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Derivation of Regional, Non-breeding Duck Population Abundance Objectives to Inform Conservation Planning in North America — 2019 Revision

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ABSTRACT
During the early 2000s, a methodology was developed to derive regional non-breeding population abundance objectives from continental abundance estimates (M. Koneff, USFWS, unpublished data). This information was foundational to North American Waterfowl Management Plan (NAWMP) Joint Venture (JV) habitat conservation planning and implementation for non-breeding waterfowl, especially wintering ducks. The 2012 NAWMP Revision and its amended population objectives motivated JVs to begin updating their waterfowl implementation plans. Fleming et al. (2017) revisited the initial work to derive non-breeding abundance objectives and developed an updated approach. Although Fleming et al. (2017) made use of the least biased and most geographically consistent datasets, they identified outstanding issues to be resolved before the derivation technique could be effectively applied across all regions of North America. We updated the work of Fleming et al. (2017) by addressing 3 of those issues. Specifically, we incorporated Canadian harvest data and calculated autumn–winter population objectives at degree block and JV-regional scales in Canada, updated and calculated winter population objectives for Mexico at degree block and JV-regional scales, and expanded the list of species for which objectives were calculated. Updated JV regional population abundance objectives for the non-breeding period are provided for 23 waterfowl species and species groups across North America.

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INTRODUCTION

Regional population abundance objectives are foundational for establishing waterfowl habitat objectives by Migratory Bird Joint Ventures (JVs). Petrie et al. (2011) described various methods used to calculate JV regional population abundance objectives for the non-breeding period. These objectives are most appropriately viewed as population targets to inform conservation planning, as they are used to calculate total dietary energy demands and habitat needed to support waterfowl populations at desired levels during autumn–winter. The most common method for establishing population objectives for the non-breeding period has involved state Mid-winter Waterfowl Survey (MWS) and county-scale harvest data. These data were combined across the U.S. and then used to apportion or "step-down" continental waterfowl population objectives to each non-breeding planning region. Continental objectives for breeding waterfowl have been established in the North American Waterfowl Management Plan [NAWMP] using long-term estimates of waterfowl abundance in primary surveyed areas as well as unsurveyed areas (NAWMP Committee 2012; Appendix A). Estimates of winter survival may be combined with NAWMP breeding objectives to back-calculate NAWMP continental objectives to the mid-winter period. Typically, migration chronology data are then used to extrapolate the mid-winter objective across the non-breeding planning period to generate an estimate of total duck use-days (DUDs) and associated energy requirements (Petrie et al. 2011).

M. Koneff (U.S. Fish and Wildlife Service [USFWS]) was the first to generate mid-winter population abundance objectives for all U.S. JVs based on a common method. Many JVs subsequently adopted Koneff's objectives for use in conservation planning models. However, Koneff's analyses were applied to the 1986 NAWMP continental objectives and reflected winter waterfowl distributions (as indexed by the MWS and harvest) during the 1970s and 1990s. The 2012 NAWMP and its 2014 NAWMP Addendum (NAWMP Committee 2014) established new quantitative breeding population objectives for the Traditional and Eastern Survey Areas (Appendix B). The 2012 NAWMP also challenged the waterfowl conservation community to consider how variation in population abundance should influence conservation planning, by establishing dual objectives reflecting the long-term average (LTA; 1955–2014) and the 80th percentile of the long-term distribution of population abundances over this period.

Waterfowl distributions of the 1970s and 1990s may no longer reflect contemporary distributions during the non-breeding period and as a result, habitat conservation objectives. Because many JVs are updating their implementation plans to address 2012 NAWMP recommendations, the NAWMP Science Support Team (NSST) thought it timely to reexamine regional population abundance objectives. Fleming et al. (2017) investigated the use of contemporary data and alternative methods to update Koneff's analysis, thereby providing a common and current basis for "stepping down" revised NAWMP population objectives to regional scales for the non-breeding period. Fleming et al. (2017), with support from the NSST, recommended an approach that generated regional population objectives separately for an autumn and winter period, which they referred to as "Methods 4B and 4D."

Although an improvement over the early work by Koneff, Fleming et al. (2017) identified a series of remaining uncertainties and shortcomings in their analysis and recommended efforts to address these in the near term. Herein we advance the work of Fleming et al. (2017) by addressing several recommendations identified in their report. Specifically, we incorporated Canadian harvest data and calculated autumn–winter population objectives at degree block and JV scales in Canada, updated and calculated winter population objectives for Mexico at degree block and JV scales, and expanded the list of species for which abundance objectives were calculated. These efforts addressed items 5, 6, and 9 in the list of uncertainties and shortcomings identified by Fleming et al. (2017:15).

Herein, we restate the basic methods of Fleming et al. (2017), describe our revisions, and present updated regional population abundance objectives for the non-breeding period. In contrast to Fleming et al. (2017), we restricted our analysis and summary to only their Methods 4B and 4D, as these were endorsed by the NSST as the preferred approach for deriving regional objectives. Hereafter, we no longer use the labels, "Methods 4B and 4D," instead presenting this simply as the recommended and most consistently available method for establishing regional population abundance objectives during autumn and winter planning periods.

METHODS

Step-down Process —The Basics

The original "step-down method" employed by Koneff used 1970–1979 and 1990–1999 state MWS abundance totals of each waterfowl species to partition the continental (NAWMP) abundance objective among states, and then used county harvest estimates (Padding et al. 2006, Raftovich et al. 2016) to allocate the state mid-winter totals among counties within a state. The general form of Koneff's equation was:

$$N_{ijk} = \frac{p_{(\mathrm{mws})ij} \times p_{(\mathrm{h})ijk} \times P_i}{0.85} \qquad \text{(Eq.1)}$$

where N_{ijk} is the mid-winter population objective for species i allocated to county k of state j, $p_{(\mathrm{mws})_{ij}}$ is the proportion of the total mid-winter count of species i (U.S. + Mexico) in state j, $p_{(\mathrm{h})_{ijk}}$ is the proportion of the state harvest of species i in county k of state j, and P_i is the continental objective for species i. The denominator 0.85 is used to back-calculate a mid-winter objective from the breeding population objective by assuming an 85% survival rate between mid-winter and the start of the breeding season. County totals were then aggregated to each JV region. Fleming et al. (2017) updated Koneff's analysis, and explored 3 other alternative methods, using recent MWS data, U.S. county harvest data, and continental population objectives corresponding to revised NAWMP objectives (NAWMP Committee 2014).

Expanding NAWMP Population Objectives to the Continental Scale

Revised population objectives of the 2012 NAWMP were based on the long-term average (1955–2014) population size of breeding ducks and the 80th percentile of the long-term distribution of population sizes for 14 common duck species or species groups (NAWMP

Committee 2014). However, these revised NAWMP objectives were based only on estimates of breeding ducks in the Traditional Survey Area (TSA) and Eastern Survey Area (ESA) (Figure 1), and thus represented only a portion of the total continental breeding population. Consequently, stepping-down NAWMP objectives from only the TSA and ESA (vs. all breeding areas) would underestimate the number of birds non-breeding areas should expect to support, and the habitat needed to support them. Koneff recognized this shortcoming and used approximations of total continental population size in his method for deriving regional population objectives. We followed a similar approach by calculating continental population estimates that would be expected when NAWMP (TSA and ESA) breeding population objectives are achieved. We intended for these expanded estimates to represent "population abundance objectives at the continental scale," and we hereafter refer to them as "continental objectives." Our methods for calculating continental objectives varied among species, or species groups, because of disparities in the quality and availability of species-specific population data.

