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ADAPTIVE HARVEST MANAGEMENT WORKING GROUP

Annual Meeting Bismarck, North Dakota April 16-19, 2002

This report provides a summary of presentations and discussions that occurred at the 14th meeting of the Adaptive Harvest Management (AHM) Working Group. The primary purposes of this meeting were to consider proposed revisions to the AHM protocols for midcontinent and eastern mallards and to develop procedures for accommodating framework-date extensions.

Flyway Reports

Atlantic Flyway.--The Atlantic Flyway supports the concepts of AHM and the management of Atlantic Flyway waterfowl based on eastern stocks of birds. There are still some concerns about basing regulations solely on mallards because of the potential of having liberal seasons in most years, and the unknown effects that such seasons may have on species such as wood ducks and some diving ducks. In that regard, some states continue to express an interest in changing certain aspects of the regulatory packages, and have requested a process for periodic review and modification of the packages. Current packages have been in effect for 5 years. If framework extensions are granted on an experimental basis, it may be another 3 years before options such as bag limit and season length can be changed. Some states had hoped packages could be changed prior to this date.

The Atlantic Flyway is hopeful that a workable AHM strategy for black ducks can be developed, and that it can be integrated with that for eastern mallards. There have been requests to modify black duck hunting regulations to allow states more flexibility in setting their seasons. These are aimed at addressing hunter concerns and improving hunter satisfaction. We hope that the completion of an AHM strategy or an International Harvest Strategy for black ducks is not required before modifications to hunting strategies can be initiated.

The Atlantic Flyway is also very interested in the development of a harvest strategy for wood ducks. We look forward to the seeing the recent modifications in wood duck modeling efforts.

At our winter meeting, the Atlantic Flyway Technical Section recommended that framework extensions be used on an experimental basis in the Liberal package only (not in the moderate option). In addition, we recommended a fixed closing date of January 31 with no early season extension option. We recommended that annual changes in regulatory packages be limited to no more than 1 step up or down. There was no consensus on the elimination of the Closed and Very Restrictive cells in the decision matrix and therefore this was not included in the recommendation. We realize that this recommendation is not in keeping with a unified approach for all flyways, however, it includes the options preferred by the majority of states.

Fred Johnson, with assistance from Diane Eggeman, has modified some of the Eastern Mallard models to include bias correction factors for survival and recruitment. Fred gave a presentation on this work at the Atlantic Flyway Technical Section meeting in March. Technical section members were concerned about the effects of these modifications and the implications on the AHM process overall. The mallard committee recommended retaining at least 1 of the previous models (with no bias correction factors) in the model set for eastern mallards. We hope to get some feedback on this issue from the AHM working group.

Another concern about AHM for eastern mallards is that a substantial harvest of these birds occurs in Canada, Ontario in particular, and consequently, harvest regulations in the U.S. are somewhat inefficient in influencing overall harvest rates. When this was discussed at our March meeting, Ontario indicated a willingness to participate in the AHM process and the development of a coordinated mallard harvest strategy. We don't know exactly how this might work since we have no direct control over Canadian regulations and the timing of regulation cycles is different. Yet, specific regulations would not necessarily have to be the same in the two countries, as long as the regulatory option (liberal, moderate, restrictive) were the same. This could be very beneficial to AHM development and we will work with Ontario to incorporate them in the process.

The Atlantic Flyway is still interested in factoring hunter satisfaction into the AHM process and looks forward to any concepts developed by the working group.

Mississippi Flyway.--The Mississippi Flyway Council has expressed concerns about several aspects of AHM protocol: 1) the utility of the very restrictive option in the regulations package (20 days, 3 duck bag limit in the Mississippi Flyway), 2) closed cells in the decision matrix in the range of historic population levels and habitat conditions, 3) annual increments of regulations changes (e.g. liberal to restrictive option in a single year), 4) incorporating hunter satisfaction into AHM. The Service Regulations Committee discussed these issues in January 2002 in the context of changing resource condition (drier prairies and recent declines in mallard populations), bias in the balance equation, and possible changes in duck season frameworks. It is timely to be more specific about how AHM decisions possibly could be constrained by considerations other than the optimal decision recommended under AHM.

