United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

FINDING OF NO SIGNIFICANT IMPACT

ENVIRONMENTAL ASSESSMENT
DUCK HUNTING REGULATIONS FOR THE 2017–18 HUNTING SEASON

In 1995, the U.S. Fish and Wildlife Service (Service) implemented the Adaptive Harvest Management (AHM) program for setting duck hunting regulations in the United States. The AHM approach provides a framework for making objective decisions in a setting of incomplete knowledge concerning waterfowl population dynamics and the impacts of regulations.

Harvest regulations were developed under the streamlined process specified in the Final Supplemental Environmental Impact Statement on the Issuance of Annual Regulations Permitting the Hunting of Migratory Birds (SEIS 2013) for the first time last year (2016–17 hunting season). As a result, AHM protocols now include a shift in timing such that regulations for the 2017–18 hunting season were determined in the fall of 2016. AHM optimization methods and decision frameworks have been adjusted to inform 2017–18 duck hunting regulations based on the breeding populations and habitat conditions observed in 2016, and the regulatory alternatives that were implemented for the 2016–17 hunting season.

For the 2017–18 hunting season, the Service considered the same regulatory alternatives as for the 2016–17 hunting season. The nature of the "restrictive," "moderate," and "liberal" alternatives has remained essentially unchanged since 1997, except that extended framework dates have been offered in the "moderate" and "liberal" regulatory alternatives since the 2002–03 season. Harvest rates associated with each of the regulatory alternatives were updated based on a hierarchical, Bayesian analysis of mallard banding and recovery information from 1998 to 2015. The expected harvest rates of adult male mallards under "liberal" hunting seasons are 0.113 (SD = 0.018), 0.140 (SD = 0.035), and 0.129 (SD = 0.029) for mid-continent, eastern, and western mallards, respectively. The estimated marginal effect of framework-date extensions has been an increase in the harvest rate of 0.005 (SD = 0.007) and 0.002 (SD = 0.009) for mid-continent and eastern mallards, respectively.

Optimal regulatory strategies for the 2017–18 hunting season were calculated using: (1) harvest-management objectives specific to each mallard stock; (2) the 2017 regulatory alternatives, (3) the harvest regulations previously selected for the 2016 season, (4) 2016 breeding population and habitat estimates, and (5) current population models. Based on liberal regulatory alternatives selected for the 2016 hunting season, 2016 survey results of

11.89 million mid-continent mallards, 3.49 million ponds in Prairie Canada, 0.72 million eastern mallards, and 1.07 million western mallards observed in Alaska (0.58 million) and in the southern Pacific Flyway (0.48 million), the optimal choice for all four flyways is the liberal regulatory alternative.

In the traditional survey area, which includes strata 1–18, 20–50, and 75–77, the 2016 total duck population estimate (excluding scoters [*Melanitta* spp.], eiders [*Somateria* spp. and *Polysticta stelleri*], long-tailed ducks [*Clangula hyemalis*], mergansers [*Mergus* spp. and *Lophodytes cucullatus*], and wood ducks [*Aix sponsa*]) was 48.4 ± 0.8 [SE] million birds. This estimate was similar to the 2015 estimate of 49.5 ± 0.8 million, and 38 percent higher than the long-term average (1955–2015). Estimated mallard (*Anas platyrhynchos*) abundance was 11.8 ± 0.4 million, which was similar to the 2015 estimate of 11.6 ± 0.4 million, and 51 percent above the long-term average of 7.8 ± 0.04 million. Estimated abundances of gadwall (*A. strepera*; 3.7 ± 0.2 million) and American wigeon (*A. americana*; 3.4 ± 0.2 million) were similar to their 2015 estimates, and were 90 percent and 31 percent above their long-term averages of 2.0 ± 0.02 million and 2.6 ± 0.02 million, respectively. The estimated abundance of green-winged teal (*A. crecca*) was 4.3 ± 0.3 million, which was similar to the 2015 estimate of 4.1 ± 0.3 million, and 104 percent above the long-term average (2.1 ± 0.02 million). 2016 marked the highest estimate in the time series for green-winged teal. Estimated 2016 blue-winged teal (*A. discors*; 6.7 ± 0.3 million) abundance was 22 percent lower than the 2015 estimate of 8.5 ± 0.4 million, but 34 percent above the long-term average of 5.0 ± 0.04 million. Estimated 2016 abundance of northern shovelers (*A. clypeata*; 4.0 ± 0.2 million) was similar to the 2015 estimate and 56 percent above the long-term average of 2.5 ± 0.02 million. Northern pintail abundance (*A. acuta*; 2.6 ± 0.2 million) in 2016 was similar to the 2015 estimate and 34 percent below the long-term average of 4.0 ± 0.04 million. Abundance estimates for redheads (*Aythya americana*; 1.3 ± 0.1 million) and canvasbacks (*A. valisineria*; 0.7 ± 0.07 million) were similar to their 2015 estimates and were 82 percent and 26 percent above their long-term averages of 0.7 ± 0.01 million and 0.6 ± 0.01 million, respectively. In 2016, estimated abundance of scaup (*A. affinis* and *A. marila* combined; 5.0 ± 0.3 million) was similar to the 2015 estimate and to the long-term average of 5.0 ± 0.05 million. The 2016 projected mallard fall flight index was 13.5 ± 1.4 million birds.

In 2005, the Service and the Canadian Wildlife Service integrated data from two previously independent waterfowl surveys conducted in eastern North America into a single composite estimate, using hierarchical models. Consequently, the total indicated bird definitions for American black ducks (*Anas rubripes*) were modified to provide a common index across surveys, and adjustments were made to the geographic stratification of the eastern survey area. Hierarchical model estimates for the time series from 1990 to the present are updated each year, resulting in estimates that may differ slightly from those previously published. In cases where the Service has traditionally not recorded observations to the species level, composite estimates are provided for multiple-species groupings (i.e., mergansers and goldeneyes [*Bucephala clangula* and *B. islandica*]). In the eastern survey area, estimated abundance of American black ducks for 2016 was 0.6 ± 0.05 million, which was 13 percent higher than the 2015 estimate of 0.5 ± 0.04 million, and similar to the 1990–2015 average of 0.6 ± 0.04 million. The 2016 estimated

abundance of mallards (0.4 ± 0.1 million) and mergansers (0.4 ± 0.04 million) were similar to the 2015 estimates and their 1990–2015 averages. Abundance estimates of green-winged teal (0.2 ± 0.04 million) and ring-necked ducks *(Aythya collaris*, 0.6 ± 0.09 million) were similar to their 2015 estimates and 1990–2015 averages. The 2016 estimate of goldeneyes (common and Barrow's, 0.4 ± 0.06 million) was similar to the 2015 estimate and 14 percent lower than the 1990–2015 average.

In general, the Canadian and U.S. prairies experienced early spring phenology in 2016. However, habitat conditions in these areas during the 2016 Waterfowl Breeding and Population Habitat Survey were poorer than in 2015 because of below-average precipitation and subsequent drying of wetlands. Most prairie and parkland regions were at best fair for waterfowl production; only areas dominated by semi-permanent and permanent wetlands were rated good. The 2016 total pond estimate (Prairie Canada and U.S. combined) was 5.0 ± 0.2 million, which was 21 percent below the 2015 estimate of 6.3 ± 0.2 million, and similar to the long-term average of 5.2 ± 0.03 million. The 2016 estimate of ponds in Prairie Canada was 3.5 ± 0.1 million. This estimate was 16 percent below the 2015 estimate of 4.2 ± 0.1 million and similar to the long-term average (3.5 ± 0.02 million). The 2016 pond estimate for the northcentral U.S. was 1.5 ± 0.05 million, which was 30 percent below the 2015 estimate of 2.2 ± 0.09 million and 11 percent below the long-term average (1.7 ± 0.01 million).

In the eastern survey area, spring phenology was advanced in southern areas, and in Newfoundland and Labrador, where good to excellent breeding conditions were reported. In the eastern Arctic, including the Ungava Peninsula in northern Quebec, and Baffin and Bylot islands, breeding conditions were average to slightly below average.

In the western boreal regions of the traditional survey area and in Alaska, habitat conditions in 2016 were similar to or improved relative to 2015, with above-average breeding conditions. Ice and snow melt timing was very early in Alaska and the western Arctic, with snow and ice melt dates that were the earliest recorded in some areas. Ice and snow melt was normal to slightly early in the north-central and south-central Arctic.

Based on review and evaluation of the information contained in the supporting documents below, I have determined that the proposed action to amend 50 CFR part 20 subpart K, to allow the hunting of certain migratory birds during the 2017–18 hunting season, will provide adequate protection to ducks and that this is not a major Federal action that would significantly affect the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act of 1969. Accordingly, the preparation of an environmental impact statement on the proposed action is not required.

Supporting Documents

1. Environmental Assessment: Duck Hunting Regulations for 2017-18
2. Waterfowl Population Status, 2016
3. Adaptive Harvest Management: 2017 Hunting Season

4. Migratory Bird Hunting Activity and Harvest during the 2014-15 and 2015-16 Hunting Seasons.
5. Economic Analysis of the Migratory Bird Hunting Regulations for the 2013–14 Season

7APR2017 — Date

James W. Kurth — Director

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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APRIL 2017

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EXECUTIVE SUMMARY

In 1995, the U.S. Fish and Wildlife Service (USFWS, or Service) implemented the Adaptive Harvest Management (AHM) program for setting duck hunting regulations in the United States. The AHM approach provides a framework for making objective decisions in a setting of incomplete knowledge concerning waterfowl population dynamics and regulatory impacts.

The 2017 regulatory process implements the regulations specified in the 2013 Final Supplemental Environmental Impact Statement on the Issuance of Annual Regulations Permitting the Hunting of Migratory Birds (US Department of the Interior [DOI] 2013). As a result, revised AHM protocols incorporate a shift in decision timing whereby the regulations for the 2017 hunting season were determined during the fall of 2016 (USFWS 2016a). Adjustments to optimization methods and AHM decision frameworks were developed to inform 2017 regulations based on the breeding populations and habitat conditions observed in 2016, and the regulatory alternatives that were selected for the 2016 hunting season (USFWS 2016a).

