Reuniting Waterfowl Management

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Abstract: Two of the most significant management programs designed to affect duck populations in North America are the North American Waterfowl Management Plan (the Plan) and the U.S. program of Adaptive Harvest Management (AHM). Both the Plan and AHM are continental in their scope, involve an extensive group of stakeholders, and rely on an adaptive process of biological planning, implementation, and evaluation. The development of these two programs has occurred independently, however. Consequently, there has been little explicit recognition that both harvest and habitat effects have to be considered for coherent management planning and evaluation. For example, harvest policy can affect whether population objectives of the Plan are met, irrespective of the success of the Plan's habitat conservation efforts. Conversely, habitat conservation activities under the Plan can influence harvest potential and therefore the amount of hunting opportunity provided. It seems increasingly clear that the Plan's duck population objectives can only be useful for conservation planning and evaluation if they are accompanied by an explicit specification of the harvest policy and environmental conditions under which they are to be achieved. This clarification also is necessary to ensure that Plan population objectives are not attained solely through the reduction of hunting opportunity in AHM. We believe then that it is imperative that these two key waterfowl-management programs work to harmonize their objectives, at least for the species of ducks important in harvest management. AHM and the Plan ought to be working toward the same ends, but that is not possible so long as the mutually reinforcing relationship of these programs is obscured by ambiguities in their respective management objectives.

Natural resource managers attempt to effect desirable levels of duck abundance in North America by managing both harvests and habitats. Much of the habitat conservation and management is conducted under the auspices of the North American Waterfowl Management Plan (U.S. Department of the Interior and Environment Canada 1986). The programs to regulate sport hunting vary by country, so we focus here on the Adaptive Harvest Management program in the U.S. (Williams and Johnson 1995). This program is responsible for managing the largest portion of the continental duck harvest. Both the Plan and AHM are continental in their scope, involve an extensive group of stakeholders, and rely on an adaptive process of biological planning, implementation, and evaluation. But each program has a unique focus. The Plan is concerned with conserving habitat for waterfowl over a decades-long timeframe, while AHM is a process for setting duck-hunting regulations on an annual basis. It seems evident that because both programs are meant to affect the same populations of birds, their management objectives should be coherent. However, the development of these two programs occurred independently, and as such there has been little recognition that the objectives of one program can profoundly affect the other. In this paper, we argue that harvest and habitat management are inextricably linked, and that the objectives of both AHM and the Plan need to explicitly reflect that linkage.

The original Plan in 1986 established the goal of restoring mid-continent duck populations to the levels observed during the 1970s. Population objectives were designated for common mid-continent species using average breeding-population estimates from the 1970s, and then specifying that these population objectives should be reached "under average environmental conditions." Habitat-

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management delivered through regional joint ventures is the Plan's major conservation strategy, but the original Plan also included regulatory prescriptions for mallards, northern pintails, and black ducks. The original population objectives remain in force today, although matters pertaining to harvest regulation were expunged when the Plan was updated in 1994 (U.S. Department of the Interior, Environment Canada, and Secretaria de Desarrollo Social 1994). Since then, the Plan has evolved largely in isolation from harvest management.

The principal goal of the regulatory process is to provide an opportunity to harvest waterfowl by establishing hunting seasons that are compatible with the long-term sustainability of waterfowl populations. The responsibility for establishing duck-hunting regulations in the U.S. is derived from the Migratory Bird Treaty Act of 1918 (as amended), which implements provisions of the international treaties for migratory bird conservation. AHM was first implemented in 1995 as a systematic approach for coping with uncertainty and disagreement concerning the biological impacts of duck-hunting regulations. The framers of AHM, in recognition of the Plan's goals, included the Plan population objective for mid-continent mallards as one of the objectives of harvest management. The idea was to provide maximum hunting opportunity, while also striving to maintain the mid-continent mallard population at or near its Plan objective.

Impetus for clarifying the relationship between the Plan and AHM arises from two recent events: (1) the AHM community has undertaken a broad discussion to clarify the role of population objectives in harvest management; and (2) the Plan community is beginning its first comprehensive biological assessment, scheduled to be completed in 2005. Both of these events underscore the urgency, as well as the opportunity, to scrutinize the objectives of each program and to ensure that they constitute a coherent overall management strategy for ducks.