Several species common to the TSA had reliable abundance estimates and objectives for the TSA: American green-winged teal, American wigeon, blue-winged teal, canvasback, gadwall, mallard, northern pintail, northern shoveler, redhead, and scaup (lesser and greater combined). For these species, we calculated continental objectives based on the relationship between estimated population abundance at the continental scale and the TSA. We used information presented in the 2012 NAWMP (NAWMP Committee 2012; Appendix A) to represent continental breeding duck population size from 2002–2011 for these species. To calculate continental objectives, we first determined the ratio between mean population size in the TSA and estimates of total continental population size during 2002–2011. We then applied this ratio to the species-specific revised NAWMP population objectives (NAWMP Committee 2014).

Our specific calculations were as follows:

$$Continental\ obj_i = \frac{NAWMP\ obj_i}{\left({N\_TSA_{i_{2002-11}}} \big/ {N\_Continental\ _{i_{2002-11}}} \right)}, \qquad \text{(Eq.2)}$$

where $NAWMP\ obj_i$ is the LTA or 80th percentile objective from the TSA for species i as provided in the 2014 NAWMP Addendum (NAWMP Committee 2014; Appendix B), $N\_TSA_{i_{2002-11}}$ is the mean population size from 2002–2011 of species i in the TSA as presented in the 2012 NAWMP (NAWMP Committee 2012; Appendix A), and $N\_Continental_{i_{2002-11}}$ is the continental population size for species i as presented in the 2012 NAWMP (Appendix A). We applied this calculation to both the LTA and 80th percentile objectives for each species, thus generating continental population objectives for the LTA and 80th percentile values (Table 1). The LTA and 80th percentile breeding population objectives from the ESA were also calculated and presented alongside the revised NAWMP objectives for mallards and green-winged teal (NAWMP Committee 2014). However, we used data from only the TSA to calculate continental objectives for these species because the vast majority of their population breeds in the TSA.

NAWMP revised objectives (NAWMP Committee 2014) for American black ducks, ring-necked ducks, and goldeneyes were based on data from only a portion of their breeding ranges, necessitating alternative methods for calculating continental objectives. Specifically, for American black ducks, we assumed that the combined areal coverage of the ESA breeding population survey and the Northeast Plot Survey would encompass essentially the entire continental breeding range of this species. Thus, we combined annual breeding population estimates from these surveys for 1998–2014 and calculated the LTA and 80th percentile to serve as our continental objectives for this species (Table 2). Similarly, for ring-necked ducks and Barrow's and common goldeneyes, we assumed that the combined areal coverage of the TSA and ESA breeding population surveys encompassed the primary breeding range of these species. We combined annual breeding population estimates from these surveys for 1998–2014 and calculated a LTA and 80th percentile value to serve as our continental objectives for ring-necked ducks and goldeneyes (Table 2). Because survey data do not differentiate between common and Barrow's goldeneyes, we assumed common goldeneyes accounted for 82% of the total goldeneye population, consistent with estimated population sizes presented in the 2012 NAWMP (NAWMP Committee 2012; Appendix A). The starting year of our time series for calculating continental objectives for these species was 1998, as opposed to 1990 in the 2014 NAWMP addendum, because it was the first year that the full extent of the ESA was surveyed.

For cinnamon teal, wood ducks, ruddy ducks, and all North American sea ducks (tribe Mergini) other than goldeneyes, we adopted recent (2002–2011) estimates of continental breeding population size presented in the 2012 NAWMP (Appendix A) as the LTA continental objective. Population survey data are lacking for significant portions of these species' breeding ranges, making annual population estimates and LTAs unreliable. We did not calculate continental objectives reflecting the 80th percentile for these species because of the same data limitations, and because population size for many of these species appear to be declining. Simply maintaining populations at existing levels was viewed as a desirable objective. Thus, for calculating regional population objectives corresponding to 80th percentile continental objectives, we used the LTA objectives for cinnamon teal, wood ducks, ruddy ducks, and sea ducks (Table 3). A complete list of species-specific continental population objectives, as calculated by the methods described herein, is presented in Table 4.

U.S. and Canadian Harvest Data

Fleming et al. (2017) relied exclusively on U.S. harvest data for their preferred method, but they identified as a high priority the need to incorporate Canadian harvest data in future revisions. Per their recommendation, we revised the analysis of Fleming et al. (2017) by incorporating Canadian harvest data to account for ducks occurring in Canada during the non-breeding period and enable calculations of population abundance objectives for JV regions in Canada.

County duck harvest estimates in the U.S. are derived through a combination of Hunter Diary and Parts Collection Surveys (Padding et al. 2006, Raftovich et al. 2016). Data from hunter diary surveys enable estimation of total duck harvest at the state, flyway, and national scale, but these surveys do not distinguish among species, sex, or age of ducks harvested. Information on harvest composition (species, sex, age) is obtained from the annual Parts Collection Survey, which is used in concert with the hunter diary data to estimate species-specific harvest at state, flyway, and national scales (Padding et al. 2006, Raftovich et al. 2016). Respondents to the Hunter Diary Survey are asked to identify not only the number of ducks (and geese) harvested, but also the county in which that harvest occurred. County harvest estimates are not generated as an explicit product of the annual surveys, because of insufficient sample sizes for individual counties. Survey results are obtained from only a portion of all U.S. counties during any given year, simply as an artifact of sample size and the randomization process for selecting survey participants. However, when multiple years of harvest data are combined (e.g., >10 years), sample sizes increase to a level where all counties, or at least all those in which waterfowl are normally harvested, become represented in the dataset. Although subject to potential biases (e.g., differential harvest effort among counties), these data are considered generally representative of the dominant patterns of harvest distribution across the U.S. Additionally, these surveys provide the only long-term source of information for generating an index of waterfowl distribution during the non-breeding period, based on methods that are consistent and repeatable in space and time.

Waterfowl harvest estimates in Canada are generated using a two-tiered survey system much like that described for the U.S. (Padding et al. 2006), except that degree blocks (1° latitude × 1° longitude) are the finest scale at which harvest can be calculated based on data submitted by survey respondents. Like the U.S. harvest estimation process, degree block harvest is not generated as an explicit product of annual estimation but may become useful as an index of the spatial distribution of harvest after combining multiple years of data.

In this revision, we used U.S. (county) and Canadian (degree block) species-specific harvest estimates from 1999–2013, as these were the same years of harvest data used by Fleming et al. (2017). Additionally, we followed analytical methods of Fleming et al. (2017) by partitioning U.S. and Canadian harvest data into autumn (1 Sep–30 Nov) and winter (1 Dec–31 Jan) time periods. For each time period, we summed species-specific harvest across all years (1999–2013) for each county and degree block. We then combined U.S. county and Canadian degree block harvest summaries to generate total duck harvest, and we calculated the proportion of total U.S. and Canadian harvest for each county and degree block, by species. These methods are described below in more detail.

Accounting for Birds Wintering Outside the U.S. and Canada

Similar to Koneff, we used U.S. and Mexico MWS data to adjust for the percentage of ducks expected to occur outside the U.S. and Canada during winter. Fleming et al. (2017) used data available from 1979, 1980, 1991, 1994, 1997, and 2000 to calculate the percentage of birds expected to winter in Mexico. We reexamined Mexico MWS data and identified an additional year (1978) during which nearly all survey areas in Mexico were flown. Thus, we used data from 1978–1980, 1991, 1994, 1997, and 2000 to calculate the percentage of birds for 13 species or species groups expected to occur in Mexico during winter (Table 5). We used these percentages to recalculate winter population objectives for Mexico, consequently affecting the number of birds to be allocated among regions in the U.S. and Canada.

We lacked data with which to estimate the number of blue-winged teal wintering outside the U.S. and Mexico; thus, we followed the approach of Fleming et al. (2017) in assuming that only 25% of blue-winged teal remained in the U.S. by mid-October (i.e., autumn) and that this decreased to 5% by the winter period. While informed by virtually no empirical data, we believe this assumption is consistent with the conclusions of Baldassarre (2014:465) that, "…only a miniscule percentage of the blue-winged teal population winters in the United States."