We discussed the lack of apparent concern among other flyways with regard to the MFC concerns and believe that greater communication would be valuable. The chair will contact other flyway AHM Working Group Members prior to their winter meetings to ensure this issue is discussed. Part of the reason for limited attention to this issue has been the number of issues considered by the Working Group in recent years. Lawrence and Humburg provided initial evaluation in 2000 regarding closed cells and the very restrictive option; however, this was viewed by the Service to be of limited utility for assessment of the flyway's concerns. Thus, additional analyses will be necessary, and the AHM Committee likely will be requested to assist in this evaluation.

The effects of hunting regulations on hunter participation and satisfaction has been a topic of much discussion and debate ever since waterfowl hunting regulations were first promulgated. It is a complex issue that has been debated for many years. In 1995, the U.S. Fish and Wildlife Service adopted a formal framework for the adaptive management of waterfowl hunting regulations, bringing increased importance and attention to the issue. To best set harvest regulations and management practices, managers need more information about the social and aesthetic aspects of the hunting experience. Managers recognize the need for better information about hunter attitudes and motivations, but it is not clear how measures of hunter satisfaction would be introduced into the AHM process and used to adjust hunting regulations.

The Mississippi Flyway Technical Committee wanted to continue to express their concerns regarding biological, technical and social impacts of framework extensions on dabbling ducks. The following concerns were expressed in today's and previous Dabbling Duck Committee meetings and AHM Workshops previously conducted by the Mississippi Flyway Technical Section.

AHM requires clearly defined objectives, recognition of disagreements and uncertainty about the role of harvest on populations, and specific use of monitoring to inform current and future harvest management decisions. In the spirit of AHM, waterfowl managers and decision makers should continue to be explicit about expectations, trade-offs, and measurement of impacts.

Biological, technical (ability to evaluate), and social uncertainties that should be considered include:

Biological uncertainties:

- Harvest impacts on other duck species or segments
- Effects on other biological processes (e.g., pairing, completion of molt, nutrient acquisition)
- Increase in harvest of other species (e.g., pintails) in southern states during mid- late-January
- Age composition of harvest
- Vulnerability of hen mallards and hen wood duck in early season openers in the north

Technical uncertainties:

- Changes in harvest rate (unresolved band reporting rates)
- Prediction and /or measurement of changes in the status of some duck populations
- Evaluation of non-harvest impacts (pairing, etc.)
- Harvest distribution objectives
- Harvest equity objectives (harvest, hunter opportunity, hunter success)
- Ability to predict and measure changes in hunter satisfaction

Social uncertainties:

- Hunter satisfaction
- Public perception of the waterfowl management community

Change in distribution of harvest among states/flyways
Divisiveness within/among flyways
Increase in non-resident hunters in Arkansas

Central Flyway.--The Central Flyway (CF) continues to support on-going AHM efforts. From a flyway perspective, refinement of harvest management for mid-continent mallards is a high priority. The CF has identified several key issues for this population. First, obtaining updated, accurate estimates of harvest rates is essential, and we are encouraged by recent progress in funding and planning a reward band study. The CF has recently completed a major banding effort, and we believe that results from this effort and other recent banding information should be incorporated into a review of banding reference areas and banding needs for mid-continent mallards. Second, the Central Flyway Council supports extensions of opening date frameworks for duck seasons, and supports directly incorporating framework extensions into the AHM process. We believe it will be important for the AHM Working Group to clearly communicate, both internally and externally, our ability to evaluate the effects of framework extensions on mallard harvest and population dynamics. Third, the CF continues to support efforts to revise the models and procedures used in AHM for mid-continent mallards. We support efforts to resolve the apparent bias in the balance equation and inclusion of prediction errors in model updating procedures. We also continue to support incorporating U.S. ponds into the recruitment model set. Fourth, the CF would like to continue work on technical aspects of possible changes to the regulatory options used in AHM for mid-continent mallards. Broader communication and discussion is needed about options analyzed by the Mississippi Flyway (i.e., treatment of “blank” cells in the decision matrix, utility of the very restrictive option, and constraining the system to preclude “skipping” regulatory packages between years). The CF would also like to obtain a better understanding of how harvest of female mallards is related to bag limits, and how changes in female harvest may influence the frequency of regulations packages.