The Roles of Harvest and Habitat in Duck Population Dynamics

In simple terms, changes in duck abundance are controlled (albeit to varying degree) by three factors: (1) intrinsic density-dependence, which ultimately depends on the quantity and quality of available habitat and the biology of each species; (2) density-independent effects on mortality and reproduction; and (3) regulated harvest. The interaction of these three factors can be understood by considering a simple description of the harvest dynamics of mid-continent mallards (Fig. 1). This graph shows a range of equilibrium breeding-population sizes for mid-continent mallards and their corresponding levels of sustainable annual harvest under average pond conditions on the breeding grounds. On the right side of the graph, in the absence of harvest, current AHM population models predict the breeding population size would average 11.5 million mallards, and the sustainable annual harvest would of course be zero. At this point, intrinsic density-dependent factors reduce recruitment so that it just matches mortality; there is no harvestable surplus. If this population were harvested at about 12%, the average breeding population size would drop to about 5.9 million, recruitment would be higher than natural mortality, and the sustainable annual harvest would reach 1.35 million ducks. If the harvest rate were increased beyond 12%, the population size would continue to drop, but the sustainable annual harvest would drop as well. Given our current understanding of mallard population dynamics, the maximum sustainable annual harvest thus occurs when the population size averages 5.9 million birds (under average pond conditions).

At least in theory, a harvest policy can be designed to achieve any point on the quadratic curve in Fig. 1. It's important to recognize that the observed average population size will depend on the harvest policy, in

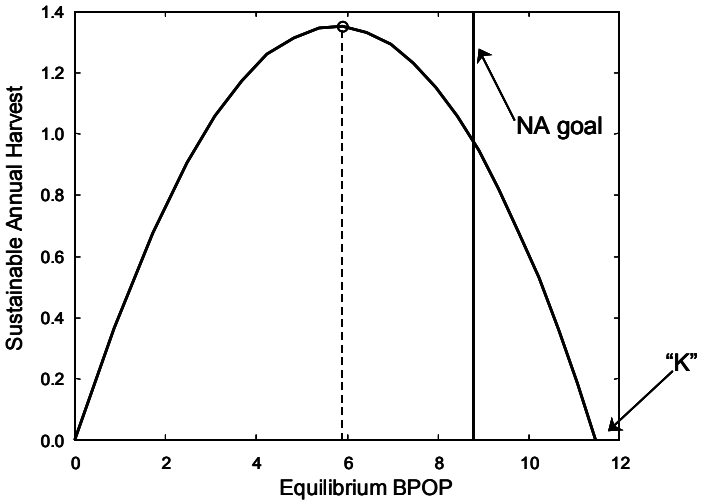

Fig. 1. Sustainable annual harvest (in millions of ducks) as a function of equilibrium population size, for mid-continent mallards (including WI, MI, and MN), using the weighted 2003 AHM model. This model suggests a carrying capacity ("K"), under average Canadian pond conditions (3.4 million ponds), of 11.5 million ducks, and a maximum sustainable harvest when the breeding population size averages 5.9 million ducks. The Plan goal for mid-continent mallards, including the three Great Lakes states, is 8.8 million.

particular, on the average harvest rate. If a management policy is chosen whose sole objective is to maximize sustainable harvest, then that policy will seek to hold the population size at around 5.9 million. On the other hand, a harvest policy could be designed to hold the population around 8.8 million, which represents the Plan objective of 8.2 million plus an objective of 0.6 million mallards breeding in the states of Minnesota, Wisconsin, and Michigan. However, this policy would be accompanied by a loss of about 30% of the maximum sustainable harvest. The current objective in AHM foregoes some harvest to keep the mallard population closer to its Plan goal. In effect, current harvest policy splits the difference, seeking to hold the population, on average, about halfway between 5.9 and 8.8 million.