We also followed Fleming et al. (2017) in relying on assumptions of Bellrose (1976) that only 1% of cinnamon teal remain in the U.S. during winter. Thus, we determined a LTA mid-winter objective for cinnamon teal by first adjusting the continental breeding objective by the assumed 85% survival rate between mid-winter and the start of the breeding season, and then calculating a value equal to 1% of this number (i.e., [(300,000/0.85) × 0.01]). We assumed that 3 times as many cinnamon teal remained in the U.S. during autumn than winter. We used these same values when calculating regional objectives corresponding to the 80th percentile NAWMP objectives (Table 3).

Modifications to Harvest and Mid-Winter Survey Data for Blue-winged and Cinnamon Teal
To step down population objectives for blue-winged and cinnamon teal separately, it was necessary to partition their combined harvest data into approximate species proportions (Fleming et al 2017). However, these species are not distinguishable in harvest surveys. To overcome this, we used eBird (http://ebird.org/content/ebird/) checklist data to index the ratio of blue-winged to cinnamon teal observed during the autumn and winter periods in each JV county where both species occur, and we then used this ratio to estimate the harvest totals of each species (Fleming et al. 2017).

Accounting for Redheads Wintering along the U.S. Gulf of Mexico Coast
As noted by Fleming et al. (2017), the MWS is not ideally designed to estimate redhead abundance, because the species often occurs in clumped distributions along nearshore coastal waters. Independent of the traditional MWS, the USFWS conducted a Gulf Coast Redhead Survey from 1981–2012 to monitor distribution and trends of redheads in nearshore coastal waters from Cedar Key, Florida, to Tampico, Mexico (F. Roetker, USFWS, unpublished data). The survey used a cruise method to enumerate total redheads within key geographic regions across the Gulf, although regions in Mexico were not surveyed every year due to logistical challenges. From 1981–2012, based on the subset of years during which all regions were surveyed (i.e., 1991, 1994, 1997, 2000), the average number of redheads using the surveyed areas was 756,000. Hence, redhead concentrations in areas not covered by the MWS can be substantial, and failure to account for these could lead to regional population objectives for the non-breeding season that underestimate the continental importance of given geographies.

Following the approach used by Fleming et al. (2017), we supplemented Texas and Louisiana MWS data with Gulf Coast Redhead Survey data for 1981–2003 and 2005–2012 to improve our calculation of the proportion of redheads wintering in the U.S. During years when Florida conducted its MWS, it was not necessary to supplement MWS data because redheads counted during the Gulf Coast Redhead Survey were already incorporated into Florida MWS counts.

However, during years when Florida did not conduct a MWS (i.e., post-2004), we used redhead counts from the Gulf survey to represent redhead distributions in Florida. Redheads enumerated in Mexico during the Gulf Coast Redhead Survey were already incorporated into Mexico MWS data. When calculating the proportion of redheads wintering outside the U.S., we used Gulf Coast Redhead Survey data from only those years when all regions were surveyed (i.e., 1991, 1994, 1997, 2000).

Regional Population Abundance Objectives for the U.S. and Canada

We used U.S. county and Canadian degree block harvest data to represent the spatial distribution of ducks during autumn–winter. Following the methods of Fleming et al. (2017), we subsetted harvest data from 1999–2013 into autumn (i.e., 1 Sep–30 Nov) and winter (1 Dec–31 Jan) to capture temporal differences in the spatial distribution of ducks. For each period, we calculated total harvest by species or species group (Table 6) by summing harvest estimates across all U.S. counties and Canadian degree blocks from 1999–2013. Within each period, we calculated harvest for individual counties and degree blocks over this same series of years, by species or species groups. We divided county and degree block harvest by total harvest to calculate the proportion of harvest within each county and degree block, for each species or species group. We multiplied these proportions by the corresponding species-specific continental population objective after adjusting it for autumn or winter survival and the percentage of the population expected to occur outside the U.S. and Canada. These calculations took the following form:

$$N_{ij} = \frac{\sum_{y=1999}^{2013} h_{ijy}}{\sum_{j=1}^{J} \sum_{y=1999}^{2013} h_{ijy}} \times \frac{P_i \times 1 - p_i}{s}, \quad \text{(Eq. 3)}$$

where N_{ij} is the autumn or winter population objective for species i, allocated to county or degree block j; h_{ijy} is the estimated harvest of species i, in county or degree block j, during year y; P_i is the continental objective for species i; p_i is the proportion of the population of species i expected to occur outside the U.S. and Canada, and s is the assumed survival rate between autumn or winter and the subsequent breeding season (s = 0.7 for the autumn analysis and s = 0.85 for the winter analysis). We then aggregated county and degree block objectives to JV regional scales in the U.S. and Canada (Figure 2). When a county or degree block was intersected by JV boundaries, the population objective was allocated to the intersecting JVs in proportion to the area of those counties or degree blocks occurring within each JV region.

Partitioning the non-breeding season into 2 time periods required calculating unique population objectives for each period. The number of birds to be allocated during the autumn period should necessarily be larger than that allocated during the winter period, because of the timing of emigration from the U.S. (teal) and mortality occurring between autumn and winter. We assumed that only 25% of blue-winged teal remained in the U.S. during our autumn period and that this decreased to 5% by winter. For all other species, we assumed that few birds had yet migrated out of the U.S. and Canada by autumn, and we thus removed the adjustment for birds wintering in Mexico when calculating autumn population objectives. We assumed a survival rate of 0.70 between autumn and the breeding season, and 0.85 between winter and the breeding season.

We calculated regional population abundance objectives corresponding to both the LTA and 80th percentile continental breeding population objectives for 23 duck species and species groups (Table 6). Regional population objectives were not calculated for North American goose or swan species, primarily because revised NAWMP population objectives for these species had not been established at time of this analysis. Additionally, several goose species are recognized as overabundant and JVs must consider these abundances in conservation planning to account for their effects as competitive foragers with ducks. Consequently, foraging demands of geese are often derived to reflect actual abundances observed from winter surveys within individual JV regions rather than objectives stepped-down from continental levels. Nevertheless, this remains an important topic for further exploration.

Regional Population Abundance Objectives for Mexico

We calculated winter population objectives for Mexico, corresponding to the LTA and 80th percentile continental breeding population objectives, for 13 species or species groups (Table 5). We assumed the vast majority of ducks remained in the U.S. or Canada during autumn, and we therefore did not calculate population abundance objectives for Mexico during the autumn period.

Like our methods for the U.S. and Canada, we assumed an 0.85 survival rate between mid-winter and the subsequent breeding season. Fleming et al. (2017) assumed 95% of blue-winged teal and 99% of cinnamon teal occupied regions outside the U.S. and Canada at mid-winter, but they lacked empirical data to calculate the percentage that wintered in Mexico versus Central or South American countries. We used eBird observational abundance data (eBird Basic Dataset. Version: EBD_relNov-2017. Cornell Lab of Ornithology, Ithaca, New York. Nov 2017) to index the relative distribution of blue-winged teal in Mexico and other countries outside the U.S. during winter. Specifically, we collaborated with the Cornell Lab of Ornithology to calculate relative abundance of blue-winged teal in Mexico and the combined countries of Cuba, Honduras, Nicaragua, Costa Rica, El Salvador, and Guatemala during December. Between these regions, eBird data revealed an approximate equal distribution, with 49% of the observed abundance occurring in Mexico and 51% in the other combined countries. We thus calculated blue-winged teal population abundance objectives for Mexico as (0.95 × continental NAWMP mid-winter objective × 0.49) and that for cinnamon teal as (0.99 × continental NAWMP mid-winter objective × 0.51) (Table 7). For all other species or species groups, we used data from the U.S. and Mexico MWS to estimate the percentage of each species or species group expected to winter in Mexico (Tables 5 and 7).