Another high priority for the CF is addressing challenges posed by developing AHM for multiple stocks of waterfowl. As work proceeds on developing AHM approaches for eastern and western mallards, northern pintails, black ducks, and possibly other species, a key question will be how these different approaches will interact with AHM for mid-continent mallards and with each other. The AHM Working Group has made progress in identifying alternative approaches (i.e., independent optimization, joint optimization, and conditional optimization) and possible guidelines for pursuing multiple-stock AHM (see December 2000 AHM workshop notes). Because resolution of these issues will require value decisions, as well as technical analyses, the AHM Working Group will need to develop effective communications tools on multiple stock harvest management for administrators and other non-technical audiences.

Finally, we emphasize that our overall harvest management objectives provide the context for all of the issues described above. In addition to continued work on the technical, biological aspects of these issues, the CF supports further efforts to define, and hopefully agree upon, our collective objectives for the hunting side of harvest management. In this regard, we support the hunter satisfaction/participation workshop being developed by Dave Case. We recognize that much of

the expertise on measuring and interpreting information on the human dimensions of waterfowl harvest exists outside the AHM Working Group. This workshop can provide an important first step in framing issues related to harvest management objectives. Whether or not information on “stocks” of hunters is directly incorporated into AHM approaches developed for stocks of ducks, we believe that a better understanding of hunter populations will help inform future decisions about waterfowl harvest management.

Pacific Flyway.--At our March meeting, the Pacific Flyway Study Committee (PFSC) reviewed topics under consideration by the AHM Working Group, including the need to address bias in the balance equation, framework extensions, and need to revise the protocol of updating model weights. The PFSC has been supportive of AHM, and has developed a better understanding of AHM based on last year’s workshop. In general, the committee sees the necessity of updating models, but is concerned about losses of hunting opportunity (days) resulting from AHM revisions and framework extensions. The Pacific Flyway Council (PFC) supports framework extensions as proposed in the recent Federal Register.

PFSC also considered the past analysis conducted by Working Group members from the Mississippi Flyway, regarding the utility of the very restrictive and closed cells in the decision matrix. The PFC recommended that USFWS examine how eliminating the closed season and the very restrictive packages influence optimal regulation decisions, considering proposed model revisions. If the results of this evaluation are consistent with past analyses using 1999 model weights, the PFC supports elimination of the very restrictive package (i.e. designate very restrictive cells as restrictive). The PFC believes that closed season cells should be eliminated (i.e. designate closed cells as restrictive) when breeding populations and pond numbers exist at levels at which seasons have been offered in the past. The PFSC discussed but did not endorse the suggestion to limit package shifts to no more than one level. Although limiting package shifts may have some benefits when optimal decisions are becoming more restrictive, limiting shifts was not seen as having the same benefits when conditions improve.

The Pacific Flyway endorses the proposed technical amendments to the existing interim harvest strategy for northern pintails, to more accurately predict harvests resulting from season frameworks established under AHM for mid-continent mallards. The PFC also supports open seasons when the predictive model constrains the bag limit to less than one bird per day. The PFC is not in favor of basing the evaluation of the strategy’s effectiveness primarily upon sustaining at least 6% annual growth of the breeding population. Recent analyses cannot detect a relationship between harvest and survival rates for northern pintails, and we believe that the underlying issue affecting pintails is recruitment. We will be providing additional comments on this topic during the pintail session later in the meeting.

