speaking, AHM is a late-season issue (proposal and adoption of a specific regulatory alternative occurs at the end of summer)

•However, the Service intends to use the same schedule it initially proposed last year to propose & finalize the *set* of regulatory alternatives (i.e., they will be proposed in the preliminary Federal Register (~March) and finalized in the supplemental (~May)

•In the preliminary Federal Register, the Service will propose no changes to the alternatives in effect last year

Short-term issues: *framework dates*

predicted



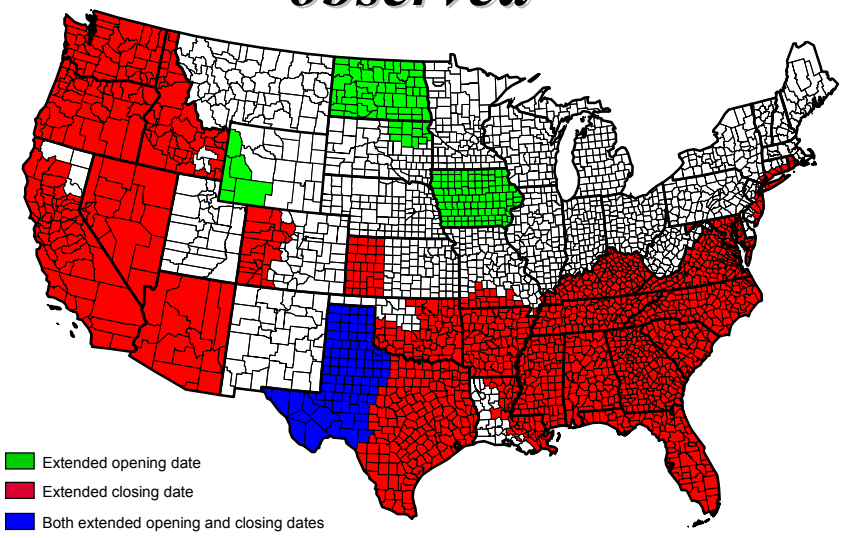
Harvest rate changes: midcontinent mallards +15%; eastern +5%

•Slide depicts predicted use of extended framework dates by duck-hunting zone, as indicated by a survey of Flyway Councils in 2000

•Based on these predictions, and on past experience with extended framework dates in Iowa and Mississippi, the Service projected an increase of 15% and 5% in harvest rates of midcontinent and eastern mallards, respectively

Short-term issues: *framework dates*

observed



Harvest rate changes: midcontinent mallards ? eastern ?

- Actual use of framework-date extensions during the 2002-03 hunting season were similar to predictions, except there was greater use of extended closing dates than expected and less use of extended opening dates
- Actual changes to harvest rate cannot be assessed until band-recovery information becomes available later this spring

Short-term issues: *framework dates*

Harvest rate = *f*(liberal regulations without extensions)

prior beliefs + data = updated (posterior) beliefs

1998:	0.108 (SE=0.013)
1999:	0.098 (SE=0.008)
2000:	0.129 (SE=0.011)
2001:	0.104 (SE=0.013)

$$h_t^L \sim Normal\left(\mu = 0.1305,\ \nu^2 = 0.0007\right)$$

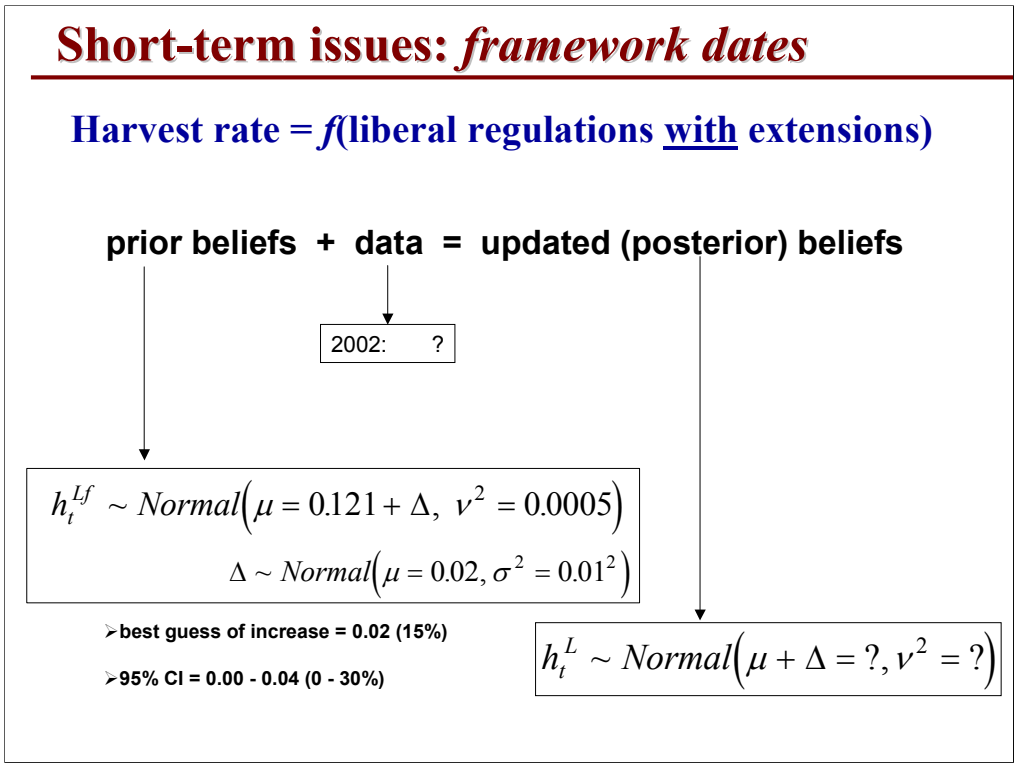
$$h_t^L \sim Normal\left(\mu = 0.121, \nu^2 = 0.0005\right)$$

•This is how we have been updating harvest rates for midcontinent mallards, based on a pilot study using reward bands

•When the current regulatory alternatives (without framework extensions) were adopted in 1997, the Service predicted that the harvest rate would average about 13% for adult males, and that annual variation (nu squared) attributable to variation in migration patterns and other uncontrolled environment factors would produce a CV of 20% ($0.0007^{1/2}/0.1305$)

•Thanks to some limited reward banding, the Service was able to estimate harvest rates of midcontinent mallards for each year during 1998-2001

•These estimates, when combined with the initial projections (thru a standard Bayesian analysis), leads to an updated mean of about 12% under the liberal alternative; the estimate of annual variation also has declined, and now represents a CV of 18%



•In the case of framework extensions, we are using a similar procedure to update harvest-rate projections

•For midcontinent mallards, it was assumed that the harvest rate would increase by delta = 0.02 (approximately 15%); however, this increase was considered highly uncertain, so we used a variance for the change that provided a 95% CI of 0-30%

•An updated estimate of delta (the marginal change in harvest rate attributed to the extension) awaits availability of band-recover data this spring

Short-term issues: *regulatory constraints*

Regulation	Flyway			
	Atlantic[a]	Mississippi	Central[b]	Pacific[c]
Shooting hours	one-half hour before sunrise to sunset			
Framework dates				
Very restrictive	Oct 1 - Jan 20	Saturday nearest Oct 1 - Sunday nearest Jan 20		
Restrictive and Moderate and Liberal	Saturday nearest Sep 24 - last Sunday in Jan			
Season length (days)				
Very restrictive	20	20	25	38
Restrictive	30	30	39	60
Moderate	45	45	60	86
Liberal	60	60	74	107
Bag limit (total / mallard / female mallard)				
Very restrictive	3 / 2 / 1	3 / 2 / 1	3 / 3 / 1	4 / 3 / 1
Restrictive	3 / 3 / 1	3 / 2 / 1	3 / 3 / 1	4 / 3 / 1
Moderate	6 / 4 / 2	6 / 4 / 1	6 / 5 / 1	7 / 5 / 2
Liberal	6 / 4 / 2	6 / 4 / 2	6 / 5 / 2	7 / 7 / 2

[a] The states of Maine, Massachusetts, Connecticut, Pennsylvania, New Jersey, Maryland, Delaware, West Virginia, Virginia, and North Carolina are permitted to exclude Sundays, which are closed to hunting, from their total allotment of season days.
[b] The High Plains Mallard Management Unit is allowed 8, 12, 23, and 23 extra days in the very restrictive, restrictive, moderate, and liberal alternatives, respectively.
[c] The Columbia Basin Mallard Management Unit is allowed seven extra days in the very restrictive, restrictive, and moderate alternatives.