So harvest policy can affect whether population objectives of the Plan are met, irrespective of the success of the Plan's habitat conservation efforts. Conversely, Plan activities can influence harvest potential and therefore the harvest-management policy. Habitat conservation could increase the carrying capacity of the environment, thereby stretching the quadratic curve to the right (Fig. 2). For example, if enough of the landscape were restored so that the mid-continent mallard population size in the absence of harvest (the carrying capacity) increased to 16 million ducks (instead of the current 11.5 million), then we would expect the optimal sustainable harvest to occur when the population size was about 8 million ducks (instead of the current 5.9 million). Two points are salient: (1) habitat management leading to an increase in carrying capacity will increase the population size at which harvest is maximized as well as increase the size of the maximum sustainable harvest; and (2) the observed population size under improved habitat conditions can only be used for evaluating Plan success if the harvest policy is considered.

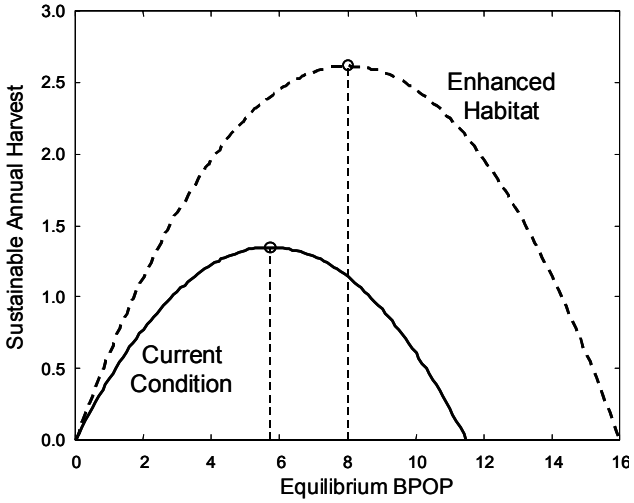

Fig. 2. Sustainable annual harvest (in millions of ducks) as a function of equilibrium population size. The solid curve ("Current Condition") is identical to the curve in Fig. 1. The dashed curve ("Enhanced Habitat") represents the sustainable harvest if the carrying capacity were increased to 16 million.

Biologists recognize that Fig. 1 is a greatly simplified representation of mallard population dynamics. In reality, mallard population growth rates, carrying capacity, and harvest potential vary significantly with the wet-dry fluctuations on the prairie breeding grounds. Nevertheless, Fig. 1 can be interpreted as the central tendency of mid-continent mallard population dynamics. Under average conditions (or on average over fluctuating conditions), the relationship between population size and sustainable harvest is described by Fig. 1, at least to the extent that our current understanding of mallard population dynamics is correct.

It's important to understand, then, that habitat conservation and harvest management are inextricably linked. Habitat conservation can affect the size of the harvestable surplus by enhancing the potential for population growth. Harvest policy can affect the degree to which available habitat is used. And observed population sizes can only be interpreted in relation to objective levels by considering the activities of both habitat and harvest management.

Implications

Our current understanding of mallard population dynamics results in a number of specific implications for habitat conservation under the Plan and harvest management under AHM.

Habitat Conservation

The Plan's population objectives cannot be interpreted without the context provided by harvest policy. The framers of the 1986 Plan might have assumed harvest rates typical of the 1970s. The population objectives of the 1970s were chosen presumably because they reflected a period in which waterfowl managers were generally satisfied with hunting opportunities. The Plan, however, does not include any explicit linkage between population objectives and harvest rates, and current harvest policy under AHM differs from that in the 1970s.

Moreover, the direct comparison of observed population levels and Plan objectives only makes

sense "under average environmental conditions." When environmental conditions are not average, a comparison of extant population levels and Plan objectives must somehow account for the difference. The nature and scale of those uncontrolled environmental conditions are not explicitly identified in the Plan. We suspect, however, that the number of ponds on the prairie breeding grounds must have figured heavily in the thoughts of the Plan's designers. If so, it's worth noting that May pond estimates during the 1970s were significantly higher than the long-term average (Fig. 3). In any case, the unspecified nature of "average environmental conditions" limits the usefulness of the Plan's population objectives for planning and evaluation purposes.