Fleming et al. (2017) further recommended development of population abundance objectives at finer scales in Mexico. We used spatially-referenced data from the Mexico MWS during 1978, 1979, 1980, 1991, 1994, 1997, and 2000 to calculate proportional distribution and population abundance objectives for 13 duck species and species groups (Table 5) at the scale of degree blocks in Mexico. The Mexico MWS is conducted across numerous wetlands that are identified as discrete "survey areas," and are the finest spatial scale at which waterfowl are enumerated. We generated a degree block grid for Mexico and assigned each survey area to its corresponding degree block, based on the latitude-longitude reported for survey areas in supplemental datasets obtained from the USFWS (M. Otto, USFWS, unpublished data). We summed mid-winter counts across survey areas within degree blocks, by species, and across all years. We then calculated the proportion of total Mexico mid-winter counts in each degree block, by species, and multiplied these proportions by national-level Mexico mid-winter duck population objectives (Table 7) to generate objectives at the degree block scale. Lastly, we aggregated degree block objectives to JV regional scales in Mexico (Sonoran and Rio Grande JVs only).

Some survey areas in Mexico encompassed portions of multiple degree blocks (e.g., large wetland complexes), but our method assigned those counts to a single geographic coordinate (i.e., approximate mid-point of survey area) as provided in the Mexico MWS archives. Thus, waterfowl counts from a large survey area (e.g., Laguna Madre and Tamaulipas Lagoons) were associated with only a single degree block, rather than allocating them across all degree blocks encompassed by the survey area. This initially resulted in spatial depictions of population objectives that failed to capture the full extent of waterfowl distribution across important wetlands and survey areas of Mexico. This issue was most prevalent on the Gulf Coast of Mexico and selected locations along the West Coast of Mexico. For these survey areas, we apportioned population objectives from these singular degree blocks to adjacent degree blocks based on expert opinion of a retired USFWS pilot biologist who participated in the Mexico MWS over multiple years (F. Roetker, USFWS Pilot Biologist-Retired). For example, the actual surveyed area for the Laguna Madre and Tamaulipas Lagoons encompassed 3 degree blocks (Table 8). Based on recollections from years of conducting the surveys and interactive viewing of aerial imagery and degree block grids, F. Roetker advised that the average distribution of waterfowl across this overall survey area be apportioned 40%, 40%, and 20%, respectively, in degree blocks 97.5W, 24.5N; 97.5W, 25.5N; and 97.5W, 23.5N (Table 8). These adjustments were incorporated as a post-processing procedure (Table 8).

RESULTS

The total duck population abundance objective, corresponding to the NAWMP long-term average, across all U.S. and Canadian JVs during autumn was 81,106,691, while that for winter was 60,831,659. This difference is attributable to the approximate 15% mortality that we assumed occurs between late October and early January, as well as our assumptions about the timing and magnitude of duck emigration to Mexico. The total Mexico winter population abundance objective corresponding to the NAWMP LTA, for the 13 species and species groups in our analysis, was 8,160,109, while that for the 80th percentile was 10,459,712 (Table 7).

We calculated regional population abundance objectives at the JV scale for both the NAWMP LTA and 80th percentile objectives (Tables 9–12). For the Rio Grande and Sonoran JVs, we calculated objectives separately for the U.S. and Mexico portions of these JV regions (Tables 13 and 14).

Spatial datasets for county and degree block results for the autumn and winter planning periods, for both the long-term average and 80th percentile objectives, can be downloaded from the following location:
https://www.fws.gov/migratorybirds/pdf/management/NAWMP/FlemingOutputFiles2019.zip
Results for the autumn planning period are referenced as Method 4B, while those for the winter planning period are referenced as 4D.

DISCUSSION

Comparison to Fleming et al. (2017)

We calculated regional JV population abundance objectives for 23 species and species groups, in contrast to the 17 used by Fleming et al. (2017). This increased the total duck population to be allocated among regions by approximately 14%. The use of Canadian harvest data resulted in regional population abundance objectives for U.S. JVs during the autumn period that were lower than those reported by Fleming et al. (2017). When using only the species and species groups included by Fleming et al. (2017), our revisions resulted in autumn population abundance objectives for U.S. JVs that were 14 million ducks lower (56,528,302 vs. 70,558,222). Essentially, these 14 million ducks were allocated to Canadian JVs in our revised analysis by virtue of our use of Canadian harvest data. The Upper Mississippi / Great Lakes JV experienced the greatest overall reduction in autumn population abundance objectives, with a decrease of 3.3 million ducks of the species included in Fleming et al. (2017). Proportional decreases were relatively similar across all JVs, ranging from 13.5–21.1%. Because very little harvest occurs in Canada during the winter period, regional population abundance objectives for the winter period were impacted minimally by the inclusion of Canadian harvest data. Additionally, Fleming et al. (2017) reported objectives for the Pacific Coast JV but was able to include only U.S. portions of that planning geography. Use of Canadian harvest data enabled calculation of habitat objectives into the Canadian portion of the Pacific Coast JV region. Per the guidance of partnership representatives, population objectives for the U.S. and Canadian portions of this JV are reported collectively as the Pacific Birds Habitat JV.

Including an additional year of Mexico MWS data impacted winter population abundance objectives for Mexico only slightly, increasing the LTA objective for all ducks from 4.3 to 4.7 million, when excluding blue-winged and cinnamon teal. For those 2 species, the combined effects of an additional year of MWS data and use of eBird data to apportion birds among Mexico and Central and South American countries reduced the Mexican LTA winter objective from 5.3 to 3.5 million.

Application of Results

Regional population abundance objectives serve as an approximation of the number of birds expected to occur in a defined area (e.g., JV region) at a given point in time during the non-breeding period. In contrast to previous methods that generated objectives specific only to the mid-winter (early January) period, our method yields population objectives for two distinct periods during autumn–winter. Petrie et al. (2011) recognized that mid-winter objectives were of limited utility for JVs at northern latitudes because few birds remain in those locales at mid-winter, making it unrealistic to extrapolate abundance estimates across the non-breeding planning period. Our methods are an improvement over previous approaches, as they give JVs the option of using either the autumn or winter objective as the basis for calculating total expected duck use-days. Generally, we expect JVs at northern latitudes to find greater utility in the autumn objective (Tables 9 and 11; Method 4B) and JVs at southern latitudes or other terminal wintering sites (e.g., coastal) to find greater value in the winter objective (Tables 10 and 12; Method 4D), as these time periods generally align with peak duck abundance in their respective landscapes. The choice for mid-latitude JVs may not be as clear and will likely depend on knowledge of region-specific migration chronology. In some cases, it may be possible to use both autumn and winter objectives to calculate or refine duck use-day objectives for the entire autumn–winter period, although we anticipate this to be unnecessary if a complete record of migration chronology is available. Additional work is needed to formulate guidance on which time period to select as the basis for JV objectives (i.e., autumn vs. winter).

Regional population objectives by themselves do not account for temporal variation in waterfowl abundance across autumn–winter, and thus must be combined with additional data to calculate overall duck use-day objectives. Petrie et al. (2011) recommended a process that combines population objectives with migration chronology data to calculate expected duck use-days across the entire non-breeding planning period. Species-specific migration chronology can be assessed from a variety of data sources including eBird (http://ebird.org/content/ebird/), the USFWS Integrated Waterbird Management and Monitoring Program (http://iwmmprogram.org/), and other systematic monitoring programs (e.g., Soulliere at al. 2013). Important in this process is selecting the date to which regional population abundance objectives are assigned, after which migration chronologies are used to extrapolate duck abundance objectives to weekly or bi-weekly periods over the remainder of the non-breeding planning period (see Soulliere at al. 2013). Early planning efforts used roughly January 1 (i.e., mid-winter) as the date to which the population objectives were assigned, because the methods for calculating objectives relied heavily on data from the MWS (e.g., Koneff's analysis) typically conducted in early January. Fleming et al. (2017), and thus our analysis, generated objectives for both an autumn and winter period, which requires identifying a temporal point of reference for each period. Fleming et al. (2017) recommended October 28 and January 1 as the temporal points of reference for autumn and winter, respectively, as these were the mid-points of those periods.