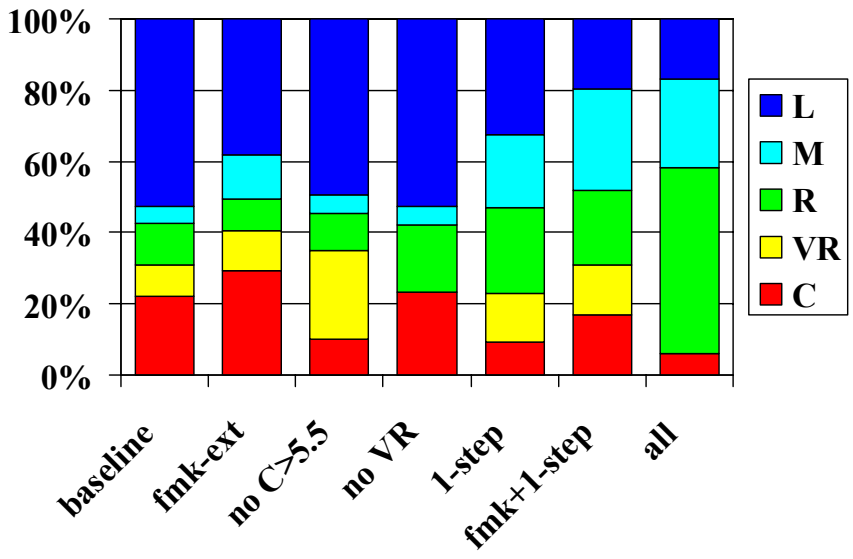
- **No closed season when bpop>5.5m**
- **No VR alternative**
- **Only one-step changes between years**

•For at least a couple of years, the Mississippi Flyway Council has recommended a number of constraints and changes to the set of regulatory alternatives:
(1) they see no need to close the hunting season as long as the midcontinent mallard population is above the level at which hunting seasons have been offered in the past (about 4.5 million for the traditional survey area, or about 5.5 million including the Lake states
(2) they would like to see the VR alternative eliminated because it does not appear to provide much protection against closed seasons, and
(3) they would like to constrain changes in regulations between years to one step

•These changes have not yet been adopted by the Service because there appears to be considerable variability in support for the options, and because the Service had hoped they could be examined in the context of a broader review of the alternatives

Short-term issues: *regulatory constraints*

Expected frequency of regulations under different scenarios…



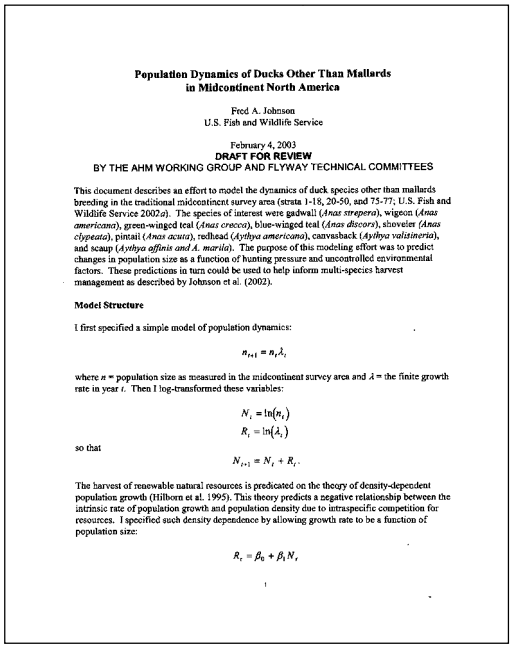
•These changes, as well as the extended framework dates, can have profound effects on the expected frequency with which each of the regulatory alternatives is used (baseline in this graph represents the current alternatives *without* framework-date extensions)

•The 1-step constraint is very effective at dampening variability in annual regulations, and greatly increases the frequency of the middle band of regulations (think of it as widening the middle band in the decision tables)

•Interestingly, there appears to be very little effect of these modifications on average population size or on the magnitude of the harvest; this means that some modifications to the alternatives can be used to address ancillary management objectives without risk detrimental effects to population or overall harvest levels

•A warning, however: these type of changes can affect the amount of annual variability in population size and harvest; generally, less variability in regulations means more variability in population size and harvest levels

Short-term issues: *species impacts*



Population Dynamics of Ducks Other Than Mallards in Midcontinent North America

Fred A. Johnson
U.S. Fish and Wildlife Service

February 4, 2003
DRAFT FOR REVIEW
BY THE AHM WORKING GROUP AND FLYWAY TECHNICAL COMMITTEES

This document describes an effort to model the dynamics of duck species other than mallards breeding in the traditional midcontinent survey area (strata 1-18, 20-50, and 75-77; U.S. Fish and Wildlife Service 2002*a*). The species of interest were gadwall (*Anas strepera*), wigeon (*Anas americana*), green-winged teal (*Anas crecca*), blue-winged teal (*Anas discors*), shoveler (*Anas clypeata*), pintail (*Anas acuta*), redhead (*Aythya americana*), canvasback (*Aythya valisineria*), and scaup (*Aythya affinis and A. marila*). The purpose of this modeling effort was to predict changes in population size as a function of hunting pressure and uncontrolled environmental factors. These predictions in turn could be used to help inform multi-species harvest management as described by Johnson et al. (2002).

Model Structure

I first specified a simple model of population dynamics:

$$n_{t+1} = n_t \lambda_t$$

where n = population size as measured in the midcontinent survey area and λ = the finite growth rate in year t. Then I log-transformed these variables:

$$N_t = \ln(n_t)$$
$$R_t = \ln(\lambda_t)$$

so that

$$N_{t+1} = N_t + R_t.$$

The harvest of renewable natural resources is predicated on the theory of density-dependent population growth (Hilborn et al. 1995). This theory predicts a negative relationship between the intrinsic rate of population growth and population density due to intraspecific competition for resources. I specified such density dependence by allowing growth rate to be a function of population size:

$$R_t = \beta_0 + \beta_1 N_t$$

- **dynamics of gadwall, wigeon, green-winged teal, blue-winged teal, shoveler, pintail, redhead, canvasback, and scaup**
- **May ponds and hunting pressure as covariates**
- **to examine effects of current AHM protocol for mallards**

- Last year, there was considerable concern in some quarters about the effect of a liberal season on species other than mallards
- To help address that concern, the Service has released a draft report that provides an assessment of the dynamics of 9 duck species other than mallards in the midcontinent region
- May ponds and 2 indices to hunting pressure were useful for predicting one-year changes in population size
- One of the models was used to simulate population sizes of the nine species in the presence of the current AHM protocol for midcontinent mallards

Short-term issues: *species impacts*

finite population growth: $n_{t+1} = n_t \lambda_t$

log-transformation:

$$N_t = \ln(n_t)$$
$$R_t = \ln(\lambda_t)$$
$$N_{t+1} = N_t + R_t$$

"density-dependent" growth:

$$R_t = \beta_0 + \beta_1 N_t$$
$$N_{t+1} = \beta_0 + (1 + \beta_1) N_t$$

adding covariates: $N_{t+1} = \beta_0 + (1 + \beta_1) N_t + \sum_k \beta_k X_{k,t}$

standardizing population size: $N'_{t,s} = \ln\left(\frac{n_{t,s}}{g_s}\right)$

final model structure: $N'_{t+1,s} = \beta_0 + (1 + \beta_1) N'_{t,s} + \sum_k \beta_k X_{k,t} + \beta_s$