Progress has continued to be slow but steady on refining the western mallard models developed by New York Coop Unit three years ago, and most work has been focused on developing consistency of scale for model parameters. Bob Trost and Marty Drut have been working on refining the recruitment model by developing better estimates of annual age ratios considering

the entire range of western mallards. In addition, the flyway has been working with CWS to obtain better estimates of mallards from major BC breeding areas, including annual trends for the past 15 years. BC has been one of the largest gaps in our estimates of western mallard breeding population trends. We will be providing additional details on these efforts later in the meeting.

Hunter-Satisfaction Initiative

The Wildlife Management Institute and D.J. Case & Associates have received a federal aid Multi-State Conservation Grant to help understanding the relationship between waterfowl hunting regulations and hunter satisfaction/participation. The goal of this project is to develop an overall framework and specific recommendations for addressing:

- how to gain a more thorough and rigorous understanding of the relationship between waterfowl hunting regulations and hunter satisfaction, recruitment, retention, and involvement in habitat conservation; and
- how to systematically incorporate this understanding into management and conservation programs.

The project has 4 specific objectives to help achieve this goal:

1. Compile the previous research and literature addressing this issue.
2. Assemble a “Think Tank” of technical and administrative representatives from Flyway Councils and U.S. Fish and Wildlife Service, and experts in the fields of hunter recruitment/retention and human dimensions research.
3. Through two meetings of the Think Tank, create a sense of direction and internal agreement regarding this issue.
4. Develop specific recommendations for improving/enhancing management programs.

The effects of hunting regulations on hunter participation and satisfaction has been a topic of much discussion and debate ever since waterfowl hunting regulations were first promulgated. It is a complex issue that has been debated for many years. In 1995, the U.S. Fish and Wildlife Service adopted a formal framework for the adaptive management of waterfowl hunting regulations, bringing increased importance and attention to the issue. AHM is one of the few large-scale, successful efforts to apply the principals of adaptive resource management; still, the social components of the harvest management process (e.g., hunter demographics, economics, and the relationship between hunting regulations and hunter participation/success, etc.) are poorly understood. Recent human dimensions studies indicate hunter participation and satisfaction are not increased substantially by regulations that provide for the maximum allowable harvest. Therefore, to best set harvest regulations and management practices, managers need more information about the social and aesthetic aspects of the hunting experience. A first step in this direction must involve systematic collection of information on hunter satisfaction and how it is influenced by hunting regulations.

Jim Ringelman surveyed duck hunters from 23 states and found differences in hunting activity, desire for specific regulations, and motivations for hunting. He also found differences in how waterfowl managers and hunters perceived the effects that hunting regulations have on hunter participation and satisfaction. Managers recognize the need for better information about hunter attitudes and motivations, but it is not clear how measures of hunter satisfaction would be introduced into the AHM process and used to adjust hunting regulations.

A survey of flyway state Technical Group and Council members (AHM Working Group Report 2000) revealed that most believed that hunter information was an important component of hunting regulation development, but less than half collected systematic data in this regard. Nearly all respondents indicated a desire to participate in a nationwide survey of hunter preferences.

At a Joint Flyway Council meeting in July 2000, a subcommittee of the AHM Working Group recommended that a “Think Tank” of experts be assembled to frame the issue and outline options for addressing it. This recommendation was re-confirmed by the AHM Working Group at the April 2001 meeting. This proposal was developed in direct response to this stated need of the AHM Working Group.

This project will bring all of the existing research findings concerning this issue together into one place. Further, it will allow the nation’s top experts to review and discuss the existing findings in detail as a group. Often, a multitude of agencies and organizations address common problems without knowledge of other similar efforts being conducted in other places. This project would capture all of the previous work done in this area, focus the best thinking on the issues, and clearly define future direction and additional research needs. Finally, the project will produce a report that will provide expert recommendations on how to enhance existing management programs to increase the participation and satisfaction of waterfowl hunters.