The AHM protocol is based on the population dynamics and status of three mallard (*Anas platyrhynchos*) stocks including the mid-continent, eastern, and western (Figure 1). Mid-continent mallards are defined as those breeding in the Waterfowl Breeding Population and Habitat Survey (WBPHS) strata 13–18, 20–50, and 75–77 (Figure 2) plus mallards breeding in the states of Michigan, Minnesota, and Wisconsin (state surveys). The prescribed regulatory alternative for the Mississippi and Central Flyways depends exclusively on the status of these mallards. Eastern mallards are defined as those breeding in WBPHS strata 51–54 and 56 (Figure 2) and breeding in the states of Virginia northward into New Hampshire (Atlantic Flyway Breeding Waterfowl Survey; Heusmann and Sauer 2000). The regulatory choice for the Atlantic Flyway depends exclusively on the status of these mallards. In 2016, western mallards were redefined as those birds breeding in two sub-stocks: Alaska-Yukon (Alaska and the Yukon Territory (WBPHS strata 1-12; Figure 2) and the Southern Pacific Flyway (California, Oregon, Washington and British Columbia [state and provincial waterfowl breeding population habitat surveys]). The regulatory choice for the Pacific Flyway depends exclusively on the status of mallards from these two sub-stocks.

For the 2017–18 duck hunting season, the Service considered the same four regulatory alternatives that were considered for the 2016-17 season:

Alternative 1 - Closed duck-hunting seasons (no action)

Alternative 2 - Issue restrictive duck-hunting regulations

Alternative 3 - Issue moderate duck-hunting regulations

Alternative 4 - Issue liberal duck-hunting regulations (proposed action)

The nature of the restrictive, moderate, and liberal alternatives has remained essentially unchanged since 1997 (USFWS 1997), except that extended framework dates (i.e., the earliest and latest dates hunting is allowed) have been offered in the moderate and liberal alternatives since 2002.

Optimal regulatory strategies for the 2017-18 hunting season were calculated using: (1) harvest-management objectives specific to each mallard stock; (2) the 2017 regulatory alternatives, (3)

the harvest regulations that were selected for the 2016 season, (4) 2016 breeding population and habitat estimates, and (5) current population models. Based on liberal regulatory alternatives selected for the 2016 hunting season, 2016 survey results of 11.89 million mid-continent mallards, 3.49 million ponds in Prairie Canada, 0.72 million eastern mallards, and 1.07 million western mallards observed in Alaska (0.58 million) and the southern Pacific Flyway (0.48 million), the optimal choice for all four flyways is the liberal regulatory alternative.

Therefore, the Service proposes to issue liberal duck-hunting regulations in 2017 (Alternative 4). The projected harvest under this alternative is about 13.9 million ducks (based on the mean annual duck harvest in the United States during 1999–2015, when regulations similar to this alternative were issued). This alternative was selected because it is consistent with results from the AHM program for mallard populations and because most other duck populations are either near or at population size objectives.

Detailed information on procedures for issuing regulations, the status of ducks, the alternatives and impacts of alternatives are presented in this Environmental Assessment.

For more information regarding this document contact Brad Bortner, Chief, Division of Migratory Bird Management, U.S. Fish and Wildlife Service Headquarters, Mail Stop MB, 5275 Leesburg Pike, Falls Church, VA 22041-3803, (703) 358-1966.

PURPOSE AND NEED FOR ACTION

Purpose

Annually, the U.S. Fish and Wildlife Service (USFWS or Service) issues regulations permitting the sport hunting of migratory birds. The 1988 Final Supplemental Environmental Impact Statement: Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds (SEIS 1988; USDOI 1988), and the 2013 Final Supplemental Environmental Impact Statement on the Issuance of Annual Regulations Permitting the Hunting of Migratory Birds (SEIS 2013; USDOI 2013) provide National Environmental Policy Act coverage for this activity. Additionally, both documents provide broad, long-term guidelines for issuing annual regulations. They do not, however, prescribe year-specific regulations; those are developed annually. The purpose of this Environmental Assessment is to facilitate the development of the 2017-18 annual duck hunting regulations.

Scope

Regulations governing the hunting of migratory birds are specified in Title 50, Code of Federal Regulations, Part 20. This assessment applies specifically to those regulations appearing in Subpart K and commonly referred to as "annual" regulations. This assessment covers regulations for ducks, which are among the most complex of migratory bird hunting regulations. Relative to ducks, few changes are proposed for most other migratory bird seasons. Most goose and swan populations in North America remain numerically sound, and some changes in season length, bag limit, etc., are being made for certain goose populations, consistent with population status and management plans. Thus, no special action is needed.

For swans in the Pacific Flyway, hunting has been assessed under a separate Environmental Assessment, and we refer the reader to that document for details (August 19, 2003 Federal Register [68 FR 50016]). In the Central, Mississippi, and Atlantic Flyways, swan harvests are limited to Tundra swans, and are guided by a cooperatively developed management plan for the Eastern Population of Tundra Swans (Ad Hoc EP Tundra Swan Committee 2007). The Eastern Population of Tundra Swans is currently above objective level and harvest is limited by permits issued to individual states per the guidelines established in the cooperatively developed management plan.

Need for Action

There continues to be high demand for utilization of the migratory game bird resource. Approximately 1 million people in the United States over the age of 16 actively hunted in the 2015 waterfowl season and harvested 13.3 million ducks (USFWS 2016b). Migratory bird populations fluctuate annually largely in response to habitat change. The Service annually evaluates demographic and habitat parameters to assess the status of migratory bird populations. It also annually sets migratory bird hunting regulations appropriate to ensure the long-term welfare of these populations.

Authority and Responsibility

Migratory game birds, including ducks, are those bird species so designated in conventions between the United States and several foreign nations for the protection and management of these birds. Under the Migratory Bird Treaty Act (16 U.S.C. 703–712), the Secretary of the Interior is authorized to determine when "hunting, taking, capture, killing, possession, sale,

purchase, shipment, transportation, carriage, or export of any * * * bird, or any part, nest, or egg" of migratory game birds can take place, and to adopt regulations for this purpose. These regulations are written after giving due regard to "the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds" and are updated annually (16 U.S.C. 704(a)). This responsibility has been delegated to the Service as the lead Federal agency for managing and conserving migratory birds in the United States. The Service develops migratory game bird hunting regulations by establishing the frameworks, or outside limits, for season lengths, bag limits, and areas for migratory game bird hunting.

After Service establishment of final frameworks for hunting seasons, the States may select season dates, bag limits, and other regulatory options for the hunting seasons. States may always be more conservative in their selections than the Federal frameworks, but never more liberal.

The SEIS 1988 (USDOI 1988) and SEIS 2013 (USDOI 2013) document the statutory authority and responsibility of the Federal Government and the States in migratory bird management.

Administrative Process

Overview

Acknowledging regional differences in hunting conditions, the Service has administratively divided the nation into four Flyways for the primary purpose of managing migratory game birds. Each Flyway (Atlantic, Mississippi, Central, and Pacific) has a Flyway Council, a formal organization generally composed of one member from each State and Province in that Flyway. The Flyway Councils, established through the Association of Fish and Wildlife Agencies, also assist in researching and providing migratory game bird management information for Federal, State, and Provincial Governments, as well as private conservation agencies and the general public.

The process for adopting migratory game bird hunting regulations, located at 50 CFR 20, is constrained by three primary factors including legal, administrative and biological. Legal and administrative factors dictate how long the rulemaking process will last. Most importantly however, the biological cycle of migratory game birds controls the timing of data-gathering activities and thus the dates on which these results are available for consideration and deliberation.

For each cycle, Service biologists gather, analyze, and interpret biological survey data and provide this information to all those involved in the process through a series of published status reports and presentations to Flyway Councils and other interested parties. Because the Service is required to take abundance of migratory game birds and other factors into consideration, the Service undertakes a number of surveys throughout the year in conjunction with Service Regional Offices, the Canadian Wildlife Service, and State and Provincial wildlife-management agencies. To determine the appropriate frameworks for each species, the Service considers factors such as population size and trend, geographical distribution, annual breeding effort, the condition of breeding and wintering habitats, the number of hunters, and the anticipated harvest.

Beginning with the 2016-17 hunting seasons, the previous two-cycle regulatory practice of setting early and late seasons separately is now compressed into a single, annual process. Biological data from the previous year (e.g., 2016) are now used to set hunting season dates and to project appropriate harvest limits for each game species (in this case, for 2017). The change gives biologists more time to analyze bird survey data that inform the Service's regulatory decisions and gives the public more time to comment on proposed rules. The change also ensures that administrative procedures will not delay the opening of state hunting seasons.

The SEIS 1988 (USDOI 1988) and SEIS 2013 (USDOI 2013) provide more complete information on the administrative process for issuing annual regulations permitting the sport hunting of migratory birds.

Schedule

The Service exercises its authority and fulfills its responsibilities through a well-established, multi-step administrative process. The Service invites comments, suggestions, and recommendations from interested persons and organizations throughout the rulemaking process to ensure that the final regulations are as responsive to the need for action as possible. The following events are major steps in the annual regulatory cycle for establishing current year migratory bird hunting regulations relating to open public meetings and Federal Register notifications. This schedule reflects the changes implemented under the preferred alternative outlined in SEIS 2013, most notably, that early and late season regulations are combined into a single process, and that regulatory proposals are developed based on data from the previous year, model predictions, or current-year information (Boomer et al. 2015). Those changes mean that the number and timing of meetings and publications also changed, so this schedule differs markedly from those published in Environmental Assessments prior to 2016.

1. A proposed rulemaking notice is published in the Federal Register in June (2016) of the year prior to the hunting season under consideration (2017). The proposal announces our intent to open seasons, provides a background and overview of the migratory bird hunting regulation setting process, and deals with the establishment of seasons, limits, and other regulations for hunting migratory game birds. The proposed rule was published in the Federal Register on June 10, 2016 (81 FR 38050).
2. The Service's Migratory Bird Regulations Committee (SRC) meets in June to consider issues for the following year's regulatory cycle and to develop initial migratory bird regulation frameworks. The SRC met on June 15, 2016.
3. Flyway Councils, technical committees, and Management Unit committees meet in August, September or October to consider available biological information and to provide recommendations on migratory bird hunting regulations to the Service for the following year. The Flyway Councils and Tech Sections met between late August and early October 2016.
4. The SRC meets in late October to formulate proposed regulations for the following year (2017), considering currently available biological information, and comments and recommendations received by the Service. The SRC met on October 25 and 26, 2016.