•This slide provides the derivation of the population model used in the assessment

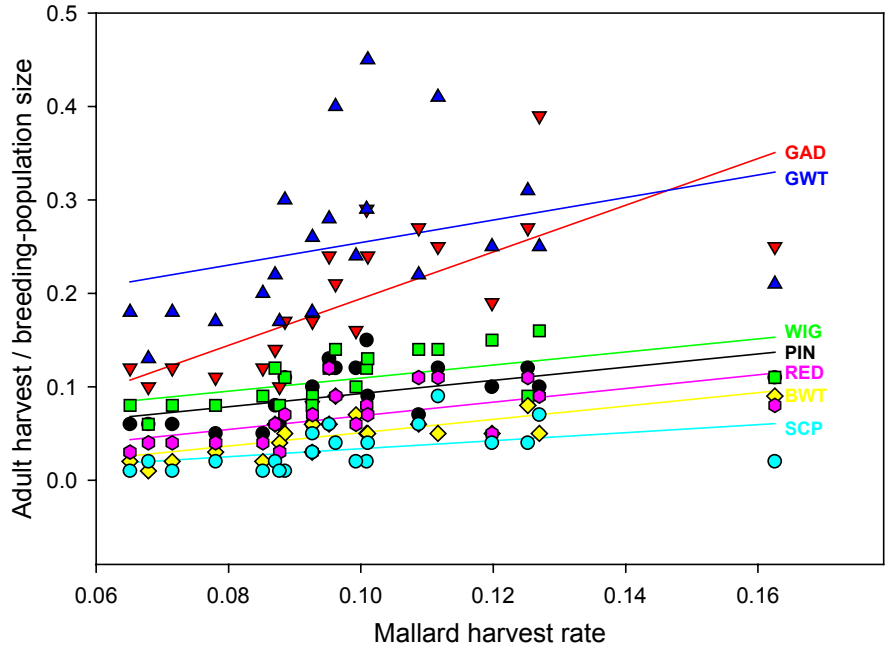
•It begins with a simple model of population growth based on population size (n) and a finite growth rate (lambda)

•After transforming these variable, a structure for density-dependent growth is added to keep population sizes within reasonable bounds

•Then covariates (like ponds) are added to allow variation in annual growth rates

•Finally, the population sizes of each species were standardized based on each species' NAWMP goal (g), so that n/g = 1 represents a species at goal

Short-term issues: *species impacts*



•Three indices to hunting pressure were examined as potential covariates (season length in the Mississippi Flyway, the number of successful duck hunters in the U.S., and mallard harvest rate);

•The logic behind the use of mallard harvest rates was this: (1) harvest rates are unavailable for most species; and (2) harvest rate of mallards is positively correlated with both species' recovery rate (Johnson and Moore 1996) and adult harvest / bpop (shown above)

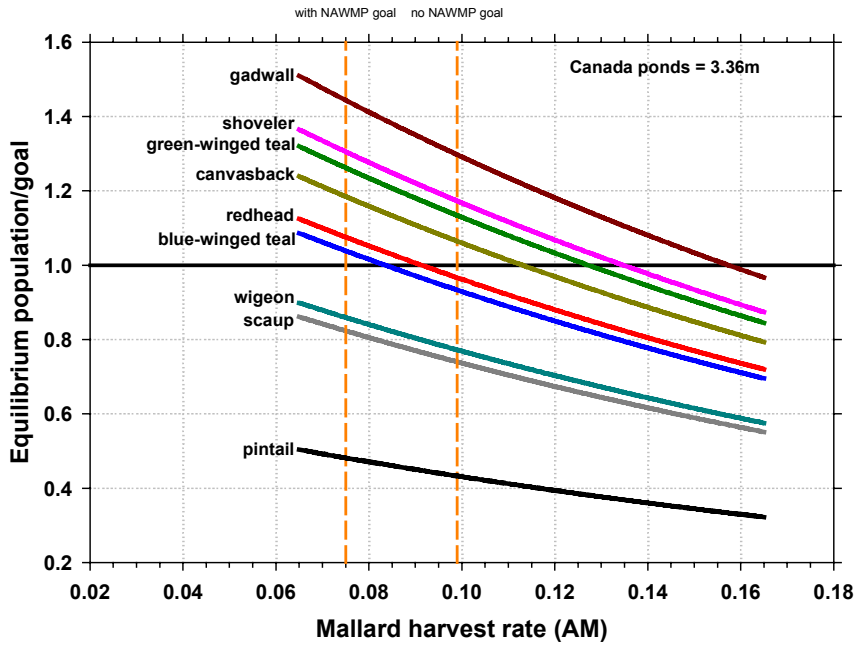
Short-term issues: *species impacts*

Coefficient	Estimate	SE	*P*	Diagnostics
intercept	-0.07150	0.07520	0.34	Normal errors: Shapiro-Wilk = 0.99 *P* = 0.43
density (1 + β_1)	0.75167	0.04995	< 0.01	
mallard harvest rate	-1.10696	0.55642	0.05	
Canadian ponds/10^6	0.03164	0.01302	0.02	
GAD	0.13939	0.05296	0.01	Independent errors: Durbin-Watson = 2.00 1^{st} order autocorrelation = -0.012
WIG	0.01057	0.04804	0.83	
GWT	0.10599	0.04972	0.03	
BWT	0.05762	0.04859	0.24	
SHO	0.11435	0.05095	0.03	Common variance: X^2 = 42.14 df = 41 *P* = 0.42
PIN	-0.13314	0.05307	0.01	
RED	0.06629	0.04939	0.18	
CAN	0.09031	0.04956	0.07	
SCP	0.0000	N/A	N/A	

•Shown here are parameter estimates for one of the population models, in which mallard harvest rate and Canadian ponds are used to predict changes in population size of the 9 species

•Although population sizes were highly species-specific, there was little evidence that the effects of population density, ponds, or hunting pressure were species-specific

Short-term issues: *species impacts*



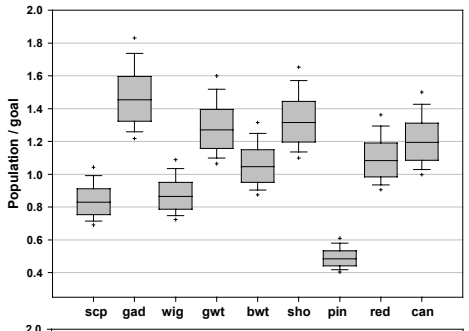
•Using that model, equilibrium population sizes were calculated for each species assuming a fixed number of Canadian ponds (3.4 million is the long-term average) and a range of mallard harvest rates.