Revisions to the AHM Protocol for Midcontinent Mallards

Following is a summary of the proposed revisions and their rationale. A detailed report concerning these revisions is available at:

<http://migratorybirds.fws.gov/reports/ahm02/MCMrevise2002.pdf>

There is an +11% bias in estimated survival rates (S), reproductive rates (R), or both. The AHMWG has applied a suitable empirical correction to both R & S estimates as an acknowledgment that the source of the bias is unknown. The degree of bias will be monitored in the future, and ancillary research is being conducted to determine its source. The bias adjustment results in model-specific optimal harvest strategies that are slightly more conservative than before. The mallard population goal of the NAWMP continues to constrain harvest over what might be appropriate for a sole objective to maximize sustainable harvest (although the severity of the constraint has increased somewhat).

The sub-models that predict survival rates have been revised to better reflect existing data. The revision acknowledges that a primary uncertainty is survivorship in the absence of harvest.

Essentially no changes have been made to the reproductive sub-models. The AHMWG attempted to include U.S. ponds (in addition to Canadian ponds) in predicting reproduction, but additional analyses are necessary and will be conducted as part of an ongoing review of the reproductive sub-models.

The procedure for updating model weights now accounts for variation in breeding-population size not explained by the models. The variance is treated as a multiplicative error in predictions and is equivalent to a CV of about 16%. This revision better reflects the uncertainty in predictions and results in more reasonable behavior of model weights. The most recently available weights (from 2001) suggest about equal weight on the additive and compensatory hunting hypotheses, and about 3/4 of the weight on the hypothesis with weakly population-dependent reproductive rates.

All of the revisions were endorsed by the AHM Working Group (AHMWG), which recommends that these revisions be implemented immediately.

Revisions to the AHM Protocol for Eastern Mallards

The set of models of eastern-mallard population dynamics have been reviewed by the AHMWG to consider, among other things: (a) whether continued reliance on a Breeding Bird Survey index is necessary; and (b) whether survival and reproductive rate estimates appear to be biased as with midcontinent mallards. Following is a summary of proposed changes and their rationale. A detailed report concerning these revisions is available at:

<http://migratorybirds.fws.gov/reports/ahm02/emal-ahm-2002.pdf>

The AHMWG recommends replacing the Breeding Bird Survey (BBS) with the federal/state breeding population survey for the purpose of predicting annual reproductive success of eastern mallards. This decision is based on evidence suggesting that the BBS index may be biased low in wet years.

There is an apparent bias of approximately +16% in survival or reproductive rates of eastern mallards, but the evidence for this bias is less conclusive than that for midcontinent mallards. Therefore, the AHMWG recommends that population models that do not correct for this apparent bias be retained along with those in which the bias is corrected.

The effect of drought in the northeastern United States on the reproductive success of eastern mallards may have increased in magnitude over time. The AHMWG recommends that further research be conducted to determine whether this is the case and, if so, to incorporate this effect in the set of population models.

The Atlantic Flyway has limited control over the total harvest of eastern mallards because of the large proportion of harvest occurring in eastern Canada. The AHMWG recommends discussions with federal and provincial managers in eastern Canada to determine whether harvest management of eastern mallards might be better coordinated between the two countries. In the interim, the AHMWG recommends that consideration be given to optimizing the U.S., rather than total, harvest of eastern mallards.

Eastern mallards appear to have considerable potential to absorb sport harvest without adverse impact. However, the AHMWG reiterates that liberal regulations promulgated solely based on the status of eastern mallards potentially can have negative impacts on other duck species in the Atlantic Flyway.

AHM for Western Mallards

The Pacific Flyway Study Committee has continued to develop the models and background information needed to incorporate explicit consideration of western mallards into the existing AHM process. Efforts have been directed at two areas identified as needing additional work based on the review of the initial model set developed by Sheaffer and Malecki (1999). The two focus areas have been: (1) improving recruitment rate models, and (2) developing better information regarding the numbers of breeding mallards in British Columbia. Both of these issues are really directed at resolving some management scale questions by converting all modeling efforts to models developed on a consistent geographic scale - the range of the western mallard.