Fleming et al. (2017) acknowledged that species-specific migration timing and temporal patterns of harvest may be skewed away from the mid-points for some regions and/or species. They further deemed it appropriate for individual JVs to select alternative temporal points of reference to better align with patterns of duck abundance in their geography, when information exists to justify it. We reiterate these suggestions and urge JVs to clearly document the process and outcome of alternative methods used to adjust regional objectives. We further identify an immediate need for consistent and more tangible guidance on selecting the date to which autumn and winter objectives are assigned and subsequently used to extrapolate over the entire planning period.

Consistent with the 2012 NAWMP, we calculated continental and regional population abundance objectives reflecting duck abundance at both LTA and 80th percentile objectives. Like Fleming et al. (2017), we were unable to offer specific guidance on the appropriate interpretation or use of these dual objectives, and we restate their observation of a pressing need for such guidance. We believe the NSST is ideally positioned to address these areas of needed guidance, and we recommend this issue be elevated to a high priority work task in the immediate future.

Uncertainties, Assumptions, and Opportunities for Future Improvement

We calculated regional population abundance objectives for all North American Joint Ventures, as this was the most logical scale for demonstrating the utility of our method for regional conservation planning in support of the NAWMP. Although our work is a revision of the methods recommended by Fleming et al. (2017) and endorsed by the NSST, these results should not be interpreted as accepted population objectives for individual Joint Ventures. Ultimately, the establishment and application of JV population abundance objectives for conservation planning are the purview of JV partnerships. Nevertheless, methods and results presented herein are offered as the recommended approach for establishing JV population objectives, as they are repeatable, transparently documented, based on data that are consistently collected, and offer a consistent method across JVs. We encourage JVs to adopt these methods, or at least adaptations of them, to promote greater inter-regional consistency in conservation planning and enhanced efficiency in pursuit of NAWMP goals and objectives.

However, we recognize that some JVs may find it necessary to use locally-derived data and expert opinion to refine or supplement their respective population objectives. In these cases, we recommend JVs include in their implementation plans a clear justification and description of modifications made to these objectives, or alternative methods used to derive them (e.g., Petrie et al. 2011). If such modifications lead to substantial changes in population objectives for certain species, it is advisable to coordinate such changes with the other JVs that are particularly important for those species to ensure adequate habitat resources are provided in aggregate.

Although highly useful in the context of conservation planning, our recommended method and accompanying datasets do not account for the full complement of factors governing the distribution and abundance of ducks throughout the autumn–winter period. These shortcomings should not detract from the utility of these results, but rather should be viewed as opportunities for future refinement. Fleming et al. (2017) provided an initial list of notable uncertainties and assumptions regarding developing distribution and abundance of non-breeding waterfowl, and we addressed 3 of them (i.e., items 5, 6, and 9 from Fleming et al. [2017]) with the revisions described herein. Remaining assumptions, uncertainties, and refinement needs are as follows:

1) Distribution of harvest was assumed to be a reliable index of the distribution of ducks during autumn–winter. Opportunities to test this assumption may be possible at state

or regional scales where rigorous surveys of waterfowl abundance across the non-breeding period have been collected over several years (e.g., Missouri, Illinois).

2) The temporal points of reference selected for both the autumn and winter periods were largely arbitrary. The 2 most common options are to use either the mid-point or date of peak abundance during the autumn or winter planning period as the reference point. These approaches assume that the spatial distribution of ducks at these points is similar to the proportional distribution of harvest as measured across the entire autumn or winter period. In effect, this assumes most harvest, and thus the index of duck abundance across space, is centered around either the mid-point or date of peak abundance. The assumptions and ramifications of these options deserve greater scrutiny, ultimately leading to clear guidance on which dates to select as the temporal points of reference for population objectives.
3) Assumptions about survival rates between the start of the breeding season and the temporal points of reference for autumn and winter periods were based on generalizations from scientific studies, most of which were derived from mallards. The implications of applying a common mortality rate across all species, which differ in life history traits and mortality risk factors, are unknown.
4) Our method did not yield independent objectives for spring migration periods. For JVs that support ducks continuously through winter and spring, the lack of independent spring population objectives is of little consequence as migration chronologies can be combined with winter population objectives to estimate duck use-days into spring. JVs hosting birds primarily during migration periods, or predominantly in spring (vs. fall), and therefore lacking a continuous record of bird abundance across the non-breeding planning period, have the greatest difficulty in predicting duck use-days. Petrie et al. (2011) explored the challenges of developing population objectives for the spring period, but additional guidance is needed.
5) Our method did not generate population objectives for geese, swans, and some sea duck species, primarily because revised NAWMP objectives for these species have not been established, but also because of limited data. This is an important need, and we recommend the NSST work closely with the NAWMP Committee, Flyway technical committees, Arctic Goose JV, and Sea Duck JV to address it.
6) We lacked empirical data on blue-winged and cinnamon teal migration chronology and distribution outside the U.S. during autumn and winter. Consequently, we used arbitrary assumptions about the percentage of their populations expected to remain in the U.S. and how these percentages change from autumn to winter. With some exceptions (e.g., Gulf Coast JV), blue-winged and cinnamon teal population objectives, and thus our assumptions about migration chronology and distribution outside the U.S., likely have a relatively small influence on JV habitat objectives. Nevertheless, efforts to refine these assumptions would be useful, especially for JVs where these species may be abundant during autumn and winter.

CONCLUSIONS

Our results build on the efforts of Fleming et al. (2017) for establishing regional population abundance objectives for JVs during the non-breeding period. Objectives are now available for

JVs in Canada, the U.S., and Mexico using consistent methods that provide clear linkages to the NAWMP, thus advancing the opportunity for inter-regional planning. Except for select geographies and time periods (e.g., Upper Mississippi / Great Lakes JV during autumn), population objectives calculated herein differ little from those in Fleming et al. (2017). Nevertheless, where possible, we encourage JV planners to use objectives in this report as they reflect the most recent adjustments to this method. Should modifications to these objectives be deemed necessary by individual JVs, we recommend the rationale and methods for doing so be documented in JV implementation plans. We encourage the NSST to evaluate the assumptions underlying this analysis and work towards further improvements and updates. This should include providing guidance on how to interpret and incorporate the dual LTA and 80th percentile objectives of the 2012 NAWMP into regional-scale conservation planning models.

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Table 1. Long-term average (LTA) and 80th percentile population abundance objectives at the continental scale and associated population data for 11 North American duck species most commonly breeding in the Traditional Survey Area (TSA).

Species	Continental Pop Size[a]	TSA[a]	TSA/C_Pop[b]	NAWMP LTA[c]	NAWMP 80th percentile[c]	Continental LTA[d]	Continental 80th percentile[e]
American green-winged teal	4,380,000	2,790,000	0.6370	2,059,000	2,631,000	3,232,409	4,130,387
American wigeon	2,780,000	2,350,000	0.8453	2,596,000	3,048,000	3,071,013	3,605,719
Blue-winged teal	7,390,000	6,030,000	0.8160	4,949,000	6,329,000	6,065,192	7,756,436
Gadwall	3,650,000	2,770,000	0.7589	1,921,000	2,977,000	2,531,282	3,922,762
Mallard	11,900,000	7,910,000	0.6647	7,726,000	9,297,000	11,623,186	13,986,637
Northern pintail	3,780,000	2,960,000	0.7831	4,003,000	5,722,000	5,111,939	7,307,149
Northern shoveler	4,260,000	3,720,000	0.8732	2,515,000	3,592,000	2,880,081	4,113,419
Canvasback	690,000	620,000	0.8986	581,000	691,000	646,597	769,016
Lesser & greater scaup	4,900,000	3,760,000	0.7673	5,026,000	5,984,000	6,549,840	7,798,298
Redhead	1,310,000	880,000	0.6718	701,000	918,000	1,043,534	1,366,568

[a] Obtained directly from the 2012 NAWMP (see NAWMP Table 1); details of their derivation provided therein.