•Equilibrium population size is the population size that eventually would be attained under constant values of the predictors; values < 1 reflect populations above goal; values >1 reflect pops. above goal

•The two dashed, vertical lines represent the average harvest rate of midcontinent mallards expected under the current AHM protocol that includes the NAWMP goal for mallards, and an AHM protocol that does not include that goal

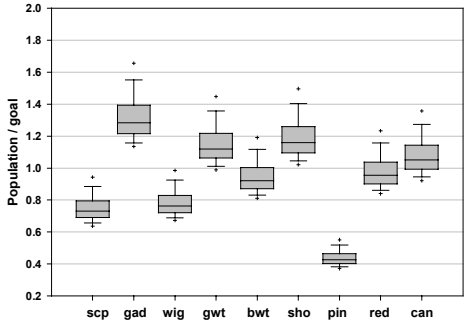
•Results suggest that more species would remain below goal under a AHM protocol that lacked the NAWMP goal for mallards

Short-term issues: *species impacts*



AHM protocol <u>with</u> NAWMP goal for midcontinent mallards

median pops below goal:
scaup, wigeon, pintail



AHM protocol <u>without</u> NAWMP goal for midcontinent mallards

median pops below goal:
scaup, wigeon, blue-winged teal, pintail, redhead

•These box plot depict simulated population sizes when the assumptions of constant pond numbers and hunting pressure are relaxed (the box represents the 25% and 75% percentiles, the horizontal line in the box is the median, the whiskers represent the 10% and 90% percentiles, and the cross-hairs represent the 5% and 95% percentiles)

•Under the current AHM protocol, only scaup, wigeon, and pintail had median populations below goal

•If the NAWMP goal for mallard were removed from the AHM protocol, blue-winged teal and redhead also would be expected to have median population sizes below goal

•Notice that population sizes are less variable in the latter case because there is less variability in regulations when there is no NAWMP goal for mallards in the AHM protocol

Short-term issues: *species impacts*

Conclusions:

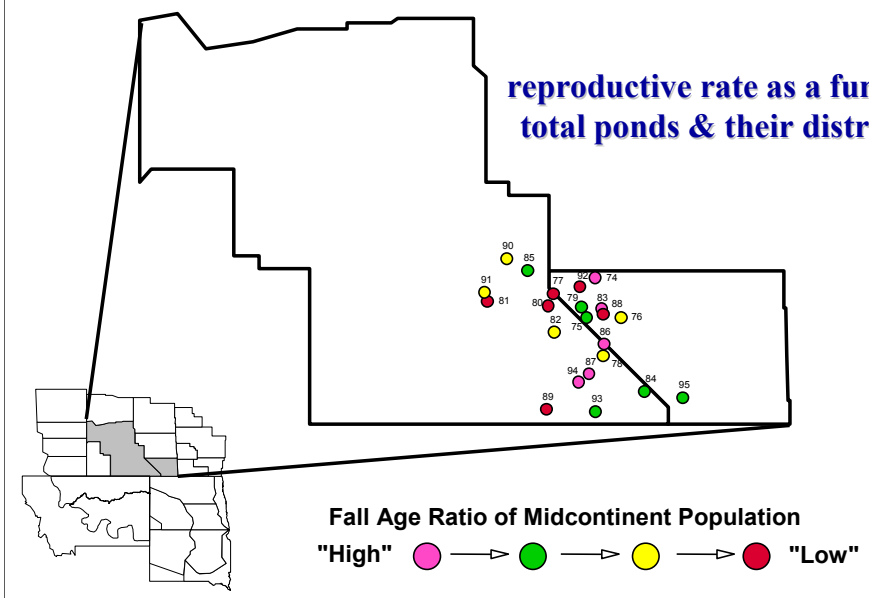
- **Model describes 82% of variability in population sizes since 1979 (but only 45-77% on a species-by-species basis)**
- **Current AHM protocol, with explicit recognition of mallard NAWMP goal, should not prevent most duck species from attaining their goals**
- **Exceptions are scaup, wigeon, and pintail; pintails would benefit only marginally from a closed season**
- **Model has several limitations and should be used with caution**
- **Model insufficient for determining species-specific harvest strategies if harvest returns are part of objective; but may be useful for determining species-specific impacts of a common hunting season**

•Model is reasonably good, explaining about 82% of all the variability in population size, although it performs more poorly on a species-by-species basis

•Model suggests that current AHM protocol is primarily a concern for scaup, wigeon, and pintails; model also suggests that a closed season on pintails would not markedly improve status

•Model has several limitations and is not useful for determining species-specific harvest strategies where harvest returns are part of the objective (in addition to the NAWMP goals)

Near-term issues: *midcontinent mallards*



•As part of last year's revisions to the models for midcontinent mallards, we had hoped to make improvements in our ability to predict reproductive rates;

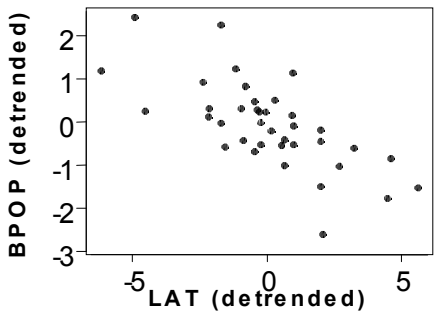
•There are indications that the inclusion of ponds, as well as the average latitude & longitude of the ponds, can help explain more of the variation in reproductive rates

•In particular, it appears fall age ratios tend to be higher when the center of the pond distribution (and therefore the distribution of mallards) is farther east

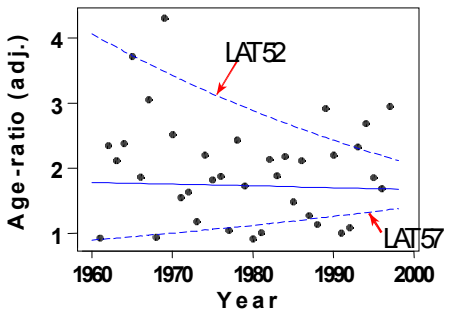
•Also, preliminary work suggests that a U.S. pond may have a different value for reproduction than a Canadian pond; this is perhaps not surprising given the difference in upland habitats between Canada and the north-central U.S.

•This work is ongoing, and we do not yet know whether these modifications can be made this year

Near-term issues: *pintails*



bias in May survey



declining productivity in the prairies

•There has been an effort for several years to model the dynamics of pintails and to develop an AHM protocol for them

•With the help of Mike Runge (Patuxent Wildlife Research Center), we have discovered two problem areas:
(1) first is the propensity for bpop size as measured by the May survey to be low when the distribution of pintails is centered at higher latitudes - this could result from movement of pintails out of the survey area during years in which they over-fly the prairies, or it could result from unrecognized variability in visibility rates in northern strata; whatever the cause, it is extremely problematic because unbiased estimates of population size are needed to correct the apparent bias in survival or reproductive rates that seem to be common to all species
(2) in all AHM models to date, we have been able to assume that the average carrying capacity is constant over time; with pintails, it appears that the productivity of more southernly habitats (i.e., the prairies) has declined significantly since the 1960s - this is problematic because we are unsure what to assume about the future - will productivity continue to decline or have conservation programs like CRP and the NAWMP arrested or reversed the decline?

•We suspect that these technical problems can be overcome; the greater concern lies with questions concerning how we wish to regulate pintail harvest as part of a comprehensive duck harvest program (e.g., should we have separate seasons for pintails, or should their season length correspond with that for mallards, with regulation done via changes in bag limits?)

Near-term issues: *western mallards*

Adaptive Harvest Management of Western Mallards
Prospectus for Research

Mark Herzog
Department of Environmental and Resource Sciences
University of Nevada
Reno, Nevada

Since the inception of adaptive harvest management (AHM), managers have acknowledged that there are three major breeding components of North American mallards (eastern, mid-continent, and western). It is likely that these populations have different harvest potentials and set-population-specific harvest-management strategies may be desirable. Recently, the AHM Working Group reviewed the status of modeling efforts for western mallards and described the assessments needed to implement AHM for this population. In general, there are three categories of issues that need to be addressed: (1) population delineation, (2) population and harvest modeling, (3) optimization of hunting regulations. This prospectus addresses these needs with the ultimate goal of producing a model set that can be implemented into the AHM framework.