Recruitment models.--One of the greatest difficulties in developing recruitment models was the lack of a Flyway-wide estimate of the harvest age ratio specific to western mallards. The approach taken by Sheaffer and Malecki was to only use harvest age ratio information from times and areas that could be clearly demonstrated to be comprised of only western mallards. This approach essentially limited the harvest age ratio information available to female mallards recovered in the southern portions of the Flyway in October. Upon review, questions were raised regarding how representative this was of the range of western mallards and whether or not the limited information available should be used as the dependent variable to model recruitment throughout the range of western mallards. Subsequently, it was decided to try a different approach; using the harvest age ratios from throughout the season for all Pacific Flyway States, the estimated derivation of this harvest from various breeding areas, and the estimated age-ratio from the mid-continent region, to estimate the age-ratio of western mallards. We are presently finalizing the estimates derived in this fashion and will compare them to those previously used in the recruitment modeling efforts for western mallards. We will then reexamine the various recruitment models and make revisions as seem warranted by the data. We expect to finish this process during the next year.

Mallards in British Columbia.--Another deficiency identified in our review of the western mallard data base was the general lack of mallard breeding population data available for British

Columbia. The Flyway has worked with CWS and the Province to examine existing information and develop new information that will help us better understand and incorporate information from the Province into the western mallard model set. We considered there to be two basic information needs regarding mallard breeding populations: (1) a better understanding of the actual number of mallards breeding in the Province, and (2) information regarding trends in these numbers over time to incorporate into the historical data set for use in refining the basic population models. To that end the Flyway has pursued two approaches to these questions. The first was to use a rather limited existing data set that has recorded the number of pairs of waterfowl by species on specific wetlands over time, and expand this information by wetland size and type based on a complete geographic index for wetlands across the Province. Andre Breault has been instrumental in pursuing this approach and has now completed these extrapolations for many of the major geographic regions of the Province. Our second need was to verify that these expanded estimates were similar to estimates derived from more traditional procedures. To this end we have been conducting cocurrent helicopter surveys in specific geographic regions of British Columbia for the past several years and comparing the results of these more comprehensive transect surveys (designed as in the May Breeding Population Survey - but assuming no visibility correction factor) to the results of the limited pair surveys expanded by wetland type and abundance. To date our results are very encouraging as we seem to have relatively close agreement between the two types of surveys for all of the areas compared to date. We will be continuing this comparison in a new geographic area again this year and will then assess the need for any more comparisons. In general, we now believe we have a reasonable estimate of the number of breeding mallards in British Columbia and also a way to examine trends over time in their abundance.

Implications of Potential Regulatory Changes

The AHMWG was asked by the U.S. Fish & Wildlife Service (USFWS) to determine how framework-date extensions might be handled within the AHM process and what the implications of large-scale implementation might be. The AHMWG recommends a Bayesian approach to accounting for the effects of framework-date extensions, which involves using available information to predict harvest impacts on mallards, while using estimates of realized harvest rates to update those predictions. No conclusive evaluation of the marginal effect of extensions on harvest rates is possible in the absence of an experimental design, which has not been considered to date. As with previous assessments, recent analyses suggest that the frequency of liberal regulations is likely to decrease significantly with implementation of framework-date extensions throughout the U.S.

The AHMWG also was asked by the USFWS to investigate the potential implications of: (a) restricting closed seasons to below the record-low size of the midcontinent population; (b) eliminating the very restrictive regulatory alternative; and (c) restricting the annual magnitude of change in regulatory alternative to one step. Based on the revisions to the midcontinent mallard models described above and the 2001 model weights, the AHMWG determined: (a) that a constraint on closed seasons above 5.5 million mallards (traditional survey area + Lake States)

likely will have minimal impact beyond a prescription for very restrictive seasons at some population levels where the season otherwise would have been closed; (b) that elimination of the very restrictive alternative simply results in its replacement with the restrictive alternative in the optimal harvest strategy; and (c) that restricting the annual change in regulation to one step successfully reduces the annual variability in annual regulations, but also decreases the expected frequency of liberal regulations by almost one half.

