The black duck has great cultural, social, and economic value to the people of eastern Canada and the eastern United States. Historically, the black duck was the most abundant duck in eastern North America and comprised the majority of the bag for most hunters. As such, when the black duck population began declining in the 1950s and restrictive harvest regulations were implemented in the 1980s, harvest management became more contentious due to the desire of both Canadian and U.S. hunters to have equitable access to the dwindling black duck resource. Although the black duck population stabilized in the 1990s and has remained fairly stable in the 2000s, most of the restrictions on black duck harvest that were implemented in the 1980s were still in place in 2012.

The need for an "adaptive" approach to the setting of waterfowl hunting seasons arises because the consequences of hunting regulations on waterfowl populations cannot be predicted with certainty. Many factors, such as weather, constantly changing habitat conditions, and hunter activity, play a role in the dynamics of duck populations and the number of ducks harvested each year. In addition, due to the nature of waterfowl themselves, it is not possible to fully observe the population (estimates of population size and vital rates are needed), there is little control over environmental factors that affect ducks, and the processes that influence duck populations are not fully understood.

For example, there are two hypotheses about the effects of hunter harvest on the black duck population. One is that hunting reduces annual survival at the population level and therefore reduces the following summer's breeding population. The alternative view is that some black ducks will die during winter regardless of hunting, especially when food or other resources are scarce, so hunting probably does not have much effect on annual survival at the population level. One way we might evaluate a hypothesis like this would be to allow a long hunting season and a large daily bag limit for black ducks for a few years to see if the population declines, or to close the season for a few years to see if the population increases. The first action is unacceptable given the risk to a highly valued resource, and the second action is equally unacceptable to duck hunters in the East.

Another unanswered question is, "What effect do mallards have on black duck population growth (or decline)?" The decline of black ducks coincided with a gradual but large and steady increase in the number of mallards in the East. Some biologists believe that mallards and black ducks compete for resources. Therefore, the increase in mallards resulted in the reduction of resources for black ducks, thus causing the black duck population decline. But again, experiments cannot be conducted to determine if this is true.

Unanswered questions like these are not uncommon in natural resources management, but decisions must still be made despite uncertainty about the consequences of various actions and despite disagreements among stakeholders about what "right" decision to make. Adaptive Resource Management is an effective way of helping managers reach consensus and, at the same time, learn more about the answers to difficult questions like the ones associated with black duck harvest management. Adaptive approaches are designed to inform decisions that have to be made at regular intervals, such as duck hunting regulations (set annually in the U.S.) so that the learning process helps managers improve their decisions over time. It is particularly useful when environmental factors that affect outcomes are unpredictable. Weather is one such factor that has an important impact on the timing of duck migration and thus on hunting success (harvest). Since 1995, an adaptive approach commonly referred to as Adaptive Harvest Management (AHM) has been used to set duck hunting seasons in the United States.

The advantage of a formal AHM framework is that it is based on common goals agreed upon by all stakeholders. AHM incorporates and recognizes uncertainty about the effects of harvest on the population, and uses data-based criteria for selecting appropriate harvest regulations, depending on the status of the black duck population. In other words, AHM provides a scientifically sound platform for regulation setting and maintains a careful balance between hunting opportunity and long-term conservation of the waterfowl resource. The use of AHM also assists greatly in minimizing debate among decision makers when establishing annual regulations. This is particularly the case with the international management of black ducks. The success of AHM for mallard harvest management led the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and the states and provinces of the Atlantic and Mississippi Flyways to take a similar approach specifically for black ducks. In the early 2000s, development began on what is now called Black Duck AHM (BDAHM).

Black Duck AHM

In general, BDAHM consists of a number of key components: (1) a population model that predicts the effects of harvest and environmental factors on black duck abundance, (2) a measure