Population Delineation

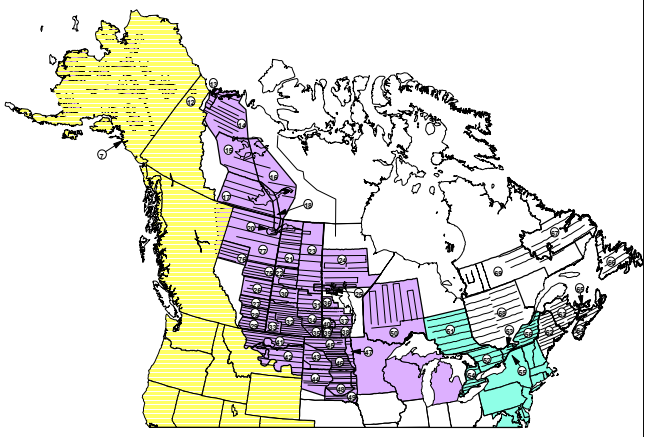
Western mallards have been defined as those breeding within the Pacific Flyway states (including Alaska), British Columbia, and the Yukon Territory. It has also been shown that some mallards breeding in Alberta are also harvested in Pacific Flyway states. Within this range, there could be considerable spatial variability in mallard demographics. This poses a problem to any model(s) designed to predict changes in abundance of the entire western mallard population. An important objective of this proposed research is to examine the degree of spatial variability in western-mallard population dynamics, and to determine how data should be aggregated to predict changes in total population size.

The data used to estimate demographic parameters must be assembled from a collection of different surveys (e.g., abundance surveys, pressures banding)—none of which encompass the entire breeding range, or are consistent across years. A primary objective of this research therefore is to review the nature, quality, and spatio-temporal domains of extant monitoring instruments to determine the extent to which spatial and temporal variability in western-mallard demographics can be reliably assessed.

Population and Harvest Modeling

Population Models

In predicting survival and recruitment rates it will be important to identify key sources of uncertainty. Initial investigations will center on the role of density dependence and a determination of appropriate predictor variables, although the final model set may or may not be similar to that for midcontinent or eastern mallards. Specification of both parametric uncertainty (given a model) and alternative functional forms will be important. Finally, because the final



How to measure abundance? How to estimate S & R?

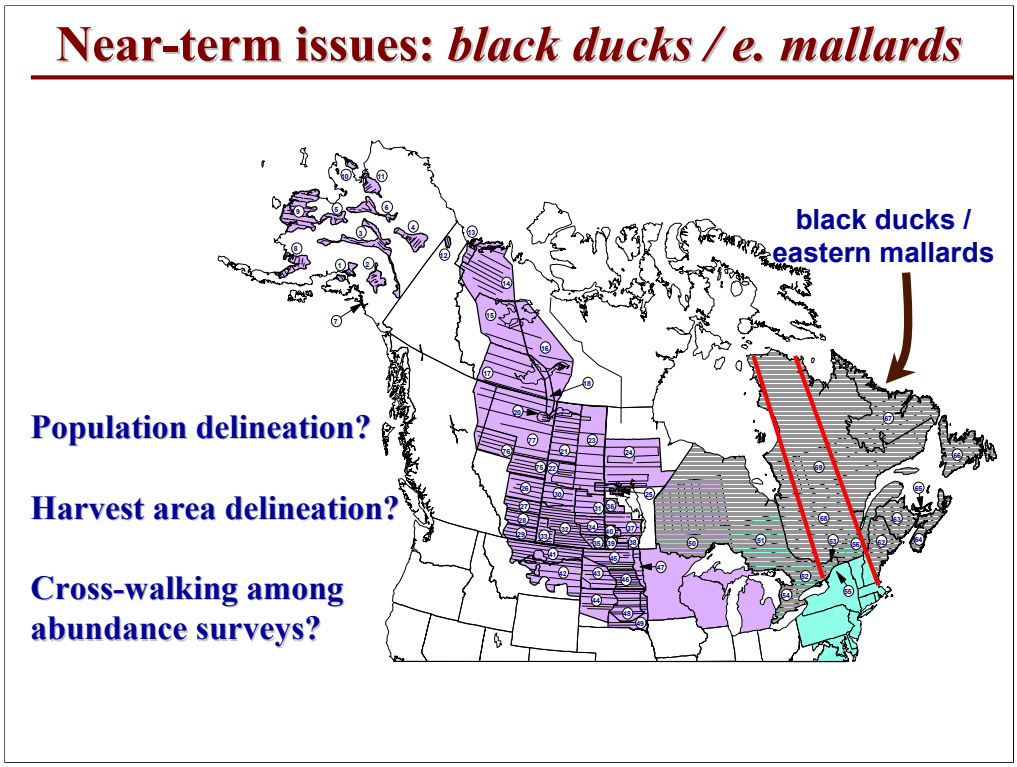
•As in the East, the Pacific Flyway is keenly interested in a harvest management strategy that is "tuned" to its particular derivation of mallards

•Almost half the mallard harvest in the Pacific Flyway is derived from the area shown in yellow (i.e., the breeding range of "western" mallards)

•Original efforts to model the dynamics of this population were hampered by monitoring programs that were fragmented in time and space, and by the difficult of estimating fall age ratio from a mixed sample of midcontinent and western mallard wings

•A new effort to develop useful models is being led by Mark Herzog and the Pacific Flyway, and they currently are assembling various population surveys and develop means to derive unbiased estimates of survival and recruitment rates

•If things go as planned, a model set could be ready for implementation as early as 2004



•Since 2002, there has been a Black Duck AHM Working Group who has been investigating the application of AHM to black ducks

•The group is technical in nature, and serves under the auspices of the International Harvest Strategy Committee, which is comprised of U.S. and Canadian federal managers

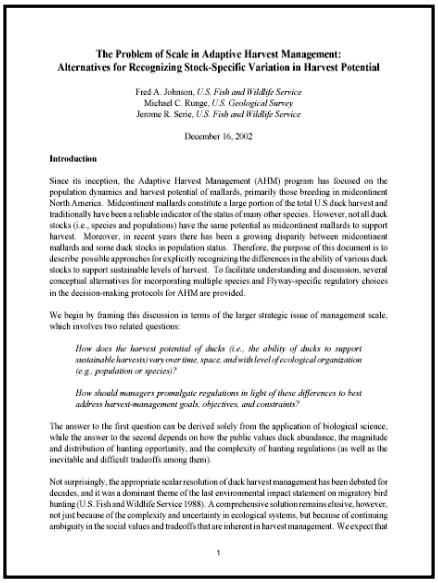
•The Working Group has defined the range of black ducks and eastern mallards as shown here in gray; eastern mallards are an integral part of the effort because of evidence that black duck productivity is reduced in the presence of mallards

•The group also has defined 3 subpopulations (red lines) and 6 harvest areas (not shown, but are the 3 Canadian breeding areas, the Mississippi Flyway, the northern Atlantic Flyway, and the southern Atlantic Flyway)

•The U.S. AHM Working Group is concerned that the population delineation of eastern mallards does not coincide with that used by the U.S. and also overlaps the definition of midcontinent mallards; we also are concerned that the black duck effort is based on CWS helicopter plot surveys and there appears to be little correlation between those surveys and midwinter surveys, the eastern survey strata, or the northeastern plot survey

•The technical work on black duck AHM is being conducted by Mike Conroy (GA Coop Unit), and it is not yet clear when or even whether any of this work might support black duck harvest management decisions

Near-term issues: *multi-stock AHM*



The Problem of Scale in Adaptive Harvest Management: Alternatives for Recognizing Stock-Specific Variation in Harvest Potential

Fred A. Johnson, *U.S. Fish and Wildlife Service*
Michael C. Runge, *U.S. Geological Survey*
Jerome R. Serie, *U.S. Fish and Wildlife Service*

December 16, 2002

Introduction

Since its inception, the Adaptive Harvest Management (AHM) program has focused on the population dynamics and harvest potential of mallards, primarily those breeding in midcontinent North America. Midcontinent mallards constitute a large portion of the total U.S duck harvest and traditionally have been a reliable indicator of the status of many other species. However, not all duck stocks (i.e., species and populations) have the same potential as midcontinent mallards to support harvest. Moreover, in recent years there has been a growing disparity between midcontinent mallards and some duck stocks in population status. Therefore, the purpose of this document is to describe possible approaches for explicitly recognizing the differences in the ability of various duck stocks to support sustainable levels of harvest. To facilitate understanding and discussion, several conceptual alternatives for incorporating multiple species and Flyway-specific regulatory choices in the decision-making protocols for AHM are provided.