[b] Calculated ratio between 2002-2011 population size from the TSA and estimated continental population size as reported in Table 1 of the 2012 NAWMP.

[c] Estimates based on data from the TSA and obtained directly from the Revised Objectives Addendum to the 2012 NAWMP.

[d] Continental LTA objective; calculated as (NAWMP LTA / (TSA/Continental_Pop)).

[e] Continental 80th percentile objective; calculated as (NAWMP 80th percentile / (TSA/Continental_Pop)).

Table 2. Long-term average (LTA; 1998–2014) and 80th percentile population abundance objectives at the continental scale for North American ducks commonly breeding in the Eastern Survey Area (ESA). Population estimates from the Traditional Survey Area (TSA) were also included when developing continental objectives for species occurring in both regions.

Species	Continental LTA	Continental 80th percentile
American black duck	956,624	1,025,528
Ring-necked duck	1,804,326	2,155,032
Goldeneye[a]	1,269,210	1,447,280
Common	1,044,976	1,191,586
Barrow's	224,234	255,694
Eastern	6,531	7,447
Western	217,703	248,247

[a] Species- and population-level objectives calculated by apportioning generic goldeneye objectives in proportion to 2011 population sizes as presented in Table 1 of the 2012 NAWMP.

Table 3. Estimated continental population size (2002–2011 mean), long-term average (LTA), and 80th percentile population abundance objectives for North American duck species with limited coverage (i.e., incomplete and or imprecise data) of spring abundance surveys in the Traditional Survey Area (TSA) or Eastern Survey Area (ESA).

Species	Continental Pop Size[a]	Continental LTA[b]	Continental 80th percentile[c]
Cinnamon teal	300,000	300,000	300,000
Wood duck	4,600,000	4,600,000	4,600,000
Ruddy duck	1,240,000	1,240,000	1,240,000
Harlequin duck	254,000	254,000	254,000
Long-tailed duck	1,000,000	1,000,000	1,000,000
Bufflehead	1,670,000	1,670,000	1,670,000
Eider	1,700,000	1,700,000	1,700,000
King	600,000	600,000	600,000
Common	1,275,000	1,275,000	1,275,000
American subspecies	300,000	300,000	300,000
Northern subspecies	550,000	550,000	550,000
Hudson Bay subspecies	275,000	275,000	275,000
Pacific subspecies	150,000	150,000	150,000
Steller's	1,000	1,000	1,000
Spectacled	17,000	17,000	17,000
Scoter	1,600,000	1,600,000	1,600,000
Black	500,000	500,000	500,000
Pacific population	200,000	200,000	200,000
Atlantic population	300,000	300,000	300,000
Surf	700,000	700,000	700,000
White-winged	400,000	400,000	400,000
Merganser	2,700,000	2,700,000	2,700,000
Hooded	1,100,000	1,100,000	1,100,000
Red-breasted	400,000	400,000	400,000
Common	1,200,000	1,200,000	1,200,000

[a] Obtained from Table 1 in the 2012 NAWMP Revision; derivation details provided therein.

[b] Continental LTA objective; for these species, we adopted recent (2002–11) estimates of continental population size as presented in the 2012 NAWMP, because long-term population data are lacking for significant portions of their breeding ranges, thus hindering estimation of reliable LTA population size.

[c] Continental 80th percentile objectives; unique values not calculated for these species because long-term population data are lacking for significant portions of their breeding ranges, thus hindering estimation of reliable 80th percentile population levels. Moreover, population sizes for many of these species are declining, and maintaining them at existing levels is viewed as a desirable objective.

Table 4. Long-term average (LTA) and 80th percentile population abundance objectives at the continental scale to inform regional population objectives for duck species and species groups in North America.

Species	Continental LTA	Continental 80th percentile
American black duck	956,624	1,025,528
American green-winged teal	3,232,409	4,130,387
American wigeon	3,071,013	3,605,719
Blue-winged teal	6,065,192	7,756,436
Cinnamon teal	300,000	300,000
Gadwall	2,531,282	3,922,762
Mallard	11,623,186	13,986,637
Northern pintail	5,111,939	7,307,149
Northern shoveler	2,880,081	4,113,419
Wood duck	4,600,000	4,600,000
Canvasback	646,597	769,016
Lesser and greater scaup	6,549,840	7,798,298
Redhead	1,043,534	1,366,568
Ring-necked duck	1,804,326	2,155,032
Ruddy duck	1,240,000	1,240,000
Harlequin duck	254,000	254,000
Long-tailed duck	1,000,000	1,000,000
Bufflehead	1,670,000	1,670,000
Eiders	1,700,000	1,700,000
King	600,000	600,000
Common	1,275,000	1,275,000
American subspecies	300,000	300,000
Northern subspecies	550,000	550,000
Hudson Bay subspecies	275,000	275,000
Pacific subspecies	150,000	150,000
Steller's	1,000	1,000
Spectacled	17,000	17,000
Scoters	1,600,000	1,600,000
Black	500,000	500,000
Pacific population	200,000	200,000
Atlantic population	300,000	300,000
Surf	700,000	700,000
White-winged	400,000	400,000
Goldeneye	1,269,210	1,447,280
Common	1,044,976	1,191,586
Barrow's	224,234	255,694
Eastern	6,531	7,447
Western	217,703	248,247
Merganser	2,700,000	2,700,000
Hooded	1,100,000	1,100,000
Red-breasted	400,000	400,000
Common	1,200,000	1,200,000

Table 5. Mean proportion of total Mid-winter Waterfowl Survey counts occurring in Mexico for 13 common duck species during 1978–1980, 1991, 1994, 1997, and 2000. Results for redheads were based only on 1991, 1994, 1997, and 2000.

Species	Mean proportion
American green-winged teal	0.113
American wigeon	0.123
Blue-winged/Cinnamon teal	0.695
Canvasback	0.049
Gadwall	0.045
Goldeneye	0.001
Mallard	0.001
Merganser	0.024
Northern pintail	0.119
Northern shoveler	0.250
Redhead	0.240
Ring-necked duck	0.094
Scaup (lesser and greater not distinguished)	0.106

Table 6. Species and species groups for which population abundance objectives for the non-breeding period were calculated for Joint Venture regions in the U.S. and Canada.

Species code	Species or species group
ABDU	American black duck
AGWT	American green-winged teal
AMWI	American wigeon
BAGO	Barrow's goldeneye
BUFF	Bufflehead
BWTE	Blue-winged teal
CANV	Canvasback
CITE	Cinnamon teal
COGO	Common goldeneye
EIDR	King eider, Common eider
GADW	Gadwall
HOME	Hooded merganser
LTDU	Long-tailed duck
MALL	Mallard
MERG	Common merganser, Red-breasted merganser
NOPI	Northern pintail
NSHO	Northern shoveler
REDH	Redhead
RNDU	Ring-necked duck
RUDU	Ruddy duck
SCAU	Lesser scaup, Greater scaup
SCOT	Surf scoter, White-winged scoter, Black scoter
WODU	Wood duck

Table 7. Population abundance objectives for 13 species or species groups in Mexico during the mid-winter planning period, corresponding to NAWMP long-term average and 80th percentile continental breeding population objectives.