The AHMWG emphasizes that it does not believe that it is within its purview to make recommendations about the desirability of implementing these or other regulatory changes.

Review of Scale Issues in AHM

Variation is a defining feature of ecological systems. Virtually all ecological systems exhibit a broad range of variation on temporal, spatial, and organizational scales, ultimately as a function of how individual organisms respond to their environment. The scales at which individuals are aggregated for management purposes is a discretionary decision, but one that can strongly influence both the benefits and costs of management. Management systems that account for important sources of ecological variation are expected to yield the highest benefits, but also are likely to be characterized by relatively high monitoring and assessment costs.

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.

To provide a conceptual framework for the problem of scale in AHM, we borrow from fisheries-management jargon and define “stock” as any aggregation of ducks used for harvest-management purposes. Thus, stocks may be defined as spatially segregated breeding-populations of conspecifics, as species, as groups of species, or as any other aggregation that has explicit spatial or organizational bounds. It is not necessary for a stock to exhibit homogeneous demographics and population processes (indeed, any stock will exhibit some degree of heterogeneity). Given this definition of stock, the problem of harvesting multiple duck stocks exhibits the following key features:

- (1) stocks vary in their potential to support sport harvest;
- (2) multiple stocks often are exposed to a common hunting season, although stock-specific harvests can be regulated within limits by stratifying hunting regulations on spatial, temporal, and organizational scales (e.g., species-specific bag limits);
- (3) stock-specific harvest returns and population trajectories are subject to considerable uncertainty, whose sources include uncontrolled environmental variation, random effects of regulations (i.e., partial controllability), uncertainties in population dynamics, and errors and biases in data-collection programs (i.e., partial observability); and
- (4) management objectives are complex, in that they must account for stock-specific values (i.e., not all stocks will be equally valued by hunters), for the legal mandate to prevent over-exploitation of any stock, and for the fact that the distribution of harvest may be as important as its magnitude.

The harvest potential of any given stock also is likely to vary among years due to variation in habitat conditions. Stocks that exhibit a high degree of annual variation in harvest potential are best harvested under a regime that allows annual changes in regulations. On the other hand, stocks exposed to relatively stable habitat conditions can be harvested effectively with regulations that are promulgated for multi-year periods.

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.

Communications Strategy

Communications efforts have been critical to implementation of AHM. This was confirmed at the April 2002 meeting of the AHM Working Group in Bismarck, North Dakota. Given the potential changes in prairie habitat conditions, the possibility of expanded framework extensions, and likely changes to various components of the AHM model set and protocols, the need for communications in the coming regulatory cycle will be significant. These issues and recommended next steps were discussed at the Working Group meeting and incorporated into a draft communications strategy.

Following are excerpts from the communications strategy developed by the AHM Working Group Communications Team (Dave Case, Dave Sharp, Mike Johnson, Dan Yparraguirre, Dale Humburg, Diane Eggeman, and Fred Johnson).

The goal of the communications strategy is that all interests involved in the waterfowl regulations-setting process support AHM as the long-term process by which duck hunting regulations should be set. The objectives of the communications strategy are that all target audiences:

Know -

- What AHM is, why it was needed, and how it improves on the regulations-setting process used prior to the 1995-96 seasons
- AHM has been developed cooperatively between the states, Flyways, USFWS, and waterfowl hunters

Feel -

- Comfortable that the AHM process is scientifically rigorous and carefully balances hunting opportunity with long-term waterfowl conservation
- Excited about the positive results for waterfowl conservation from AHM

Do-

- Support AHM as the process by which duck hunting regulations should be set, even when the regulatory choice may seem inappropriate

The following should guide development and implementation of communications efforts. Be cautious about communicating (“speculating”) on potential habitat, population, and regulatory package interactions. Separate what we DO know about habitat and populations from what we DON’T know about resulting regulations.