We begin by framing this discussion in terms of the larger strategic issue of management scale, which involves two related questions:

How does the harvest potential of ducks (i.e., the ability of ducks to support sustainable harvests) vary over time, space, and with level of ecological organization (e.g., population or species)?

How should managers promulgate regulations in light of these differences to best address harvest-management goals, objectives, and constraints?

The answer to the first question can be derived solely from the application of biological science, while the answer to the second depends on how the public values duck abundance, the magnitude and distribution of hunting opportunity, and the complexity of hunting regulations (as well as the inevitable and difficult tradeoffs among them).

Not surprisingly, the appropriate scalar resolution of duck harvest management has been debated for decades, and it was a dominant theme of the last environmental impact statement on migratory bird hunting (U.S. Fish and Wildlife Service 1988). A comprehensive solution remains elusive, however, not just because of the complexity and uncertainty in ecological systems, but because of continuing ambiguity in the social values and tradeoffs that are inherent in harvest management. We expect that

1

how does the harvest potential of ducks vary over time, space, and with level of ecological organization?

how should managers promulgate regulations in light of these differences to best address harvest-management goals, objectives, and constraints?

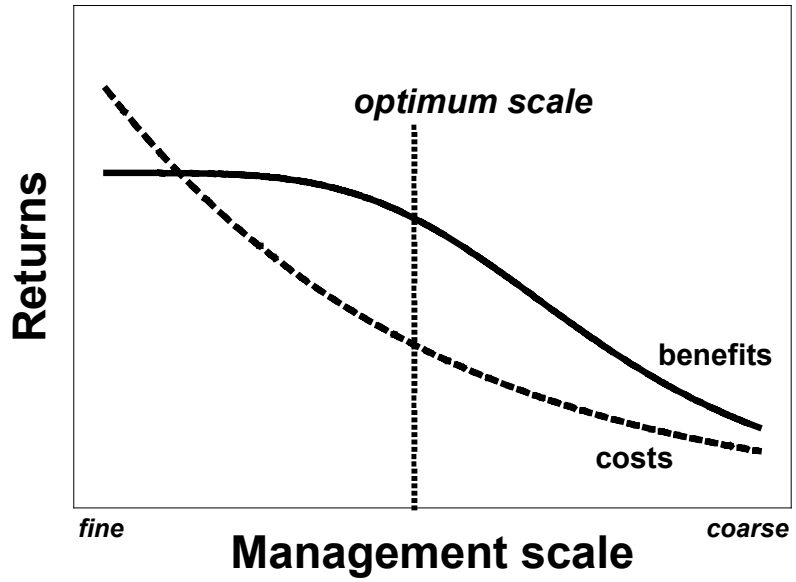
•As modeling efforts continue for an increasing number of species, it is becoming critical to understand how these efforts fit within a larger context. The problem of species-specific harvesting is but part of the larger problem of management scale, which involves 2 related questions (above).

• The answer to the first question can be derived solely from the application of biological science, while the answer to the second depends on how the public values duck abundance, the magnitude and distribution of hunting opportunity, and the complexity of hunting regulations (as well as the inevitable and difficult tradeoffs among them).

•The AHM Working Group has produced this document, which is intended to begin the dialogue about some of the most important scale issues. The conceptual alternatives described in this document are intended only to illustrate what we believe to be the range of possible approaches and, as such, are intended to identify and contrast key features. It is entirely possible that none of the alternatives as described is acceptable. If so, our hope is that discussion of the alternatives will lead to other, more viable ones.

•The AHM Working Group is interested in receiving feedback from the Flyways on this document prior to its annual meeting in April.

Near-term issues: *multi-stock AHM*

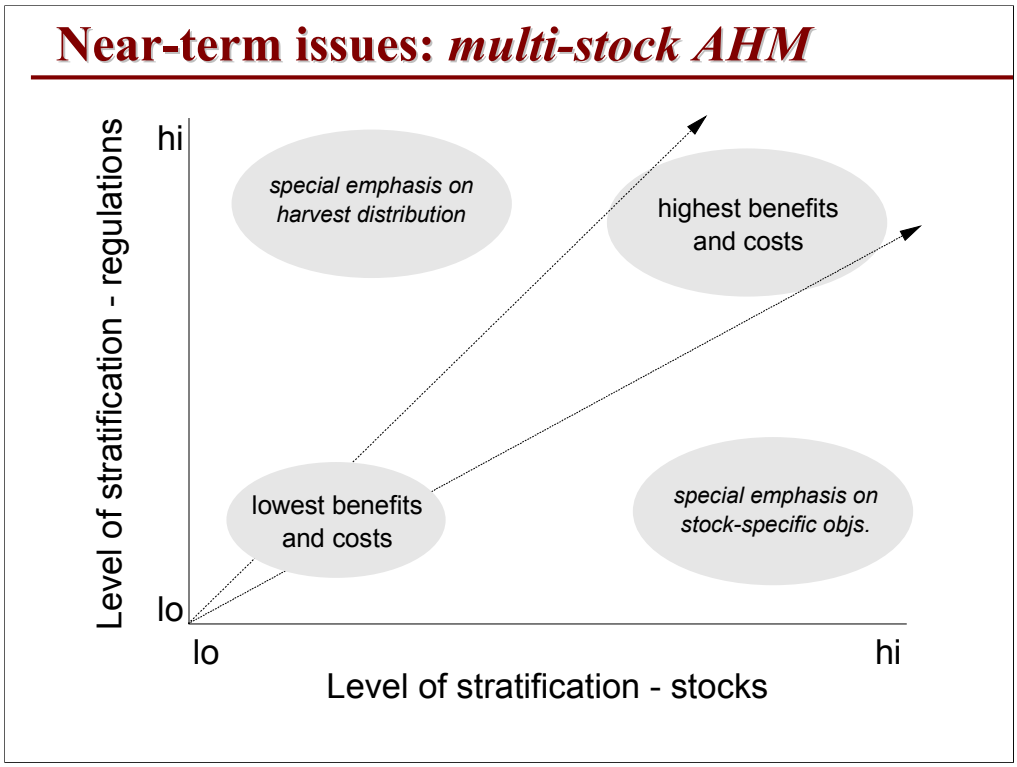


•First, a little theory.

•Throughout the history of duck-harvest management, there has been a persistent effort to account for increasingly more sources of variation in harvest potential. This tendency was justified, at least to some degree, by a gradual accumulation of information that allowed managers to identify sources of variation at progressively finer scales.