5. A proposed rulemaking notice for the following year's regulations is published in the Federal Register in winter, for the following year's (2017) regulations. The proposed rule for 2017 seasons was published in the Federal Register on February 9, 2017 (82 FR 10222). Final season frameworks are scheduled to be published in late April 2017. Final State selections are scheduled to be published in late May or early June, prior to the opening of seasons on September 1 of that calendar year.
6. Flyway Councils and technical committees meet in February or March (2017), to consider biological information and migratory bird issues that pertain to the hunting regulations the following year (2018).

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Adaptive Harvest Management

In 1995 the Service implemented the AHM program for setting duck hunting regulations in the United States (USFWS 2016a), based on the concept of adaptive resource management (Walters 1986). The AHM approach provides a framework for making objective decisions in a setting of incomplete knowledge concerning waterfowl population dynamics and regulatory impacts.

This approach explicitly recognizes that the consequences of hunting regulations cannot be predicted with certainty, and provides a framework for making objective decisions in the face of that uncertainty (Williams and Johnson 1995). Inherent in the adaptive approach is an awareness that management performance can be maximized only if regulatory effects can be predicted reliably. Thus, adaptive management relies on an iterative cycle of monitoring, assessment, and decision-making to clarify the relationships among hunting regulations, harvests, and waterfowl abundance.

In regulating waterfowl harvests, managers face four fundamental sources of uncertainty (Nichols et al. 1995, Johnson et al. 1996, Williams et al. 1996):

1. Environmental variation - the temporal and spatial variation in weather conditions and other key features of waterfowl habitat; an example is the annual change in the number of ponds in the Prairie Pothole Region, where water conditions influence duck reproductive success;
2. Partial controllability - the ability of managers to control harvest only within limits; the harvest resulting from a particular set of hunting regulations cannot be predicted with certainty because of variation in weather conditions, timing of migration, variable hunter effort, and other factors;
3. Partial observability - the ability to estimate key population attributes (e.g., population size, reproductive rate, harvest) only within the precision afforded by extant monitoring programs; and
4. Structural uncertainty - an incomplete understanding of biological processes; a familiar example is the long-standing debate about whether harvest is additive to other sources of mortality or whether populations compensate for hunting losses through reduced natural mortality. Structural uncertainty increases contentiousness in the decision-making

process and decreases the extent to which managers can meet long-term conservation goals.

AHM was developed as a systematic process for dealing objectively with these uncertainties. The key components of AHM include (Johnson et al. 1993, Williams and Johnson 1995):

1. A limited number of regulatory alternatives, which describe Flyway-specific season lengths, bag limits, and framework dates;
2. A set of population models describing various hypotheses about the effects of harvest and environmental factors on waterfowl abundance;
3. A measure of reliability (probability or "weight") for each population model; and
4. A mathematical description of the objective(s) of harvest management (i.e., an "objective function"), by which alternative regulatory strategies can be compared.

These components are used in a stochastic optimization procedure to derive a regulatory strategy. A regulatory strategy specifies the optimal regulatory choice, with respect to the stated management objectives, for each possible combination of breeding population size, environmental conditions, and model weights (Johnson et al. 1996). The setting of annual hunting regulations then involves an iterative process:

1. Each year, an optimal regulatory choice is identified based on resource and environmental conditions, and on current model weights;
2. After the regulatory decision is made, model-specific predictions for subsequent breeding population size are determined;
3. When monitoring data become available, model weights are increased to the extent that observations of population size agree with predictions, and decreased to the extent that they disagree; and
4. The new model weights are used to start another iteration of the process.

By iteratively updating model weights and optimizing regulatory choices, the process should eventually identify which model is the best overall predictor of changes in population abundance. The process is optimal in the sense that it provides the regulatory choice each year necessary to maximize management performance. It is adaptive in the sense that the harvest strategy "evolves" to account for new knowledge generated by a comparison of predicted and observed population sizes.

The AHM protocol is based on the population dynamics and status of three mallard (*Anas platyrhynchos*) stocks including the mid-continent, eastern, and western (Figure 1). Mid-continent mallards are defined as those breeding in the Waterfowl Breeding Population and Habitat Survey (WBPHS) strata 13–18, 20–50, and 75–77 (Figure 2) plus mallards breeding in the states of Michigan, Minnesota, and Wisconsin (state surveys). The prescribed regulatory alternative for the Mississippi and Central Flyways depends exclusively on the status of these mallards. Eastern mallards are defined as those breeding in WBPHS strata 51–54 and 56 (Figure 2) and breeding in the states of Virginia northward into New Hampshire (Atlantic Flyway

Breeding Waterfowl Survey; Heusmann and Sauer 2000). The regulatory choice for the Atlantic Flyway depends exclusively on the status of these mallards. In 2016, western mallards were redefined as those birds breeding in two sub-stocks: Alaska-Yukon (Alaska and the Yukon Territory (WBPHS strata 1-12; Figure 2) and the Southern Pacific Flyway (California, Oregon, Washington and British Columbia [State and Provincial waterfowl breeding population habitat surveys]). The regulatory choice for the Pacific Flyway depends exclusively on the status of mallards from these two sub-stocks.

The flyway-specific regulatory alternatives prescribed by mid-continent, eastern, and western mallard AHM in any given year determine the overall season length, daily bag limit for ducks, daily bag limit for mallards, and framework dates for that year's duck hunting season. For certain other species, smaller bag limits and/or shorter season lengths may be prescribed within the overall season length and daily bag limit, either by species-specific harvest strategies (see USFWS 2016a) or based on current information on their population status.

When AHM was first implemented in 1995, three regulatory alternatives characterized as liberal, moderate, and restrictive were defined based on regulations used during 1979–1984, 1985–1987, and 1988–1993, respectively. These regulatory alternatives also were considered for the 1996 hunting season. In 1997, the regulatory alternatives were modified to include: (1) the addition of a very-restrictive alternative; (2) additional days and a higher duck bag limit in the moderate and liberal alternatives; and (3) an increase in the bag limit for hen mallards in the moderate and liberal alternatives. In 2002, the Service further modified the moderate and liberal alternatives to include extensions of approximately one week in both the opening and closing framework dates.

In 2003, the very-restrictive alternative was eliminated at the request of the Flyway Councils. Expected harvest rates under the very-restrictive alternative did not differ significantly from those under the restrictive alternative, and the very-restrictive alternative was expected to be prescribed for <5% of all hunting seasons. Also, at the request of the Flyway Councils the Service agreed to exclude closed duck-hunting seasons from the AHM protocol when the population size of mid-continent (traditional survey area plus the Great Lakes region) mallards is ≥5.5 million. Based on our assessment, closed hunting seasons do not appear to be necessary from the perspective of sustainable harvesting when the mid-continent mallard population exceeds this level. The impact of maintaining open seasons above this level also appears to be negligible for other mid-continent duck species, as based on population models developed by Johnson (2003). However, complete or partial-season closures for particular species or populations could still be deemed necessary in some situations regardless of the status of mid-continent mallards.

Each of the AHM regulatory alternatives considered has specific regulations for each of the four Flyways that were developed through consultations with the Flyway Councils and others. These alternatives were considered because of their wide-based support by the Flyway Councils and because harvest rates associated with the alternatives were biologically justifiable.

Thus, the alternative actions considered in this Environmental Assessment include:

Alternative 1 - Closed duck-hunting seasons (no action)

Alternative 2 - Issue restrictive duck-hunting regulations

Alternative 3 - Issue moderate duck-hunting regulations

Alternative 4 - Issue liberal duck-hunting regulations (proposed action)

The proposed action (Alternative 4) is to issue annual hunting regulations that will be similar to those of 2016. The four alternatives differ primarily in their season lengths and daily bag-limits, which are considered the primary tools for regulating duck harvest. Because duck hunting seasons remained closed until the Service proposes to open them via the annual regulatory process, Alternative 1 constitutes no action.

Other Regulatory Considerations

The Service has developed policies on the use of various regulations. Generally, these policies have minimized or eliminated the use of some regulatory options, regardless of the regulatory alternative that is selected. Restricting shooting hours beyond the traditional times of one-half hour before sunrise until sunset is not a preferred method to reduce harvest. In 2011, the Service revised the criteria for duck season zones and split seasons, adding one additional zone and one additional split that a State may use in establishing duck seasons. Since 1988, a point-system option that is more liberal than the conventional daily bag limit has not been offered, and the Service has not offered any point-system option since 1994. Special seasons will continue to be considered when adequate data are available to allow an evaluation of their impacts and additional harvest opportunity is warranted.

Special seasons provide hunting opportunity in certain geographic areas on birds that otherwise would be lightly harvested during regular seasons or to provide limited additional hunting opportunities for youth. There are currently four special seasons offered for duck hunting. Two of the special seasons are in September, are less than or equal to 16 days in length, and are primarily intended to provide harvest opportunity for blue-winged teal that otherwise migrate south before the regular season. These seasons include (1) a teal season offered in some non-production states within the Atlantic, Mississippi, and Central Flyways; and (2) a combined teal and wood duck season offered in Florida, Kentucky and Tennessee. The third special season allows states to select two days designated as "Youth Waterfowl Hunting Days," where the days must be held outside any regular duck season on a weekend, holidays, or other non-school days when youth hunters would have the maximum opportunity to participate. The bag limit may include ducks, geese, mergansers, coots, moorhens, and gallinules and would be the same as those allowed in the regular season. Finally, the fourth special season allows some states along the east coast to select a separate 60-day season for certain sea ducks (scoters, eiders, and long-tailed ducks). All four special seasons are available in each of the AHM regulatory alternatives, and thus, the alternatives in this Environmental Assessment, except Alternative 1, which allows no open seasons.

Additionally, the Pacific Flyway regulations do not apply to Alaska. For all open-season alternatives, the season length is 107 days and the framework dates are September 1 to January 26. Daily bag limits vary from 5-8 for the restrictive alternative, and 7-10 in the moderate and liberal alternatives, depending on the area hunted.

Alternative 1: Closed duck-hunting seasons (no action)

Alternative 2: Issue restrictive duck-hunting regulations

Atlantic Flyway

Season Length: Not more than 30 days.

Limits:

(1) The daily bag limit is 3 ducks, including no more than 1 female mallard.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: October 1–January 20.

Mississippi Flyway

Season Length: Not more than 30 days.