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Black Duck Management Strategy

in North America

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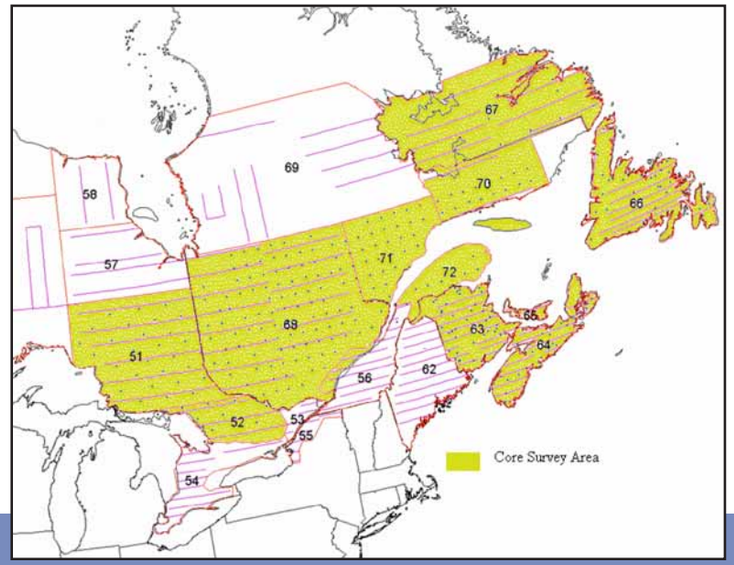
of reliability of each idea or hypothesis within the population model, (3) an overall harvest objective, and (4) a limited set of hunting season packages or regulatory alternatives.

The BDAHM population model, developed over the course of 10 years, incorporates data on black duck and mallard population sizes, harvest levels, reproductive output, and survival estimates to predict the spring black duck breeding population. There are two main hypotheses regarding black duck population dynamics in the model. The first hypothesis is that the abundance of mallards negatively affects black duck reproductive output. The second hypothesis considers whether hunting mortality has any impact on the annual survival rate of black ducks at the population level. Each model output provides a predicted breeding population size, which is compared with the observed breeding population the following spring. The observed breeding population within the core breeding area is estimated each spring based on the integration of helicopter plot survey (Canadian Wildlife Service) and fixed wing transect (USFWS) survey data.



Core Black Duck Survey Area showing aerial survey transects (lines) and helicopter plots (squares).

The Black Duck International Harvest Strategy

The current International Harvest Strategy has been developed between Canada and the U.S. over the course of several years. The strategy aims to achieve 3 main objectives:

(1) Maintain the black duck population at a level commensurate with legal mandates and that provides use appropriate for the habitat carrying capacity;

(2) Maintain societal values associated with the hunting tradition; and

(3) Maintain equitable access (between Canada and the U.S.) to the black duck resource.

In order to achieve objective #1 (maintain black duck population), the strategy strives to maintain harvest levels that are 98% of maximum sustained yield. In theory, this should result in a black duck population that remains stable to slightly increasing while allowing for sustained harvest that satisfies objective #2 (maintain hunting tradition and societal values associated with hunting). The BDAHM assumes objective #2 would be met by a strategy that minimized the frequency of closed seasons, minimized the frequency of regulatory changes between years, and maximized open seasons over time. The final component of the strategy and the BDAHM process is to ensure equal harvest opportunity of the black duck resource for each country (Canada and the U.S.). This is accomplished by allocating the available annual harvest of black ducks equally between the two countries. Allowable harvest is based on expected harvest rates of black ducks in each country given specific regulatory options (packages). However, as previously mentioned, waterfowl managers recognize that control over realized harvest rates is not perfect, so the BDAHM strategy considers equal opportunity to be achieved if the share of the annual harvest is within the range of 40%-60% in either country.

Each year, black duck and mallard breeding populations are used, in conjunction with harvest management objectives and the current knowledge of mallard competition and the effects of hunting mortality, to develop the optimal harvest policy for each country for the upcoming hunting season. At decision-making points, the AHM strategy uses the model's prediction to determine whether hunting regulations should be liberal or more restrictive. Every year, when the predicted population size is compared with the observed size, the hypotheses under scrutiny are re-evaluated based on how much they contribute to (or detract from) making an accurate prediction. Thus, the model's parameters may change from year to year, depending on how well each hypothesis performs. This approach will enable harvest managers to improve regulatory decisions over time by reducing the uncertainty about key aspects of black duck population dynamics.

There are 4 regulatory options in Canada (liberal, moderate, restrictive, closed) and 3 in the U.S. (moderate, restrictive, closed). These regulatory packages are defined by recent harvest rates of adult male black ducks. The current harvest rates correspond with the moderate Canadian package and the restrictive U.S. package. These country specific packages (moderate in Canada and restrictive in the U.S.) are the exact season regulations in place during the 2012-2013 hunting season. The moderate package in the U.S. would consist of a second black duck in the daily bag and a 60-day season. Canadian packages are yet to be determined, but will result in harvest rates that are within previously agreed upon ranges.