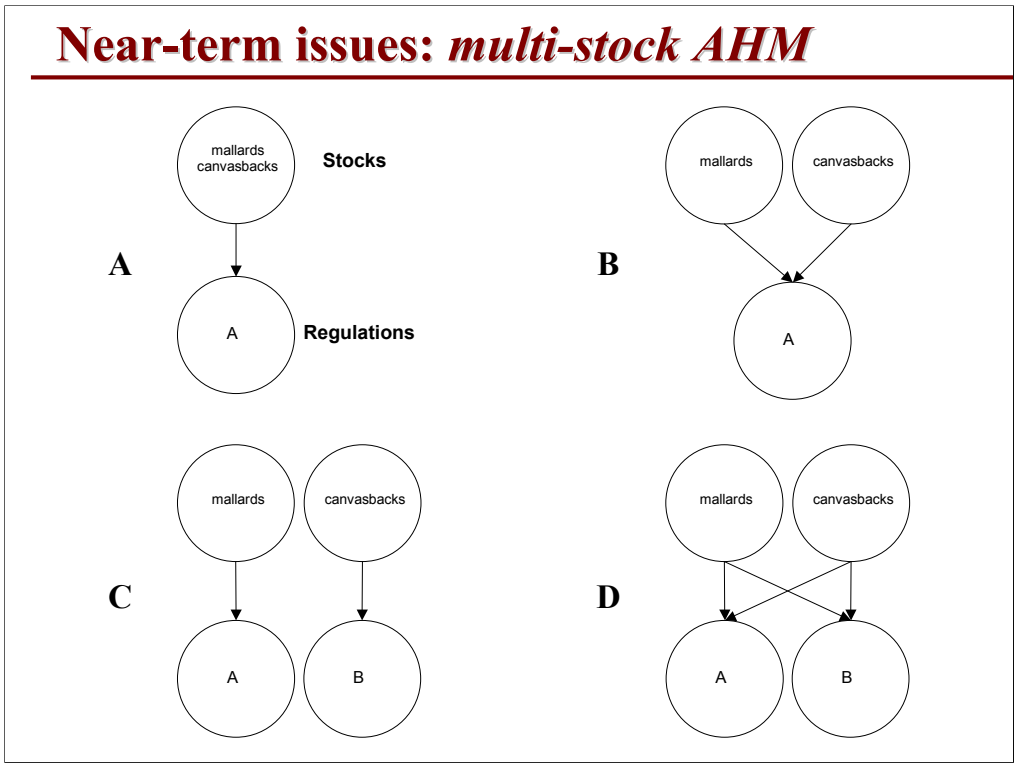
•However, there is reason to question the efficacy of continuing this trend indefinitely. As the spatial, temporal, and organizational scales at which harvest management is delivered become progressively finer, the marginal gain in management benefit is likely to shrink (i.e., a point of diminishing return). At the same time, it is likely that management costs would continue to increase. Therefore, beyond some point, net management benefits are expected to decline.

• The challenge now confronting duck-harvest managers is to decide what level of management resolution is appropriate given modern data-collection programs, acceptable regulatory mechanisms, the desires of hunters, legal mandates for species conservation, and the magnitude of spatial, temporal, and organizational variability in duck harvest potential.



•In defining the scales of duck-harvest management, it may be helpful to think about levels of "stratification" in both stocks and in hunting regulations. As in statistical inference, the purpose of stratification is to increase efficiency by dividing heterogeneous units into smaller, more homogeneous ones. In a harvest-management context, a high level of stratification involves the delineation of many, relatively homogeneous duck populations. It also refers to regulations that vary on fine spatial, temporal, and organizational scales and, thus, to those designed to exploit differences in harvest potential among stocks. As mentioned previously, a high level of stratification (or alternatively, a fine resolution or scale of management) is expected to produce the highest harvest benefits, but also is accompanied by the highest costs. Conversely, a low level of stratification in populations and regulations leads to the lowest benefits and costs.

•In deciding an appropriate level of stratification, it is important to recognize the relationship between the level of stratification of stocks and that of hunting regulations. Regulations that are highly stratified on spatial, temporal, or organizational scales are not particularly advantageous if the number of identified stocks is small. An important exception to this rule, however, involves the case where the harvest-distribution goals cannot be met passively, and so require regulations that are highly stratified. In this case, however, coarsely stratified stocks will increase the chance of negative biological impacts on the less productive segments of those stocks. These adverse impacts can be prevented by the delineation of more stocks, but there could be difficulties in addressing harvest-distribution goals if this is accompanied by a low level of stratification in regulations. The challenge to managers, then, is to determine the intermediate level of stratification in stocks and regulations that represents an acceptable balance among competing considerations.



•An example may be helpful in demonstrating these concepts. Suppose that we have two species, like mallards and canvasbacks, that vary in their potential to support harvest. A course-grain approach to management would treat the two species as a single, aggregate stock subject to a common hunting season (Fig. A).

•However, if harvest potential varies greatly between the two species, then an objective to maximize long-term cumulative duck harvest may sacrifice viability of the less productive species for harvest of the more productive one. An alternative would be to divide (stratify) the single stock into two, represented by the two species (Fig. B).

•Now the dynamics of the two species could be tracked separately and the harvest-management objective could be modified to help ensure persistence of the less productive species. However, the two species would still be subject to a common set of regulations.

•If hunters can distinguish between the two species on the wing, or if the two species winter in different regions, regulations could be stratified so as to allow regulations that are species- or area-specific (Fig. C), and two independent optimizations of harvest strategies would be possible. This approach is currently in use with midcontinent and eastern mallards.

•Unfortunately, identification of birds on the wing is difficult in many cases and wintering areas are rarely disjunct (Fig. D). Accounting for these problems requires a joint consideration of the species- or area-specific decisions because they are not independent in their effects. Moreover, there is no unique regulatory strategy that will maximize harvests of the two stocks, because the maximum allowable harvest could be allocated (distributed) in many different ways. Thus, this situation requires a consideration of the most desirable harvest distribution, which then must be

Near-term issues: *multi-stock AHM*

Development of Alternatives:

- **Spatial scale:**
  - ***regulatory decisions should be allowed to vary among Flyways**
  - ***for the moment, finer-grained stratification in regulations not considered**

- **Temporal scale:**
  - ***only annual decision making considered**
  - ***but recognize that "stabilized regulations" may be of interest**
  - ***and recognize that amount of annual variability in regulations of interest**

- **Organizational scale:**
  - ***identification of stocks limited to species and populations of conspecifics**
  - ***concerned about hunters ability to shoot selectively**

•The authors developed the alternatives based on these premises.

•Spatial scale - would like to fully attain the goal of Flyway-specific harvest strategies before exploring finer-scale stratification (e.g., splitting the Atlantic Flyway north-south)

•Temporal scale - no intra-year decision making (e.g., Special Sept. Teal Season & regular season in same decision-making framework); are prepared to deal with stab regs (regs in place for a fixed number of years) or dampening variability in annual regs (e.g., by constraining changes in regulations to one step)

•Organizational scale - just species and populations as smallest organizational unit (e.g., no sex-specific regulations beyond that traditionally used); also authors are concerned about hunters ability to shoot selectively where different species or populations are exposed to a common harvest

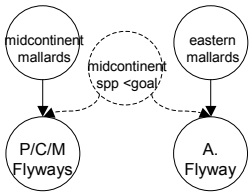
Near-term issues: *multi-stock AHM*

Alternative A:

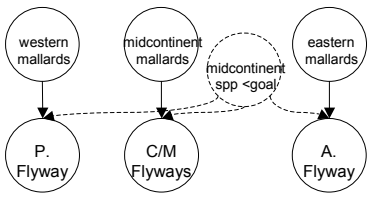
-*focus*: mallards (eastern, midcontinent, and western)

-*goal*: maximize mallard harvest, while avoiding seasons that push other midcontinent species below NAWMP goals

-*independent seasons*: as-needed basis



A



B

•This alternative involves continuing the current AHM protocols based on mallards, but devaluing mallard harvests associated with regulatory decisions that are expected to result in population levels of other species below their goals in the North American Waterfowl Management Plan (NAWMP). This is similar in concept to the current approach for midcontinent mallards, in which regulation-specific mallard harvests are devalued if the decision is expected to produce a subsequent population size below the NAWMP goal for midcontinent mallards. The devaluation of harvest works in such a way as to decrease the likelihood that regulatory choices that contribute to the maintenance or reduction of the population level below its goal will be considered optimal.

•This approach would be phased in gradually to accomplish the goal of Flyway-based management. In the first phase, the constraint based on the status of other species would be introduced into the two existing optimization processes for midcontinent and eastern mallards (Fig. A). At least initially, the constraint would be based on the status of the nine other principal species breeding in the midcontinent region (gadwall, American wigeon, green-winged teal, blue-winged teal, northern shoveler, northern pintail, redhead, canvasback, and scaup). The constraint would be applied to all Flyways because all Flyways share the harvest of these nine midcontinent species.

•In the next phase, a western stock of mallards would be introduced and used to determine the optimal regulatory choice for the Pacific Flyway (Fig. B). All Flyways would still be subject to the constraint based on the nine midcontinent species.