Limits:

(1) The daily bag limit is 3 ducks, including no more than 2 mallards, no more than 1 of which may be a female.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest October 1–Sunday nearest January 20.

Central Flyway

Season Length: Not more than 39 days (51 days in the High Plains Mallard Management Unit).

Limits:

(1) The daily bag limit is 3 ducks, including no more than 1 female mallard.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest October 1–Sunday nearest January 20.

Pacific Flyway

Season Length: Not more than 60 days (67 days in the Columbia Basin Mallard Management Unit).

Limits: The daily bag limit is 4 ducks, including no more than 3 mallards, no more than 1 of which may be a female.

Framework Dates: Saturday nearest October 1–Sunday nearest January 20.

Alternative 3: Issue moderate duck-hunting regulations

Atlantic Flyway

Season Length: Not more than 45 days.

Limits:

(1) The daily bag limit is 6 ducks, including no more than 4 mallards, no more than 2 of which may be female.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Mississippi Flyway

Season Length: Not more than 45 days.

Limits:

(1) The daily bag limit is 6 ducks, including no more than 4 mallards, no more than 1 of which may be female.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Central Flyway

Season Length: Not more than 60 days (83 days in the High Plains Mallard Management Unit).

Limits:

(1) The daily bag limit is 6 ducks, including no more than 5 mallards, no more than 1 of which may be female.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Pacific Flyway

Season Length: Not more than 86 days (93 days in the Columbia Basin Mallard Management Unit).

Limits: The daily bag limit is 7 ducks, including no more than 5 mallards, no more than 2 of which may be female.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Alternative 4: Issue liberal duck-hunting regulations (proposed action)

Atlantic Flyway

Season Length: Not more than 60 days.

Limits:

(1) The daily bag limit is 6 ducks, including no more than 4 mallards, no more than 2 of which may be female.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, no more than 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Mississippi Flyway

Season Length: Not more than 60 days.

Limits:

(1) The daily bag limit is 6 ducks, including no more than 4 mallards, no more than 2 of which may be female.

(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, only 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Central Flyway

Season Length: Not more than 74 days (97 days in the High Plains Mallard Management Unit).

Limits:

(1) The daily bag limit is 6 ducks, including no more than 5 mallards, no more than 2 of which may be female.
(2) In addition to other ducks, a daily limit of 5 mergansers is permitted, only 2 of which may be hooded mergansers.

Framework Dates: Saturday nearest September 24–last Sunday in January.

Pacific Flyway

Season Length: Not more than 107 days (107 days in the Columbia Basin Mallard Management Unit).
Limits: The daily bag limit is 7 ducks, including no more than 2 female mallards.
Framework Dates: Saturday nearest September 24–last Sunday in January.

AFFECTED ENVIRONMENT

Ducks

The taxonomic family Anatidae, principally subfamily Anatinae (ducks), and its habitat comprise the affected environment. A complete list of species and general description of habitats are found in SEIS 1988 (USDOI 1988) and SEIS 2013 (USDOI 2013).

Duck Population Status Monitoring

Spring Surveys

Federal, provincial, and state agencies conduct surveys each spring to estimate the size of duck breeding populations and to evaluate habitat conditions. These surveys are conducted using fixed-wing aircraft and helicopters, and cover over 2.0 million square miles that encompass principal breeding areas of North America (Figure 2). The traditional survey area (strata 1–18, 20–50, and 75–77) comprises parts of Alaska, Canada, and the northcentral United States, and includes approximately 1.3 million square miles. The eastern survey area (strata 51–72) includes parts of Ontario, Quebec, Labrador, Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, New York, and Maine, covering an area of approximately 0.7 million square miles. In Prairie and Parkland Canada and the northcentral United States, aerial waterfowl counts are corrected annually for visibility bias by conducting ground counts. In the northern portions of the traditional survey area and in the eastern survey area, duck estimates are adjusted using visibility correction factors derived from a comparison of airplane and helicopter counts. Annual estimates of duck abundance are available since 1955 for the traditional survey area and since 1996 for all strata (except 57–59, 69) in the eastern survey area. However, portions of the eastern survey area have been surveyed since 1990. In the traditional survey area, estimates of pond abundance in Prairie Canada are available since 1961 and in the northcentral United States since 1974. Several Provincial and State agencies also conduct breeding waterfowl surveys using various methods; some have survey designs that allow calculation of measures of precision for their estimates. Information about habitat conditions is supplied primarily by biologists working in the survey areas and ancillary weather information is obtained from agricultural and weather internet sites.

The Waterfowl Breeding Population and Habitat Survey (WBPHS) begins in early May and ends in mid-June. It provides population estimates of the total duck population and for each of several

major duck species nesting in principal breeding areas of North America. The survey also provides an estimate of the number of ponds in the northcentral United States and in Prairie Canada. Information from this survey is most reliable for abundant and widely distributed species such as the mallard; it is less reliable for species with lower abundance and for those species whose nesting range is partly outside the survey area. Thus, for example, changes in the status of mallard breeding populations are measured with greater precision than those for canvasback and scaup.

Results of breeding waterfowl abundance and habitat surveys are published annually. Results for 2016 were published in Waterfowl Population Status, 2016 (Table 1, USFWS 2016a).

Winter Surveys

An extensive waterfowl survey is conducted each year in early January. Coordinated by the Service, it is conducted cooperatively with the States and other agencies. The purpose of this survey is to record the number and distribution of waterfowl wintering in the United States and the condition of wintering habitat. It provides supplementary information on the status of various waterfowl species for which breeding ground surveys are unsatisfactory or are being developed. Counts obtained from the mid-winter survey should be considered indices because they do not cover the entire winter range of most species, and because they do not account for imperfect detection.

Results of special surveys are generally published annually in Flyway Data Books maintained by Service representatives to the Flyways, and are available online (https://www.fws.gov/birds/surveys-and-data/reports-and-publications/flyway-data-books.php).

Duck Harvest, Harvest Rates, and Survival Monitoring

Waterfowl Harvest Survey

The Service conducts a mail survey each year to gather data on the activity and success of waterfowl hunters (Tables 2 & 3). The survey is based on a sample of migratory bird hunters from each state whose names and addresses were gathered through the Migratory Bird Harvest Information Program (HIP). Information from this survey is used in developing annual estimates of the United States waterfowl harvest.

Some of the mail survey cooperators are asked in subsequent seasons to send in wings or tail feathers from migratory birds they shoot. Prepaid envelopes are provided for submitting these parts to the Service. Examination of plumage reveals the species, age, and sex of harvested birds. Data from the Parts Collection Survey are used in conjunction with data from the larger HIP survey, allowing national estimates to be made of the species composition and age and sex ratios of harvested waterfowl. Age ratios of the harvest provide indices to the recruitment rates for various populations. The most recent survey results are published in Migratory Bird Hunting Activity and Harvest for the 2014-15 and 2015-16 Hunting Seasons (Table 2 & 3, USFWS 2016b).

Banding Programs

Approximately 200,000 ducks are banded annually to gather information needed for managing waterfowl. Band-recovery data are used to determine the distribution of harvest from various breeding and wintering areas and to define the source of birds harvested in an area. Band recoveries from hunters provide an index to the harvest rate; this rate is useful for understanding the effects of changes in hunting regulations. Direct recoveries are those recoveries that occur within the first year after the bird was banded. Harvest rates can be estimated from direct recovery rates, if band-reporting and band-loss rates are known. Band loss is assumed to be negligible, and in the U.S, band reporting rates typically range between 70 and 80% (Boomer et al. 2013, Garrettson et al. 2014). All these data are used to support the adaptive harvest management program.

Duck Breeding Population Status and Habitat Conditions in 2016

In the traditional survey area, which includes strata 1–18, 20–50, and 75–77 (Figure 2), the 2016 total duck population estimate (excluding scoters [*Melanitta* spp.], eiders [*Somateria* spp. and *Polysticta stelleri*], long-tailed ducks [*Clangula hyemalis*], mergansers [*Mergus* spp. and *Lophodytes cucullatus*], and wood ducks [*Aix sponsa*]) was 48.4 ± 0.8 [SE] million birds. This estimate was similar to the 2015 estimate of 49.5 ± 0.8 million, and 38% higher than the long-term average (1955–2015). Estimated mallard abundance was 11.8 ± 0.4 million, which was similar to the 2015 estimate of 11.6 ± 0.4 million, and 51% above the long-term average of 7.8 ± 0.04 million. Estimated abundances of gadwall (*A. strepera*; 3.7 ± 0.2 million) and American wigeon (*A. americana*; 3.4 ± 0.2 million) were similar to their 2015 estimates, and were 90% and 31% above their long-term averages of 2.0 ± 0.02 million and 2.6 ± 0.02 million, respectively. The estimated abundance of green-winged teal (*A. crecca*) was 4.3 ± 0.3 million, which was similar to the 2015 estimate of 4.1 ± 0.3 million, and 104% above the long-term average (2.1 ± 0.02 million). 2016 marked the highest estimate in the time series for green-winged teal. Estimated 2016 blue-winged teal (*A. discors*; 6.7 ± 0.3 million) abundance was 22% lower than the 2015 estimate of 8.5 ± 0.4 million, but 34% above the long-term average of 5.0 ± 0.04 million. Estimated 2016 abundance of northern shovelers (*A. clypeata*; 4.0 ± 0.2 million) was similar to the 2015 estimate and 56% above the long-term average of 2.5 ± 0.02 million. Northern pintail abundance (*A. acuta*; 2.6 ± 0.2 million) in 2016 was similar to the 2015 estimate and 34% below the long-term average of 4.0 ± 0.04 million. Abundance estimates for redheads (*Aythya americana*; 1.3 ± 0.1 million) and canvasbacks (*A. valisineria*; 0.7 ± 0.07 million) were similar to their 2015 estimates and were 82% and 26% above their long-term averages of 0.7 ± 0.01 million and 0.6 ± 0.009 million, respectively. In 2016, estimated abundance of scaup (*A. affinis* and *A. marila* combined; 5.0 ± 0.3 million) was similar to the 2015 estimate and to the long-term average of 5.0 ± 0.05 million. The 2016 projected mallard fall flight index was 13.5 ± 1.4 million birds.