Species	Long-term Average Mid-winter Objective	80th Percentile Mid-winter Objective
American green-winged teal	488,702	624,466
American wigeon	469,901	551,717
Blue-winged and cinnamon teal	3,459,594	4,376,994
Canvasback	38,896	46,260
Gadwall	165,620	256,664
Goldeneye species	2,428	2,769
Mallard	8,697	10,465
Northern pintail	780,509	1,115,681
Northern shoveler	852,826	1,218,032
Redhead	378,845	496,119
Ring-necked duck	250,561	299,263
Ruddy duck	150,132	150,132
Scaup species	1,037,472	1,235,223
Total	8,084,183	10,383,785

Table 8. Manual adjustment of degree block calculations to better reflect distribution of waterfowl from Mexico mid-winter waterfowl survey areas that span multiple degree blocks but were assigned a single survey coordinate. Apportionment among adjacent degree blocks based on insights from retired U.S. Fish and Wildlife Service Pilot Biologist, Fred Roetker.

		Apportionment among adjacent degree blocks	
Degree block of survey area	Survey area	Degree block	Percentage
97.5W, 24.5N	Laguna Madre & Tamaulipas Lagoons	97.5W, 24.5N	40
		97.5W, 25.5N	40
		97.5W, 23.5N	20
98.5W, 22.5N	Deltas de Rio Tamesi y Rio Panuco	98.5W, 22.5N	85
		97.5W, 22.5N	15
92.5W, 18.5N	Tabasco Lagoons	92.5W, 18.5N	20
		94.5W, 18.5N	10
		93.5W, 18.5N	10
		91.5W, 18.5N	25
		92.5W, 17.5N	10
		91.5W, 17.5N	25
89.5W, 21.5N	Yucatan Lagoons	89.5W, 21.5N	35
		90.5W, 20.5N	35
		90.5W, 21.5N	15
		88.5W, 21.5N	5
		87.5W, 21.5N	10
113.5W, 30.5N	Mexicali to Tiburon	113.5W, 30.5N	25
		113.5W, 31.5N	25
		112.5W, 30.5N	25
		112.5W, 29.5N	25
114.5W, 27.5N	Scammon's Lagoon	114.5W, 27.5N	80
		114.5W, 28.5N	20
112.5W, 24.5N	Bahia Magdalena	112.5W, 24.5N	35
		111.5W, 24.5N	30
		112.5W, 25.5N	35

Table 9. Joint Venture population abundance objectives for the autumn planning period, corresponding to NAWMP long-term average continental objectives.

	Species[a]											
Joint Venture[b]	ABDU	AGWT	AMWI	BAGO	BUFF	BWTE	CITE	CANV	COGO	EIDR	GADW	HOME
AMJV	32,739	27,569	6,041	0	32,522	10,457	0	799	6,235	125	16,981	44,273
ACJV	284,962	398,208	126,317	6,281	332,283	102,814	0	5,113	189,979	1,545,221	52,192	362,563
CDN IWJV	33	3,115	23,842	0	3,700	492	0	255	0	0	2,088	0
CHJV	8,046	53,380	20,743	0	17,377	33,269	0	2,364	3,791	0	80,051	42,206
CVJV	0	260,434	360,746	2,411	15,338	2,305	2,563	53,771	14,736	0	95,624	4,679
EGCPJV	184	24,319	8,251	0	6,851	40,458	0	879	306	0	38,868	21,710
EHJV	891,636	340,125	140,182	0	244,109	30,851	0	29,493	0	1,129,908	28,687	0
GCJV	4,169	646,744	302,283	0	32,041	818,580	1,470	47,326	3,052	0	738,226	97,796
US IWJV	0	416,118	795,113	238,387	155,043	4,250	3,034	62,819	260,920	0	288,399	40,603
LMVJV	1,931	443,716	198,358	0	18,267	209,126	1	52,136	2,578	0	527,691	117,205
NGPJV	0	15,269	35,908	1,943	3,147	4,952	57	1,980	8,399	0	18,186	2,486
No JV	0	1,369	2,407	0	1,412	30	14	347	0	0	529	0
OPJV	0	158,668	213,263	0	5,573	70,178	306	25,520	4,202	0	219,045	32,925
PBHJV	0	192,450	626,452	35,015	87,525	155	152	17,053	20,751	0	34,415	44,267
PLJV	0	146,631	196,180	0	16,039	71,978	1,215	14,268	24,128	0	104,742	19,234
PHJV	1,267	68,579	198,281	0	73,782	70,949	0	126,231	0	380	179,464	0
PPJV	2,228	420,488	476,260	5,100	271,048	299,966	62	202,404	182,549	0	616,207	207,657
RBJV	1	76,878	62,245	0	6,027	38,549	18	4,375	6,400	0	37,591	5,764
RGJV	0	5,376	17,067	0	838	4,877	447	2,428	1,615	0	6,911	0
SFBJV	0	5,306	13,735	650	860	34	36	2,582	2,489	0	3,154	110
SJV	0	55,066	72,539	334	9,147	3,108	1,210	3,041	3,693	0	21,215	3,274
UMRGLRJV	137,001	818,861	427,793	4,354	986,725	331,130	0	220,216	753,891	0	485,630	523,553
WBA	419	29,598	47,716	0	58,802	13,869	0	47,170	0	330	16,992	0
TOTAL	1,364,615	4,608,267	4,371,722	294,476	2,378,458	2,162,377	10,586	922,569	1,489,715	2,675,964	3,612,888	1,570,305

Table 9. Continued.

	Species[a]											
Joint Venture[b]	LTDU	MALL	MERG	NOPI	NSHO	REDH	RNDU	RUDU	SCAU	SCOT	WODU	TOTAL
AMJV	5,396	264,376	129,023	6,984	3,794	1,245	15,518	73,656	18,000	8,103	379,480	1,083,316
ACJV	562,897	893,516	386,032	196,654	87,535	11,037	282,025	222,814	559,349	1,284,072	1,247,019	9,138,882
CDN IWJV	0	56,475	1,983	18,205	5,689	550	1,500	471	6,874	171	238	125,682
CHJV	0	190,144	7,446	31,761	46,474	4,567	27,634	17,484	80,363	0	216,542	883,643
CVJV	0	489,433	1,626	759,822	588,117	15,124	48,114	19,813	35,013	1,615	89,187	2,860,471
EGCPJV	0	56,816	584	7,063	19,670	5,532	18,920	5,825	32,764	0	148,187	437,189
EHJV	236,421	1,192,735	1,014,966	323,695	29,624	60,729	332,340	112,112	1,141,774	585,516	658,179	8,523,083
GCJV	4,270	158,877	15,171	653,224	550,757	197,858	179,402	62,466	1,008,347	7,622	157,373	5,687,054
US IWJV	7,393	1,759,683	166,932	963,915	431,104	100,015	75,317	232,025	380,047	35,332	61,094	6,477,543
LMVJV	0	914,821	12,974	297,746	420,633	44,842	135,228	64,187	445,281	1,662	530,880	4,439,264
NGPJV	2	130,773	6,939	22,797	14,503	7,351	3,779	4,007	8,691	1,298	7,905	300,375
No JV	0	3,104	0	3,359	5,191	0	823	1,654	1,435	726	531	22,932
OPJV	0	189,748	2,011	106,825	100,206	61,609	97,833	25,810	204,380	0	68,513	1,586,613
PBHJV	9,216	716,344	44,374	704,719	151,207	3,521	38,615	7,450	259,221	101,640	52,494	3,147,035
PLJV	0	344,157	10,603	152,402	95,545	57,859	29,885	44,474	63,360	0	26,611	1,419,311
PHJV	82	1,809,973	3,725	854,009	277,025	101,564	33,775	41,776	388,045	1,955	9,530	4,240,390
PPJV	8,404	2,537,163	38,627	878,519	585,409	380,731	414,534	321,649	1,546,619	23,370	699,383	10,118,378
RBJV	0	214,580	3,105	72,330	37,502	15,740	8,641	6,142	27,611	1,239	18,013	642,751
RGJV	0	5,162	0	10,179	7,915	790	2,764	5,012	11,303	25	958	83,667
SFBJV	0	26,941	0	17,942	20,957	145	492	4,512	15,204	76	2,648	117,874
SJV	681	56,988	1,244	109,885	127,933	16,928	14,596	54,564	37,362	558	1,664	595,030
UMRGLRJV	590,542	4,254,790	428,935	915,233	474,070	333,189	774,104	429,311	2,747,916	187,237	2,181,251	18,005,733
WBA	3,228	314,445	3,222	155,413	27,226	67,555	38,681	13,084	319,882	3,972	8,872	1,170,475
TOTAL	1,428,532	16,581,046	2,279,520	7,262,680	4,108,089	1,488,481	2,574,519	1,770,299	9,338,841	2,246,189	6,566,553	81,106,691

Table 9. Continued.