•An important feature of Alternative A is the ability to have independent seasons or bag limits (including season closures) for species of special concern. For example,

Near-term issues: *multi-stock AHM*

Alternative B:

-*focus*: species' guilds (low vs. high harvest potential)

-*goal*: maximize duck harvest for each guild

-*independent seasons*: 2 and only 2

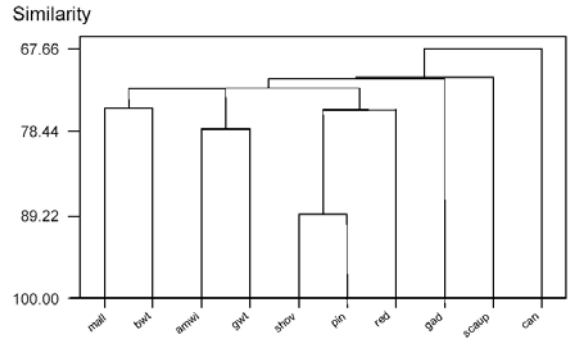


Fig. 3. Cluster dendrogram of the ten principal species in the midcontinent region based on inter-species correlations in annual growth rates.

•Alternative B is based on the idea of a species guild, which we use here to mean a group of duck species with similar harvest potentials. The key feature of this alternative is that each guild would be the subject of an independent optimization process, whereby the choice of regulatory alternative could vary by guild. For the sake of discussion, we propose only two guilds - one comprised of species with relatively high harvest potentials and the other comprised of species with relatively low harvest potentials. The goal is to take advantage of the hunting opportunity afforded by relatively productive species, while protecting those species where harvest may be more of an issue in species management. For the purposes of this exercise, we focused solely on the ten principal species in the midcontinent region, although we recognize that some other key species (e.g., wood ducks, black ducks) ultimately would have to be accommodated.

•It is difficult to assess the harvest potential of a species directly, so we considered a number of surrogate measures for grouping species into guilds. Initially, we calculated inter-species correlations in annual growth rates and used these as measures of similarity in a cluster analysis (above). Some of the groupings made intuitive sense (e.g., mallards and blue-winged teal, wigeon and green-winged teal), while others were more difficult to explain (e.g., shovelers and pintails). An acceptable process for assigning each species to one of the 2 guilds would have to be developed.

•It would be necessary to spatially stratify each guild optimization process to pursue the goal of Flyway-based management. For example, the spatial structure of Guild 1 probably would follow that of Alternative A, in which three breeding stocks of mallards and three harvest areas were defined. For Guild 2, spatial stratification might only be necessary upon inclusion of key species which did not breed in the midcontinent region and/or wintered in only some Flyways (e.g., black ducks).

Near-term issues: *multi-stock AHM*

Alternative C:

-*focus*: "least common denominator" (LCD)

-*goal*: maximize LCD harvest

-*independent seasons*: only 1 season for all species

•Both Alternative A and Alternative B depend to some extent on the ability of hunters to identify duck species, an ability that has sometimes been called into question. An inability to identify ducks in the hand may have been a contributing factor to the apparent ineffectiveness of stock-specific hunting regulations. In recognition of this problem, we thought it appropriate to present what we refer to as the "least-common-denominator" (LCD) approach. This approach involves a focus on a duck species which is deemed to have relatively low harvest potential.

•The designation of the LCD species might be Flyway-specific (e.g., black ducks in the Atlantic Flyway), and the management objective would be to maximize long-term cumulative harvest of that species. However, all duck species would be exposed to the same regulations; there would be no independent seasons for other species.

•This alternative provides the simplest regulations conceivable, while maximizing species protection. A large segment of the hunting public (47%) has indicated that simplifying regulations would increase their hunting satisfaction. This approach also probably all but eliminates the potential for species-specific season closures.

Near-term issues: *multi-stock AHM*

Feature	Alternative A	Alternative B	Alternative C
focus	mallard	species' guilds	"least-common denominator (LCD)"
management goals	maximizing mallard harvest, while avoiding seasons that result in other species below population goals	maximizing sustainable duck harvest (in the aggregate)	maximizing LCD harvest, and (implicitly) minimizing the risk of adverse impact to other species
duck harvest potential	intermediate	highest	lowest
# of independent hunting seasons	one to many	two	one
potential for species-specific season closures	higher	lower	extremely low
regulatory complexity (# of stock-specific regulations)	potentially high and temporally variable	moderate and temporally constant	lowest
difficulty in developing population models	intermediate	highest	lowest

•This table helps understand some of the tradeoffs inherent in the alternative approaches. Generally, the effort to realize higher duck harvests is accompanied by more complex and variable regulations, and by greater demands on technical assessment capabilities.

Longer-term issues: *hunter satisfaction*

Multi-State Conservation Grant
The Wildlife Management Institute and D.J. Case & Associates

Title: **Understanding the relationship between waterfowl hunting regulations and hunter satisfaction/participation…**

Goals:

***how to gain a more thorough understanding of the relationship between regulations and hunter satisfaction, recruitment, retention, and involvement in habitat conservation**

***how to systematically incorporate this understanding into mgmt programs**

Objectives:

***compile previous research & literature**

***assemble a "think tank" of managers and human-dimensions researchers**

***create a conceptual framework**

***develop recommendations about how to proceed**

•From the beginning of the AHM process, there has been a desire to somehow account for the effects of regulations on hunter satisfaction and participation. In recognition of that interest, WMI and DJ Case & Assoc. solicited federal aid begin framing the issue.

•The goals and objectives of this study are being pursued in close cooperation with the AHM Working Group & Task Force. This work is just now beginning.

Longer-term issues: *regulatory alternatives*

AHM helps ensure sustainable harvesting through an optimal use of specified alternatives. Thus, specification of alternatives principally involves social considerations.

- **How many regulatory alternatives should there be?**
- **What are desirable or acceptable ranges of season lengths, bag limits, and framework dates?**
- **How often should the regulatory alternatives be reviewed and what are appropriate criteria for modifying them?**

•The AHM Task Force also has as its charge a review of the regulatory alternatives. This review will be facilitated by the recent realization that specification of regulatory alternatives may be more a social than biological issue.

•There currently is no timetable for this review.

Questions (1)

- **Framework-date extensions:**
  - ***Would your state likely use extensions the way you did this past hunting season if a liberal season were offered the again in the 2003-04 season? What if the 2003-04 season were moderate?**
  - ***Did your state conduct any formal or informal evaluation of the extensions this past season? If so, please pass along the info.**

- **Regulatory constraints:**
  - ***Do you favor any of the 3 constraints recommended by the Mississippi Flyway? Which ones? Why?**
  - ***For the 1-step constraint, should the limitation on regulatory change occur both during times of restriction and liberalization, or just during restrictions?**
  - ***Are there additional analyses you would like to see to help you form an opinion about these 3 constraints?**

- **Other species impacts:**
  - ***Are there any comments / suggestions for the technical analyses?**
  - ***What do you see as the management implications of the results?**

•Areas for which the AHM Working Group needs some feedback -

Questions (2)

- **Multi-stock AHM:**

***For which species (or group of species), if any, would independent season lengths (and possibly bag limits and framework dates) be acceptable?**

***For which species (or group of species), if any, would only independent bag limits (fixed or varying annually) be acceptable (assuming that season length for these species is specified based on some unrelated group of birds)?**

***For which species (or group of species), if any, would periodic closed seasons be acceptable (assuming that season length and bag limits for these species were specified based on some unrelated group of birds)?**
***Do you agree with the premises used to develop the alternatives (e.g., limiting spatial stratification to a Flyway level)? Why or why not?**

Questions (3)

- **Multi-stock AHM:**

  ***Details aside, is there any sense of agreement on a conceptual approach so that technical work can go forward?**

  ***Are there alternatives not considered in the report that should be?**

  ***Any other comments / suggestions?**