In 2005, the USFWS and Canadian Wildlife Service (CWS) integrated data from two previously independent waterfowl surveys conducted in eastern North America into a single composite estimate, using hierarchical models. Consequently, the total indicated bird definitions for American black ducks (*Anas rubripes*) were modified to provide a common index across surveys, and adjustments were made to the geographic stratification of the eastern survey area. Hierarchical model estimates for the time series from 1990 to the present are updated each year,

resulting in estimates that may differ slightly from those previously published. In cases where the Service has traditionally not recorded observations to the species level, composite estimates are provided for multiple-species groupings (i.e., mergansers and goldeneyes [*Bucephala clangula* and *B. islandica*]). In the eastern survey area, estimated abundance of American black ducks for 2016 was 0.6 ± 0.05 million, which was 13% higher than the 2015 estimate of 0.5 ± 0.04 million, and similar to the 1990–2015 average of 0.6 ± 0.04 million. The 2016 estimated abundance of mallards (0.4 ± 0.1 million) and mergansers (0.4 ± 0.04 million) were similar to the 2015 estimates and their 1990–2015 averages. Abundance estimates of green-winged teal (0.2 ± 0.04 million) and ring-necked ducks (*Aythya collaris*, 0.6 ± 0.09 million) were similar to their 2015 estimates and 1990–2015 averages. The 2016 estimate of goldeneyes (common and Barrow'scombined, 0.4 ± 0.06 million) was similar to the 2015 estimate and 14% lower than the 1990–2015 average.

In general, the Canadian and U.S. prairies experienced early spring phenology in 2016. However, habitat conditions in these areas during the 2016 WBPHS were poorer than in 2015 because of below-average precipitation and subsequent drying of wetlands. Most prairie and parkland regions were at best fair for waterfowl production; only areas dominated by semi-permanent and permanent wetlands were rated good. The 2016 total pond estimate (Prairie Canada and U.S. combined) was 5.0 ± 0.2 million, which was 21% below the 2015 estimate of 6.3 ± 0.2 million, and similar to the long-term average of 5.2 ± 0.03 million. The 2016 estimate of ponds in Prairie Canada was 3.5 ± 0.1 million. This estimate was 16% below the 2015 estimate of 4.2 ± 0.1 million and similar to the long-term average (3.5 ± 0.02 million). The 2016 pond estimate for the northcentral U.S. was 1.5 ± 0.05 million, which was 30% below the 2015 estimate of 2.2 ± 0.09 million and 11% below the long-term average (1.7 ± 0.01 million).

In the eastern survey area, spring phenology was advanced in southern areas, and in Newfoundland and Labrador, where good-to-excellent breeding conditions were reported. In the eastern Arctic, including the Ungava Peninsula in northern Quebec, and Baffin and Bylot islands, breeding conditions were average to slightly below average. In the western boreal regions of the traditional survey area and in Alaska, habitat conditions in 2016 were similar to or improved relative to 2015, with above-average breeding conditions. Ice and snow melt timing was very early in Alaska and the western Arctic, with snow and ice melt dates that were the earliest recorded in some areas. Ice and snow melt was normal to slightly early in the north-central and south-central Arctic.

More information about 2016 duck breeding population status, habitat conditions, and production may be found in Waterfowl Population Status, 2016 (Table 1, USFWS 2016c).

Harvest Management

Objectives

The basic harvest-management objective for mid-continent mallards is to maximize cumulative harvest over the long term, which inherently requires perpetuation of a viable population. Moreover, this objective is constrained to avoid regulations that could be expected to result in a subsequent population size below the goal of the North American Waterfowl Management Plan

(NAWMP; USFWS 2016a). According to this constraint, the value of harvest decreases proportionally as the difference between the goal and expected population size increases. This balance of harvest and population objectives results in a regulatory strategy that is more conservative than that for maximizing long-term harvest, but more liberal than a strategy to attain the NAWMP goal (regardless of effects on hunting opportunity). The current objective for mid-continent mallards uses a population goal of 8.5 million birds, which consists of 7.9 million mallards from the WBPHS (strata 13–18, 20–50, and 75–77), and corresponds to the mallard population goal in the 1998 update of the NAWMP (less the portion of the mallard goal comprised of birds breeding in Alaska [NAWMP Committee 1988]) and a goal of 0.6 million for the combined states of Michigan, Minnesota, and Wisconsin.

For eastern and western mallards, there is no NAWMP goal or other established target for desired population size. Accordingly, the management objective for eastern and western mallards is to maximize long-term cumulative (i.e., sustainable) harvest.

Optimal Regulatory Strategies

We used stochastic dynamic programming (Williams et al. 2002) to evaluate a pre-survey decision process and calculate optimal regulatory strategies. For the Mississippi and Central Flyways, we based this optimization on: (1) the current regulatory alternatives, including the closed-season constraint; (2) current population models and associated weights for mid-continent mallards; and (3) the dual objectives of maximizing long-term cumulative harvest and achieving a population goal of 8.5 million mid-continent mallards. The resulting regulatory strategy (Table 4) includes options conditional on the regulatory alternative selected the previous hunting season. Note that prescriptions for closed seasons in this strategy represent resource conditions that are insufficient to support one of the current regulatory alternatives, given current harvest-management objectives and constraints. However, closed seasons under all of these conditions are not necessarily required for long-term resource protection, and simply reflect the NAWMP population goal and the nature of the current regulatory alternatives. Assuming that regulatory choices adhered to this strategy (and that current model weights accurately reflect population dynamics), breeding-population size would be expected to average 6.90 million (SD = 1.45 million). Based on a liberal regulatory alternative selected for the 2016 hunting season, an estimated 2016 population size of 11.89 million mid-continent mallards and 3.49 million observed ponds in Prairie Canada, the optimal choice for the Mississippi and Central Flyways in 2017 is the liberal regulatory alternative (Table 4).

We calculated the optimal regulatory strategy for the Atlantic Flyway based on: (1) the current regulatory alternatives; (2) the eastern mallard population models and current model weights; and (3) an objective to maximize long-term cumulative harvest. The resulting regulatory strategy includes options conditional on the regulatory alternative selected the previous hunting season (Table 3). We simulated the use of this regulatory strategy to determine expected performance characteristics. Assuming that harvest management adhered to this strategy (and that 2016 model weights accurately reflect population dynamics), breeding-population size would be expected to average 1.03 million (SD = 0.23 million). Based on a liberal regulatory alternative selected for the 2016 hunting season, and a 2016 estimated breeding population size

of 0.72 million eastern mallards, the optimal choice for the 2017 hunting season in the Atlantic Flyway is the liberal regulatory alternative (Table 5).

We calculated the optimal regulatory strategy for the Pacific Flyway based on: (1) the current regulatory alternatives, (2) current (1990–2016) population models and parameter estimates, and (3) an objective to maximize long-term cumulative harvest (Table 6). The resulting regulatory strategy includes options conditional on the regulatory alternative selected in the 2016 hunting season. We simulated the use of this regulatory strategy to determine expected performance characteristics. Assuming that harvest management adhered to this strategy (and that current model parameters accurately reflect population dynamics), breeding-population size would be expected to average 0.60 million (SD = 0.07 million) in Alaska and 0.56 million (SD = 0.05 million) in the southern Pacific Flyway. Based on liberal regulatory alternative selected for the 2016 hunting season, and an estimated 2016 breeding population size of 0.58 million mallards in Alaska and 0.48 million in the southern Pacific Flyway, the optimal choice for the 2017 hunting season in the Pacific Flyway is the liberal regulatory alternative (Table 6).

Results of the AHM program are published annually. This year's AHM results are published in Adaptive Harvest Management, 2017 Hunting Season (USFWS 2016a).

Habitat Management

Habitat management in both quantity and quality is necessary to sustain duck populations at desired levels. Habitat management is largely addressed by federal, state, non-government organizations, and private landowners through wildlife refuges, other wildlife or management areas, and habitat conservation programs. Habitat management is being coordinated in part through the NAWMP and its associated Joint Ventures (NAWMP Committee 2004a,b).

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

Despite substantial investment of effort in data collection and analytical work and thought, relationships among hunting regulations, harvests, and survival of migratory birds are not known precisely (USDOI 1988, USDOI 2013). However, comparisons of harvest indicators between years of relatively liberal and relatively restrictive hunting regulations suggest that harvest and harvest rate can be influenced by regulations. If the major regulatory components (bag limit, season timing and length) are altered in a restrictive manner, reductions in harvest rate generally result. Similarly, liberal regulations can result in increased harvest rates, at least within limits. Thus, we have the ability to produce general changes in harvest rates through gross regulatory actions.

AHM is a goal-oriented decision-making process in which management performance can be improved as the effects of management actions and other events become better understood. Thus, AHM allows for the accumulation and incorporation of new information regarding the effect of duck harvest regulations on population status.

Mallard population models are based on the best available information and account for uncertainty in population dynamics and the impact of harvest. Model-specific weights reflect the

relative confidence in alternative hypotheses and are updated annually using comparisons of predicted and observed population sizes. For mid-continent mallards, current model weights favor the weakly density-dependent reproductive hypothesis (>99%) and the additive-mortality hypothesis (71%). For eastern mallards, current model weights favor the weakly density-dependent reproductive hypothesis (81%) and the additive-mortality hypothesis (78%). Unlike mid-continent and eastern mallards, we consider a single functional form to predict western mallard population dynamics, but consider a wide range of parameter values, each weighted relative to the support from the data.

Our models of regulation-specific harvest rates also allow for the marginal effect of framework-date extensions in the moderate and liberal alternatives. A previous analysis (USFWS 2001) suggested that implementation of framework-date extensions might be expected to increase the harvest rate of mid-continent mallards by about 15%, or in absolute terms by about 0.02 (SD = 0.01). Based on the observed harvest rates during the 2002–2015 hunting seasons, the updated (posterior) estimate of the marginal change in harvest rate attributable to the framework-date extension is 0.005 (SD = 0.007). The estimated effect of the framework-date extension has been to increase harvest rate of mid-continent mallards by about 5% over what would otherwise be expected in the liberal alternative. However, reliable inference about the marginal effect of framework-date extensions ultimately depends on a rigorous experimental design (including controls and random application of treatments).