Plan partners have recognized these limitations for some time, so they have chosen instead to rely on regional habitat objectives or waterfowl vital rates as performance measures. A precise interpretation of Plan population objectives is important, however, for the development of cogent regional objectives. Only if the meaning of the Plan's population objectives is consistent at continental and regional scales will habitat conservation programs truly reflect the needs of the birds. In other words, consistency across scales is necessary so that regional habitat objectives "add up" to that which will be necessary to support continental-level population objectives. For example, if Plan objectives at the continental scale reflect desired population sizes under a policy of maximum sustainable harvest, but the associated regional population objectives are interpreted as carrying capacities, then the habitat provided at the regional level will not be enough to achieve the continental population objectives. Coherence of Plan objectives at multiple spatial scales is therefore essential.

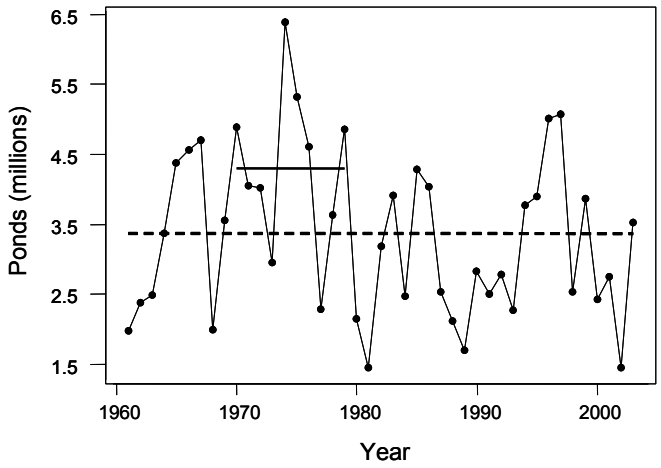

Fig. 3. May ponds in Canada, 1961-2003. The mean number of ponds for the period of record is shown with a dashed line; the mean for 1970-1979 is shown with a solid bar.

Harvest Management

Currently, the AHM objective used for determining an optimal harvest policy for mid-continent mallards is to maximize long-term cumulative harvest, subject to a devaluation of harvest that occurs when the projected mallard population size is expected to drop below the Plan objective in the subsequent breeding season (USFWS 2003). This devaluation of harvest acts to produce regulatory choices that will encourage population growth at the expense of hunting opportunity whenever the mallard population falls below the Plan objective. As noted above, current models for mid-continent mallard dynamics suggest that the maximum long-term harvest would occur by managing the population near 5.9 million ducks. Including the Plan objective raises the target population size to about 7.3 million and foregoes about 15% of the annual harvest. While the effects on average population size and long-term cumulative harvest are moderate, the impact on hunting regulations is much more profound. Inclusion of the Plan objective is expected to reduce the frequency of liberal seasons by half and to double the frequency of closed seasons compared to a harvest policy that does not incorporate the Plan population objective for mallards. The duck harvest community is therefore understandably concerned about the role of Plan population objectives in determining harvest policy. And clearly, the intent of the Plan is to achieve its population objectives through habitat conservation, *not* through reduction of harvest.

A more general question that needs to be addressed by the waterfowl harvest community is whether the harvest-management objective for mid-continent mallards needs to incorporate *any* external population objective. The objective to maximize long-term cumulative harvest already incorporates an implicit conservation ethic, because you cannot accomplish this objective without harvesting sustainably. On the other hand, there may be other reasons to incorporate an external population objective; for example, to further reduce the risk of low population sizes, to guard against over-harvest of other species, or to capture other goals such as wildlife viewing. If an explicit population objective is included in AHM, we believe that considerable thought needs to be given to the purposes such an objective is intended to achieve.

One notable reason to include an external population objective might be related to the impact of a common

set of hunting regulations on a larger suite of duck species. U.S. hunting regulations for most duck species are largely determined by the harvest potential of mid-continent mallards under AHM. But it seems evident that at least a few other species – northern pintail, scaup, and canvasback among them – may not be able to sustain the same harvest pressure as mallards. How is such variation in harvest potential to be accommodated with common harvest regulations? This may be the most profound question currently facing the waterfowl harvest community. Several approaches to this question are being discussed (Johnson et al. 2002); one solution might involve use of an external population objective to temper regulations that would otherwise be more liberal.