- Immediately focus on changes to AHM protocol this year with technical and administrative audiences.

- Build (reinforce) internal support/agreement for AHM process.
- Create all products for web-based access/distribution.
- AHM Working Group members are critical to effective communications and must play an aggressive, active role.
- Communicate “results” from the first seven years of implementation.
- When populations decline, especially if they decline significantly, external communications will become more important and more difficult.

There also a number of ongoing issues affecting communications effort:

- AHM is a dynamic process—continuous improvement (this may be perceived as somewhat contradictory to previous messages regarding “stability” of regulations).
- The widening gap in expertise and understanding on technical issues (statistics, modeling, etc.) between various internal audiences, even biologists.
- The need to maintain a long-term perspective in AHM.
- The knife-edge nature of the decision matrix.
- Expectations of AHM may be out of line among technical committees and Councils.
- Uncertainty about how non-mallards/multiple stocks fit in.
- The need for rigorous, systematically-gathered information on hunter preferences and satisfaction.
- Allocation of harvest opportunity with and among flyways.
 - Concern that there are blank cells in the decision matrix mean at levels of ponds and ducks where seasons were open in the past.
- The general lack of understanding among many audiences of the regulatory process overall, natural fluctuations in duck populations in North America, and the element of uncertainty involved in managing waterfowl populations--the real basis for AHM.

Consistent, carefully crafted messages are critical to successful communications efforts. Following are key messages that will be fine-tuned and updated over the next few weeks.

- Prairies (and associated duck populations) are dynamic ecosystems, wet and dry cycles are part of normal (and beneficial) processes.
- AHM is a dynamic process—continuous improvement.
- Why are we making changes to AHM protocols and models now? We are incorporating emerging biological understanding, technical improvements, and harvest management experience.
- AHM models predict changes in population size, but do not necessarily represent the biological mechanisms by which those changes occur.
- AHM improves on a process that has been successful at perpetuating waterfowl populations.
- The proportion of total mortality attributable to hunting is relatively low.
- The regulatory process (see Central Flyway web site description) and how AHM fits into it.
- Results/successes of AHM implementation to date—we’ve learned things and it’s reduced contentiousness.

AHM Working Group
Annual Meeting
April 16-19, 2001
Bismarck, ND

Agenda

Tuesday - April 16

8:00am-12:00pm

- (1) USFWS, Flyway Council, & CWS reports
- (2) Communications update (Dave Case)
- (3) Hunter-satisfaction initiative (Dave Case, Dale Humburg)

1:00pm-5:00pm

- Revisions to midcontinent mallard models and weights (Mike Runge, Jim Dubovsky, Bill Kendall, Jeff Lawrence, Jim Gammonley, Fred Johnson)
- Exploring possible changes in regulatory structure for midcontinent mallards (i.e., utility of VR alternative, constraints on closed seasons, minimizing annual changes in regulations) (Jeff Lawrence, Dale Humburg)

Wednesday - April 17

8:00am-12:00pm:

- Revisions to eastern mallard models (Fred Johnson, Diane Eggeman)
- Accommodating framework-date extensions (Fred Johnson, Andy Royle, Mike Runge)

1:00pm-5:00pm:

- Review of scale issues in AHM (Fred Johnson)
- Spatial, temporal, and organizational variability in duck demographics (Pam Garrettson and Mark Otto)
- Accounting for multiple species in AHM: An example (Fred Johnson)

Thursday - April 18

- Field trip (Mike Johnson, Dave Sharp)

Friday - April 19

8:00am-12:00pm:

- Progress reports on selected species (≤ 15 min. each)
 - Pintails (Mike Runge)
 - Western mallards (Bob Trost)
 - Wood ducks (Pam Garrettson)
 - Black ducks (Jerry Serie)
- Meeting synthesis
 - Action items
 - Communications - strategies and tactics