Current predictions of harvest rates of adult-male mid-continent mallards associated with each of the regulatory alternatives are provided in Table 7. Predictions of harvest rates for the other age-sex cohorts are based on the historical ratios of cohort-specific harvest rates to adult-male rates (Runge et al. 2002). These ratios are considered fixed at their long-term averages and are 1.5407, 0.7191, and 1.1175 for young males, adult females, and young females, respectively. We make the simplifying assumption that the harvest rates of mid-continent mallards depend solely on the regulatory choice in the Mississippi and Central Flyways.

The predicted harvest rates of eastern mallards are updated in the same fashion as that for mid-continent mallards based on preseason banding conducted in eastern Canada and the northeastern U.S. Like mid-continent mallards, harvest rates of age and sex cohorts other than adult male mallards are based on constant rates of differential vulnerability as derived from band-recovery data. For eastern mallards, these constants are 1.1534, 1.3306, and 1.5090 for adult females, young males, and young females, respectively (Johnson et al. 2002). Regulation-specific predictions of harvest rates of adult-male eastern mallards are provided in Table 5.

In contrast to mid-continent mallards, framework-date extensions were expected to increase the harvest rate of eastern mallards by only about 5% (USFWS 2001), or in absolute terms by about 0.01 (SD = 0.01). Based on the observed harvest rates during the 2002–15 hunting seasons, the updated (posterior) estimate of the marginal change in harvest rate attributable to the framework-date extension is 0.002 (SD = 0.009). The estimated effect of the framework-date extension has been to increase harvest rate of eastern mallards by about 1.3% over what would otherwise be expected in the liberal alternative.

Based on available estimates of harvest rates of mallards banded in California and Oregon during 1990–95 and 2002–07, there was no apparent relationship between harvest rate and regulatory changes in the Pacific Flyway. This is unusual given our ability to document such a relationship in other mallard stocks and in other species. We note, however, that the period 2002–07 was comprised of both stable and liberal regulations and harvest rate estimates were based solely on reward bands. Regulations were relatively restrictive during most of the earlier period and harvest rates were estimated based on standard bands using reporting rates estimated from reward banding during 1987–1988. Additionally, 1993–1995 were transition years in which full-address and toll-free bands were being introduced and information to assess their reporting rates (and their effects on reporting rates of standard bands) is limited. Thus, the two periods in which the Service would like to compare harvest rates are characterized not only by changes in regulations, but also in estimation methods.

Consequently, the Service lacks a sound empirical basis for predicting harvest rates of western mallards associated with current regulatory alternatives in the Pacific Flyway. In 2009, the Service began using Bayesian statistical methods for improving regulation-specific predictions of harvest rates (Table 7). The methodology is analogous to that currently in use for mid-continent and eastern mallards except that the marginal effect of framework date extensions in moderate and liberal alternatives is inestimable because there are no data prior to implementation of extensions. In 2008, the Service specified prior regulation-specific harvest rates of 0.01, 0.06, 0.09, and 0.11 with associated standard deviations of 0.003, 0.02, 0.03, and 0.03 for the closed, restrictive, moderate, and liberal alternatives, respectively. The prior for the liberal regulation was then updated in 2011 with a harvest rate of 0.12 and a standard deviation of 0.04. The harvest rates for the liberal alternative were based on empirical estimates realized under the current liberal alternative during 2002–2007 and determined from adult-male mallards banded with reward bands and standard bands in the southern Pacific Flyway. In 2015, the Service assessed the influence of Washington and British Columbia banding and recovery data on harvest rates and found that the addition of those bands had a negligible influence on harvest rate estimates. Starting in 2016, the Service included Washington and British Columbia banding and recovery data in updates to harvest rate distributions. Harvest rates for the moderate and restrictive alternatives were based on the proportional (0.85 and 0.51) difference in harvest rates expected for mid-continent mallards under the respective alternatives. And finally, harvest rate for the closed alternative was based on what the Service estimated would be realized with a closed season in the U.S. (including Alaska) and a very restrictive season in Canada, similar to that for mid-continent mallards. A relatively large standard deviation (CV = 0.3) was chosen to reflect greater uncertainty about the mean harvest rate of western mallards than that for mid-continent mallards (CV = 0.2). Current predictions of harvest rates of adult-male western mallards associated with each regulatory alternative are provided in Table 7.

SOCIOECONOMIC CONSEQUENCES OF ALTERNATIVES

As with environmental consequences, it is also difficult to predict precisely the socioeconomic impacts of regulatory alternatives. Limited knowledge precludes detailed, quantitative assessments. Consequently, certain assumptions regarding impacts are necessary, and the impacts must be discussed in general terms. Some important assumptions are:

1. The major socioeconomic impacts of annual waterfowl hunting regulations are on participants in waterfowl hunting.
2. Factors not related to regulations (e.g., hunter success, availability of birds, hunting sites, weather, and habitat) will affect hunter participation and therefore also affect the socioeconomic environment.
3. Capital or fixed expenditures (e.g., purchase of guns) are likely to be affected more by hunter numbers, while variable costs (e.g., purchase of fuel) are probably more closely related to hunter days afield.
4. The total economic value of waterfowl hunting represents a negligible portion of the national product.

In 2013, the Service conducted analyses to determine the amount of consumer surplus associated with waterfowl hunting (USFWS 2013). Consumer surplus is an estimate based an individual's willingness to pay to hunt waterfowl. Flyway-specific estimates of daily consumer surplus were used to determine the economic value of the baseline (restrictive migratory bird hunting regulations) and the estimated effects of changes expected under different regulatory alternatives.

Alternative 1: Closed duck-hunting seasons (no action)

Environmental Impacts

Ducks

Alternative 1 would provide maximum short-term benefits for most ducks. It would result in no legal harvest of ducks occurring in the United States, and likely maximize the number of ducks breeding in 2018. Compared to the proposed action, approximately 13.9 million more ducks (based on the mean annual duck harvest in the United States during 1999–2015 when similar regulations to this alternative were issued, Table 3) could survive to breed in 2018 under a closed season. However, since hunting mortality likely compensates for at least some natural mortality, the net increase that would survive until spring 2018 would be less than 13.9 million birds.

Revenues from the sale of Federal and State duck stamps, state hunting licenses, and taxes on hunting equipment for wetland and other habitat protection and management would drop precipitously. For example, there would be a loss of about $22.9 million in potential revenues from the sale of federal duck stamps ($25 each) to adult duck hunters (mean of 915,600 active adult duck hunters in 2014 and 2015, USFWS 2016b). Hunters over the age of 16 must purchase a federal duck stamp each year if they want to hunt migratory waterfowl. Ninety-eight cents out of every dollar generated by the sales of federal duck stamps go directly to purchase or lease wetland habitat for protection in the National Wildlife Refuge System. Many states also issue their own duck stamps. In some states, the stamps are purely a collector's item, but in others, the stamps have a similar role in hunting and conservation as federal duck stamps. The amount of State revenues tied directly to state duck stamps is unknown, but it is likely more than $15 million.

Contributions from waterfowl hunters toward wetland and waterfowl habitat protection, such as that being encouraged through the NAWMP, would likely be substantially reduced if there were no duck season. In 1988, contributions to just one private, non-profit organization (Ducks

Unlimited, Inc.) that solicits funds for waterfowl habitat protection and enhancement amounted to about $65 million. An unknown amount of habitat would be lost if the incentive for its conservation were diminished as a result of a closed duck season. In some areas, such as California's Central Valley, where most of the Pacific Flyway waterfowl winter, the majority of the suitable habitat is privately owned and managed by hunting clubs that would lose a strong incentive to manage habitats for waterfowl if the season were closed.

Endangered Species
The Service obtains a biological opinion pursuant to Section 7 of the Endangered Species Act prior to establishing annual hunting regulations for migratory birds. The Service conducts this Section 7 consultation before establishing any special hunting seasons for any migratory game bird in the contiguous United States, Alaska, Hawaii, Puerto Rico, and the Virgin Islands. This consultation ensures that there will be no likelihood of jeopardy to a listed species or its habitat.

Socioeconomic Impacts
Hunters
Hunters would be deprived of all hunting opportunity for ducks. Many hunters would discontinue hunting and a portion of these would not return to hunting when seasons were opened again. Adult duck hunters spent a mean of 6.0 million days afield during the 2014-15 and 2015-16 seasons (Table 3, USFWS 2016b). Estimates of days afield have remained at about this level for the past decade, so we expect similar days spent afield in 2017. Many hunters would strongly object to a closed season on ducks and would be less supportive of waterfowl conservation and related habitat programs (USFWS and US Census Bureau 2012). The national estimate of the consumer surplus that would be lost without duck hunting regulations ranges from $263 to $345 million (2013$) annually, with a mid-point estimate of $304 million (USFWS 2013). The estimates of the total increase in consumer surplus because of duck hunting range from $304 million for the restrictive alternative to $368 million for the preferred (liberal) alternative.

Nonhunters and Nongovernment Organizations
Most nonhunters and nongovernmental organizations have little interest in specific waterfowl regulations and likely would be unaffected by any alternative. Some interested parties would favor this alternative because it provides maximum short-term, albeit small, benefits to ducks. Some, however, would view it as an unnecessarily extreme measure that would do little to improve duck populations in the near-term and would have adverse effects on the long-term welfare of duck habitats and populations. A small number of individuals and groups, who oppose all hunting, would support this alternative.

Governments
A closure of duck seasons would generate greatly increased public comment and Congressional inquiries seeking explanations for the extreme action taken. Duck hunter numbers would not be maintained and the States and Service would see substantial declines in revenues from the sale of licenses and duck stamps. Government programs to conserve waterfowl and their habitats would lose financial and other support, both directly and indirectly. States and Flyway Councils would strongly oppose a total closure of duck seasons.

Businesses
Businesses tied to waterfowl hunting would see dramatic declines in revenues because there would be little demand for goods and services from duck hunters. An estimated $1.7 billion (2013$) were spent by waterfowl (includes ducks, geese, and swans) hunters for travel and equipment in the United States during the 2011 hunting season (USFWS 2013). We would expect similar expenditures in 2017 under the proposed action; therefore closure of duck seasons under this alternative would result in a loss of hundreds of millions of dollars of economic activity, much of which is directed at small businesses. An unknown proportion of that money might be diverted to substitute activities, such as upland game hunting or fishing. Large establishments catering to a broader clientele may not be affected as seriously. However, for some (e.g., hunting guides) a closed season would be devastating.