Recommendations

We suggest that we use our current understanding of environmental and harvest dynamics of ducks derived from AHM and other research as a basis to help clarify the nature of the Plan population objectives. Certainly, our understanding of population dynamics will continue to evolve, and thus there needs to be an ongoing, joint AHM-Plan effort to periodically review population objectives. Ultimately, managers need to be clear about whether population objectives represent the optimal level for maximizing harvest yield, a habitat carrying capacity, or something else. The Plan population objective for mid-continent mallards is a reasonable place to begin this clarification, but the population objectives of several other species (e.g., northern pintails, scaup, black ducks) also require attention sooner rather than later. Clarification of the Plan population objectives in turn will allow Plan partners to ensure coherent regional habitat conservation objectives. We hasten to add, however, that while Plan partners can begin immediately to *clarify* the nature of their population objectives, they cannot *set* those objectives for mallards or other important species without the concurrence and support of the harvest-management community.

In the short term, the AHM and the Plan communities need to become more aware of the deficiencies and ambiguities in our current population objectives. Until a satisfactory resolution of these issues is achieved, we believe it may be advisable to temporarily de-couple the Plan population objective for mallards from AHM, so the harvest-management community can focus on the more fundamental questions of whether, why, and how an external population goal should be included in the AHM objective function. As long as the Plan population objectives remain ambiguous, it will be difficult, if not impossible, to develop a strong, defensible rationale for how the Plan objective for mallards should influence harvest policy. An important corollary, however, is that other approaches must be found to manage harvest of species other than mallards that are less able to sustain liberal harvests (e.g., northern pintail, scaup, canvasback).

To resolve the broader problems, we urge the creation of a small task group that can begin to bridge harvest and habitat management objectives. Representatives from the AHM Working Group and the Plan Science Support Team (NSST) should work together to suggest approaches for clarifying and harmonizing AHM and Plan population objectives. At the same time, we urge that the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and Flyway Councils press ahead with clarifying harvest management objectives. We hasten to emphasize that reaching consensus about population, harvest, and habitat objectives inherently involves subjective values, and therefore lies beyond the sole purview of those dealing with the technical aspects of the two management programs. The AHM Working Group and NSST can offer alternative solutions, but the Plan Committee, the Flyway Councils, and the federal wildlife agencies will need to be intimately involved in finalizing these objectives.

There is urgency for progress. Although *ad hoc* adjustments suggested above could carry AHM through the 2004 regulatory cycle, it would be highly desirable to be on a new course by 2005. For the Plan, although the 2004-2005 continental progress assessment can begin before the issue of mid-continent duck objectives is settled, it cannot be concluded because of the fundamental implications of population objectives for habitat conservation objectives. Regional habitat objectives flow directly from regional and continental population objectives, which form the basis for nearly everything done under the Plan.

We believe it is imperative that the Plan and AHM programs begin work now to harmonize program objectives, at least for the species of ducks important in harvest management. Unified, coherent duck population objectives for harvest and habitat management should be agreed upon and should form the basis for future actions under both AHM and the Plan. AHM and the Plan ought to be working toward the same ends, but that is not possible so long as the mutually reinforcing relationship of these programs is obscured by ambiguities in population objectives.

Literature Cited

Johnson, F.A., M.C. Runge, and J.R. Serie. 2002. The problem of scale in adaptive harvest management: alternatives for recognizing stock-specific variation in harvest potential. U.S. Fish and Wildlife Service, Washington, D.C. [Available online at http://migratorybirds.fws.gov/reports/ahm02/ScaleAlternatives.pdf]

U.S. Department of the Interior and Environment Canada. 1986. The North American Waterfowl Management Plan. U.S. Department of the Interior, Washington, D.C., USA.

U.S. Department of the Interior, Environment Canada, and Secretaria de Desarrollo Social. 1994. 1994 Update to the North American Waterfowl Management Plan: Expanding the commitment. U.S. Department of the Interior, Washington, D.C., USA.

U.S. Fish and Wildlife Service [USFWS]. 2003. Adaptive harvest management: 2003 duck hunting season. U.S. Department of Interior, Washington, D.C., USA.

Williams, B.K. and F.A. Johnson. 1995. Adaptive management and the regulation of waterfowl harvests. Wildlife Society Bulletin 23:430-436.