Alternative 2: Issue restrictive duck-hunting regulations

Environmental Impacts

Ducks
Under Alternative 2, duck harvests would likely be about 6.2 million (based on the mean annual duck harvest in the United States during 1988–93 when regulations similar to this alternative were issued, Table 2). Compared to harvest expected under the proposed action of about 13.9 million ducks, harvest would likely be reduced by about 7.7 million ducks.

Endangered Species
As indicated above under Alternative 1, review of annual hunting regulations under Section 7 of the Endangered Species Act ensures that no jeopardy to threatened or endangered species occurs.

Socioeconomic Impacts

Hunters
The season length would be reduced by 30–47 days (depending on the Flyway) and the daily bag limit would be reduced by 3 ducks relative to the proposed action. Less recreational opportunity would be available for hunters, so hunter numbers would likely decrease compared to the proposed action under which about 915,600 people are expected to hunt ducks. Most hunters would believe that these regulations are too restrictive, considering the current status of ducks (USFWS 2016c). A few hunters would believe that these regulations are appropriate based on the belief that more restrictive regulations would promote additional growth of waterfowl populations. The estimate of the national annual consumer surplus that would be achieved under this alternative ranges from $263 to $345 million (2013$), with a mid-point of $304 million (USFWS 2013).

Nonhunters and Nongovernmental Organizations
Based on public comments received in the past, most non-hunters and non-governmental organizations favor more liberal regulations, while a few would consider this alternative appropriate. A few others would consider any season too liberal.

Governments
Revenues from the sale of waterfowl hunting licenses and duck stamps likely would be lower than under the proposed action, and thus less money would be available for waterfowl management activities. States and Flyway Councils would oppose restrictive duck seasons.

Businesses
Duck hunter expenditures likely would be lower than the $1.7 billion (2013$) expected under the proposed action This would be a result of season length reduced by 30–47 days (depending on the Flyway) and the likely reduction in active hunter numbers relative to the proposed action.

Alternative 3: Issue moderate duck-hunting regulations

Environmental Impacts

Ducks
Under Alternative 3, duck harvests would likely be about 13.0 million (based on the mean annual duck harvest in the United States during 1979–84 and 1995–96 when regulations similar to this alternative were issued, Table 2). Compared to harvest expected under the proposed action of about 13.9 million ducks, harvest would likely be reduced by about 0.9 million ducks.

Endangered Species
As indicated above under Alternative 1, review of annual hunting regulations under Section 7 of the Endangered Species Act ensures that no jeopardy to threatened or endangered species occurs.

Socioeconomic Impacts

Hunters
The season length would be reduced by 14–21 days (depending on the Flyway) and the total daily bag limit would remain the same relative to the proposed action and the 2016 hunting season. Less recreational opportunity would be available for hunters. Most hunters would believe that these regulations are too restrictive, considering the current status of ducks (USFWS 2016c, USFWS and U.S. Census Bureau 2012). A few hunters would believe that these regulations are appropriate based on the belief that more restrictive regulations would promote additional growth of waterfowl populations. The national mid-point estimate of the consumer surplus expected under this alternative is $336 million (2013$) annually (USFWS 2013).

Nonhunters and Nongovernmental Organizations
Based on comments received in the past, some non-hunters and non-governmental organizations would favor this alternative. A few organizations disagree with relatively minor details of the alternative. Others favor more restrictive regulations, and some believe that all hunting should be discontinued.

Governments
Duck hunter numbers would likely remain the same compared to 2015, and this would maintain revenues to the States and Service through similar sales of waterfowl hunting licenses and duck stamps. States and Flyway Councils would oppose a moderate duck season.

Businesses
Duck hunter expenditures likely would be lower than the $1.7 billion (2013$) expected under the proposed action, but greater than that of a closed season. This would be a result of reduced season length by 14–21 days (depending on the Flyway).

Alternative 4: Issue liberal duck-hunting regulations (proposed action)

Environmental Impacts

Ducks

Under Alternative 4, duck harvest would likely be about 13.9 million (based on the mean annual duck harvest in the United States during 1999–2015 when regulations similar to this alternative were issued, Table 3). Compared to the harvests expected under the Alternatives 2 and 3 (about 6.2 and 13.0 million ducks, respectively), harvest would likely be increased by 7.7 million (compared to Alternative 2) and 0.9 million (compared to Alternative 3) ducks or fewer, but would remain similar to the average annual harvest since 1999.

Endangered Species

As indicated above under Alternative 1, review of annual hunting regulations under Section 7 of the Endangered Species Act ensures that no jeopardy to threatened or endangered species occurs.

Socioeconomic Impacts

Hunters

Most hunters would support the continuation of liberal regulations and the maximum amount of hunting opportunity that would result (USFWS and US Census Bureau 2012). Hunter numbers would probably remain about the same or increase slightly relative to 2015 when similar regulations to this alternative were issued. The national estimate of the consumer surplus expected under this alternative ranges from $318 to $419 million (2013$) annually, with a mid-point estimate of $368 million (USFWS 2013).

Nonhunters and Nongovernmental Organizations

A few organizations and non-hunters disagree with relatively minor details of the alternative (e.g., greater opportunity could be provided to harvest scaup and pintails). Others favor more restrictive regulations, and some believe that all hunting should be discontinued.

Governments

All Flyway Councils supported this alternative. States always have the option of being more conservative than allowed by the Federal framework. Duck hunter numbers would likely remain the same or increase slightly compared to those of 2015 and this would maintain or increase revenues to the States and Service through greater sales of waterfowl hunting licenses and duck stamps.

Businesses

This alternative maximizes likely hunter expenditures compared to the other alternatives. Duck hunter expenditures are expected to be about $1.7 billion (2013$), similar to those estimated during the 2013 hunting season when similar regulations to this alternative were issued.

CONSULTATION AND COORDINATION

A well-established process for public involvement in decision-making on duck hunting regulations includes a series of public meetings and notices published in the Federal Register throughout the year leading to establishment of specific regulations in September prior to the

onset of hunting (see Administrative Process section under Purpose and Need for Action; also complete details on the process can be found in USDOI 1988 and USDOI 2013).

Prior to developing proposed regulations, information from the most recently conducted biological surveys was made available to management agencies and the public. The CWS and Provinces of Canada participated in the biological surveys and provided assessments of populations and habitat from their perspective. Results of biological surveys and other technical data were presented and reviewed at technical meetings held in conjunction with the four Flyway Council meetings in August, September and October. Participants at these meetings included members and consultants from the Flyway Councils, biologists and administrators from State conservation agencies, and other interested persons. The Flyway Councils developed regulatory recommendations, which were presented to the Service for consideration and action. The Service Regulations Committee subsequently met to formulate proposed regulations after considering current biological information, socioeconomic effects, and comments and recommendations received by the Service. Proposed regulations were published in the Federal Register, and comments were invited from interested persons and organizations to ensure that the final regulations are as responsive to the need for action as possible. After considering comments received by the Service, final regulations will be announced in late May or early June, prior to the opening of hunting seasons in September of that calendar year.

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Public and Professional Contacts

Officials in the organizations listed below have been involved in meetings and correspondence with Service personnel in 2016–17 in regard to their viewpoints and informational needs for waterfowl. Input from all of these sources was considered in development of this document.

State and Territorial Organizations

All State and Territorial wildlife agencies

Regional and National Organizations

Atlantic Flyway Council
Mississippi Flyway Council
Central Flyway Council
Pacific Flyway Council
Canadian Wildlife Service

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Table 1. Total duck breeding population size estimates (in thousands) in the traditional survey area (survey strata 1–18, 20–50, and 75–77), 1955–2016 (adapted from USFWS 2016c).

Year	Ducks	SE
1955	39,603.6	1,264.0
1956	42,035.2	1,177.3
1957	34,197.1	1,016.6
1958	36,528.1	1,013.6
1959	40,089.9	1,103.6
1960	32,080.5	876.8
1961	29,829.0	1,009.0
1962	25,038.9	740.6
1963	27,609.5	736.6
1964	27,768.8	827.5
1965	25,903.1	694.4
1966	30,574.2	689.5
1967	32,688.6	796.1
1968	28,971.2	789.4
1969	33,760.9	674.6
1970	39,676.3	1,008.1
1971	36,905.1	821.8
1972	40,748.0	987.1
1973	32,573.9	805.3
1974	35,422.5	819.5
1975	37,792.8	836.2
1976	34,342.3	707.8
1977	32,049.0	743.8
1978	35,505.6	745.4
1979	38,622.0	843.4
1980	36,224.4	737.9
1981	32,267.3	734.9
1982	30,784.0	678.8
1983	32,635.2	725.8
1984	31,004.9	716.5
1985	25,638.3	574.9
1986	29,092.8	609.3
1987	27,412.1	562.1
1988	27,361.7	660.8
1989	25,112.8	555.4
1990	25,079.2	539.9
1991	26,605.6	588.7
1992	29,417.9	605.6
1993	26,312.4	493.9
1994	32,523.5	598.2
1995	35,869.6	629.4
1996	37,753.0	779.6

Table 1. Total duck breeding population size estimates (in thousands) in the traditional survey area (survey strata 1–18, 20–50, and 75–77), 1955–2016 (adapted from USFWS 2016a), continued.

Year	Ducks	SE
1997	42,556.3	718.9
1998	39,081.9	652.0
1999	43,435.8	733.9
2000	41,838.3	740.2
2001	36,177.5	633.1
2002	31,181.1	547.8
2003	36,225.1	664.7
2004	32,164.0	579.8
2005	31,734.9	555.2
2006	36,160.3	614.4
2007	41,172.2	724.8
2008	37,276.5	638.3
2009	42,004.8	701.9
2010	40,893.1	718.4
2011	45,554.1	766.5
2012	48,575.3	796.8
2013	45,607.3	749.8
2014	49,152.2	831.1
2015	49,521.7	812.1
2016	48,362.8	827.6

Table 2. Active adult hunters, duck hunter days per active adult hunter, and total duck harvest from the Mail Questionnaire Survey, 1965–2001 (estimates are not directly comparable with those from the later Migratory Bird Harvest Information Program survey (adapted from Pacific Flyway Mail Questionnaire Harvest Survey Results 1965–2001)).

Year	Hunters	Days	Harvest
1965	1,282,029	10,576,800	8,752,435
1966	1,501,945	11,214,900	11,988,175
1967	1,622,213	9,679,400	12,762,927
1968	1,514,863	12,818,500	8,073,108
1969	1,738,791	15,898,600	12,984,103
1970	2,024,983	15,589,300	15,897,446
1971	2,005,502	14,206,700	13,949,384
1972	1,819,087	13,512,500	13,586,081
1973	1,727,277	14,300,700	11,892,081
1974	1,813,798	15,254,900	12,800,480
1975	1,852,985	14,278,200	15,487,193
1976	1,761,268	14,222,300	15,194,855
1977	1,760,300	14,567,400	13,470,309
1978	1,758,377	14,325,300	15,354,513
1979	1,700,387	13,328,600	14,414,775
1980	1,614,066	12,446,400	13,251,663
1981	1,495,221	12,525,100	12,194,495
1982	1,462,230	11,533,300	11,871,608
1983	1,458,642	11,954,300	12,923,294
1984	1,470,248	10,873,700	12,575,696
1985	1,337,656	11,200,100	9,544,245
1986	1,340,598	10,482,900	9,509,204
1987	1,256,160	7,775,900	9,202,875
1988	1,019,738	8,312,600	5,029,908
1989	1,051,270	8,066,600	6,238,874
1990	1,074,845	8,893,600	6,165,864
1991	1,063,567	8,734,800	6,237,647
1992	1,047,823	9,336,000	6,527,096
1993	1,098,587	10,975,600	7,002,971
1994	1,182,024	12,252,500	8,649,706
1995	1,241,439	13,240,800	12,960,239
1996	1,278,524	14,964,200	13,807,118
1997	1,411,904	14,486,100	15,903,432
1998	1,378,529	14,449,100	16,933,075
1999	1,366,639	13,879,800	15,966,620
2000	1,367,792	14,996,100	15,326,485
2001	1,377,259	10,576,800	13,994,285

Table 3. Active duck hunters[1,2], duck hunter days afield[1], and total duck[1] harvest from the Migratory Bird Harvest Information Program survey, 1999–2015.

Year	Hunters	Days	Harvest
1999	1,001,100	8,388,800	16,188,300
2000	1,155,900	8,115,100	15,966,200
2001	1,177,400	8,406,400	14,131,800
2002	1,084,300	7,475,400	12,439,000
2003	1,075,100	7,492,300	13,165,400
2004	1,034,500	7,413,100	12,385,900
2005	1,002,000	6,520,000	12,512,000
2006	988,300	6,835,400	13,808,200
2007	1,009,000	7,026,400	14,579,000
2008	994,200	6,735,900	13,721,800
2009	988,200	6,816,900	13,139,700
2010	983,000	6,634,500	14,865,800
2011	994,600	7,109,200	15,949,400
2012	1,006,900	7,082,000	15,704,500
2013	892,600	6,234,500	13,717,600
2014	961,500	5,971,700	13,270,400
2015	869,700	5,496,200	10,993,000

[1]Includes data for sea ducks.

[2]Hunters are counted twice if they hunt sea ducks in addition to other ducks, so may be biased high.

Table 4. Optimal regulatory strategy [a] for the Mississippi and Central Flyways for the 2017 hunting season, predicated on a liberal alternative selected the previous year (2016). This strategy is based on current regulatory alternatives (including the closed-season constraint), mid-continent mallard models and weights, and the dual objectives of maximizing long-term cumulative harvest and achieving a population goal of 8.5 million mallards. The shaded cell indicates the regulatory prescription for the 2017 hunting season (adapted from USFWS 2016c).

	Ponds[c]																		
BPOP[b]	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5	4.75	5	5.25	5.5	5.75	6
≤4.5	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
4.75–6.25	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
6.5	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	M	L	L
6.75	R	R	R	R	R	R	R	R	R	R	R	R	R	M	L	L	L	L	L
7.0	R	R	R	R	R	R	R	R	R	R	R	M	L	L	L	L	L	L	L
7.25	R	R	R	R	R	R	R	R	M	L	L	L	L	L	L	L	L	L	L
7.5	R	R	R	R	R	R	M	L	L	L	L	L	L	L	L	L	L	L	L
7.75	R	R	R	R	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
8.0	R	R	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
8.25	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
≥8.5	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

[a] C = closed season, R = restrictive, M = moderate, L = liberal.

[b] Mallard breeding population size (in millions) observed in the WBPHS (strata 13–18, 20–50, 75–77) and Michigan, Minnesota, and Wisconsin.

[c] Ponds (in millions) observed in Prairie Canada in May.

Table 5. Optimal regulatory strategy[a] for the Atlantic Flyway for the 2017 hunting season. This strategy is based on current regulatory alternatives, eastern mallard models, model weights, and an objective to maximize long-term cumulative harvest. Predicated on a liberal season selected the previous year (2016), the shaded cell indicates the regulatory prescription for 2017 (adapted from USFWS 2016c).

	Previous Regulation			
BPOP[b]	Closed	Restrictive	Moderate	Liberal
≤0.3	C	C	C	C
0.325	C	C	C	C
0.35	C	C	C	C
0.375	R	C	C	C
0.400	L	R	R	C
0.425	L	L	L	L
≥0.45	L	L	L	L

[a] C = closed season, R = restrictive, L = liberal.

[b] Number of mallards (in millions) observed in eastern Canada (WBPHS strata 51–54, 56) and the northeastern U.S. (AFBWS).

Table 6. Optimal regulatory strategy[a] for the Pacific Flyway during the 2017 hunting season, predicated on a liberal alternative selected the previous year (2016). This strategy is based on current regulatory alternatives, updated western mallard (1990–2016) population models and parameter estimates, and an objective to maximize long-term cumulative harvest. The shaded cell indicates the regulatory prescription for 2017 (adapted from USFWS 2016c).

Southern Pacific Flyway BPOP[b]	Alaska BPOP[c]														
	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.60	0.65	0.7	≥0.75
0.05	C	C	C	C	C	C	C	C	C	C	C	C	R	R	L
0.1	C	C	C	C	C	C	C	C	C	C	R	R	L	L	L
0.15	C	C	C	C	C	C	C	C	R	R	L	L	L	L	L
0.2	C	C	C	C	C	C	R	R	M	L	L	L	L	L	L
0.25	C	C	C	C	C	R	M	L	L	L	L	L	L	L	L
0.3	C	C	C	R	R	L	L	L	L	L	L	L	L	L	L
0.35	C	C	C	R	L	L	L	L	L	L	L	L	L	L	L
0.4	C	C	R	L	L	L	L	L	L	L	L	L	L	L	L
0.45	C	R	L	L	L	L	L	L	L	L	L	L	L	L	L
0.5	R	L	L	L	L	L	L	L	L	L	L	L	L	L	L
≥0.55	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

[a] C = closed season, R = restrictive, M = moderate, L = liberal.

[b] Estimated number of mallards (in millions) observed in California, Oregon, Washington, and British Columbia.

[c] Estimated number of mallards (in millions) observed in Alaska and the Yukon (WBPHS strata 1–12).

Table 7. Harvest rates and standard deviations of adult male mid-continent, eastern, and western mallards expected in 2017 under different regulatory alternatives, compared with historic harvest rates (adapted from USFWS 1997 and USFWS 2016c).

Mallard stock	Expected in 2017		Historic Rates[a]	
Regulatory alternative	Mean	SD	Mean	SD
Mid-continent				
Closed (U.S.)	0.009	0.002		
Restrictive	0.055	0.013	0.078	0.012
Moderate	0.0977	0.022	0.093	0.006
Liberal	0.113	0.018	0.118	0.027
Eastern				
Closed	0.080	0.023		
Restrictive	0.106	0.039	0.117	0.005
Moderate	0.129	0.047	0.144	0.016
Liberal	0.140	0.035	0.177	0.026
Western				
Closed	0.009	0.018		
Restrictive	0.066	0.017	0.120	0.018
Moderate	0.110	0.029	0.124	0.030
Liberal	0.129	0.029	0.133	0.012

[a] Restrictive = 1988–1993, Moderate = 1985–1987, Liberal = 1979–1984.

Figure 1. Survey areas currently assigned to the eastern, mid-continent, and western stocks of mallards for the purposes of AHM.

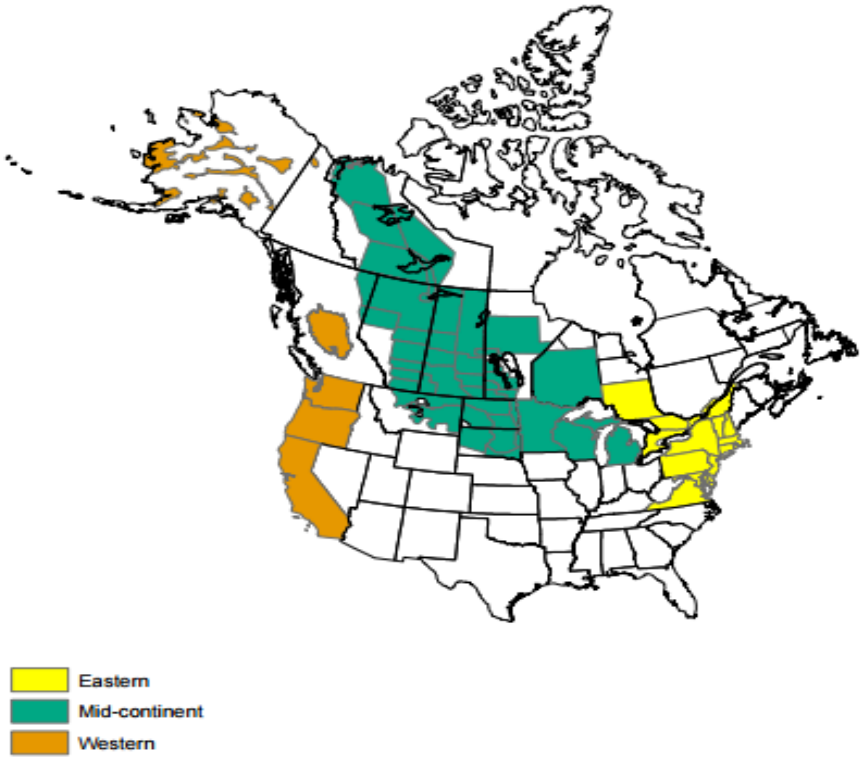

Figure 2. Strata and transects of the Waterfowl Breeding Population and Habitat Survey (yellow or light gray = traditional survey area, green or dark gray = eastern survey area).