[a] ABDU = American black duck, AGWT = American green-winged teal, AMWI = American wigeon, BAGO = Barrow's goldeneye, BUFF = bufflehead, BWTE = blue-winged teal, CANV = canvasback, CITE = cinnamon teal, COGO = common goldeneye, EIDR = common and king eider, GADW = gadwall, HOME = hooded merganser, LTDU = long-tailed duck, MALL = mallard, MERG = common and red-breasted merganser, NOPI = northern pintail, NSHO = northern shoveler, REDH = redhead, RNDU = ring-necked duck, SCAU = lesser and greater scaup, SCOT = surf, white-winged, and black scoter, WODU = wood duck.

[b] AMJV = Appalachian Mountains Joint Venture (JV), ACJV = Atlantic Coast JV, CDN IWJV = Canadian Intermountain West JV, CHJV = Central Hardwoods JV, CVJV = Central Valley JV, EGCPJV = East Gulf Coastal Plain JV, EHJV = Eastern Habitat JV, GCJV = Gulf Coast JV, US IWJV = United States Intermountain West JV, LMVJV = Lower Mississippi Valley JV, NGPJV = Northern Great Plains JV, NoJV = No JV exists, OPJV = Oaks and Prairies JV, PBHJV = Pacific Birds Habitat JV, PCJV = Pacific Coast JV (Canada only), PLJV = Playa Lakes JV, PHJV = Prairie Habitat JV, PPJV = Prairie Pothole JV, RBJV = Rainwater Basin JV, RGJV = Rio Grande JV, SFBJV = San Francisco Bay JV, SJV = Sonoran JV, UMRGLRJV = Upper Mississippi / Great Lakes JV, WBA = Western Boreal Area.

Table 10. Joint Venture population abundance objectives for the winter planning period, corresponding to NAWMP long-term average continental objectives.

	Species[a]											
Joint Venture[b]	ABDU	AGWT	AMWI	BAGO	BUFF	BWTE	CITE	CANV	COGO	EIDR	GADW	HOME
AMJV	111,579	20,012	21,495	0	79,795	500	0	27,762	22,457	0	112,258	61,986
ACJV	642,273	227,722	171,552	5,016	1,021,421	102,139	0	107,658	250,007	1,074,216	98,724	576,544
CDN IWJV	0	107	584	0	397	0	0	0	0	0	164	0
CHJV	73,856	63,168	60,657	0	53,973	1,066	0	14,832	53,669	0	225,829	96,605
CVJV	0	782,578	819,091	8,163	71,947	2,925	2,395	108,020	61,811	0	140,447	7,912
EGCPJV	18,595	98,397	60,999	0	38,434	4,529	0	21,755	10,301	0	150,016	121,152
EHJV	184,377	2,343	2,204	0	45,791	68	0	8,516	0	1,128,777	2,389	0
GCJV	3,110	700,810	254,183	0	59,822	198,407	189	83,150	21,877	0	594,716	54,671
US IWJV	0	113,845	290,046	182,499	96,598	110	72	39,038	482,484	0	74,630	25,215
LMVJV	15,448	702,801	272,855	0	46,991	37,850	0	131,670	17,894	0	837,717	201,987
NGPJV	0	272	1,557	1,941	1	0	0	0	15,344	0	438	79
No JV	0	6,509	3,395	0	5,573	63	21	2,972	596	0	1,150	0
OPJV	202	185,875	336,761	0	25,568	1,886	5	70,582	11,532	0	330,793	48,656
PBHJV	0	185,374	541,913	55,755	251,991	30	25	23,447	44,797	0	19,277	34,406
PLJV	68	48,139	128,440	634	15,794	510	13	15,107	48,501	0	61,713	13,228
PHJV	0	246	61	0	100	51	0	132	0	0	48	0
PPJV	0	1,250	457	1,551	998	68	0	0	11,436	0	1,256	1,502
RBJV	0	3,701	6,292	0	511	27	0	329	8,260	0	2,345	649
RGJV	0	10,988	29,809	0	4,856	2,585	59	9,643	2,684	0	15,926	481
SFBJV	0	11,624	30,224	227	11,910	47	33	15,014	12,666	0	3,504	0
SJV	0	100,488	74,442	858	17,842	2,353	715	15,498	5,968	0	29,647	1,649
UMRGLRJV	74,532	44,989	34,461	0	111,924	595	0	25,581	144,020	0	107,244	46,836
WBA	0	100	55	0	43	13	0	99	0	0	21	0
TOTAL	1,124,038	3,311,337	3,141,531	256,643	1,962,280	355,820	3,528	720,803	1,226,304	2,202,992	2,810,252	1,293,559

Table 10. Continued.

	Species[a]											
Joint Venture[b]	LTDU	MALL	MERG	NOPI	NSHO	REDH	RNDU	RUDU	SCAU	SCOT	WODU	TOTAL
AMJV	6,180	472,757	131,017	20,500	16,635	17,955	50,151	86,762	115,563	15,452	191,024	1,581,840
ACJV	1,027,383	1,065,064	886,467	200,558	89,987	118,050	629,095	620,177	2,331,361	1,565,430	1,837,484	14,648,328
CDN IWJV	0	11,126	99	187	36	0	52	0	351	0	85	13,188
CHJV	0	918,972	27,222	79,976	72,518	20,085	73,752	32,300	205,291	9,008	174,113	2,256,893
CVJV	523	721,548	16,814	1,564,535	581,459	33,803	76,994	111,341	179,998	6,794	146,367	5,445,464
EGCPJV	0	782,294	14,699	118,086	67,882	16,835	99,371	36,159	139,717	5,947	842,538	2,647,705
EHJV	90,558	119,663	301,399	5,823	363	9,922	2,209	3,524	75,002	70,860	3,232	2,057,021
GCJV	0	294,943	80,798	893,854	412,618	358,097	255,296	70,771	1,190,343	2,396	327,348	5,857,397
US IWJV	1,896	1,567,316	135,140	258,566	103,826	47,471	54,217	93,076	283,297	590	33,720	3,883,651
LMVJV	0	4,051,162	4,204	729,082	669,672	69,945	279,457	81,212	737,209	1,405	1,619,200	10,507,762
NGPJV	0	72,932	4,793	1,339	188	235	422	0	1,010	0	210	100,760
No JV	0	3,265	0	3,632	4,087	0	250	3,208	20,519	4,242	1,613	61,094
OPJV	0	597,751	6,756	235,382	99,923	74,387	179,991	17,092	239,033	8	121,943	2,584,127
PBHJV	11,499	733,725	76,238	700,143	100,377	5,474	62,480	20,385	723,359	155,710	47,784	3,794,189
PLJV	678	478,340	24,589	105,839	32,514	16,292	32,029	892	33,626	800	5,366	1,063,112
PHJV	0	13,941	0	900	236	340	85	0	0	0	0	16,140
PPJV	0	69,820	447	949	1,283	362	236	2	1,944	0	227	93,788
RBJV	339	132,790	2,147	1,676	1,110	1,030	137	962	842	0	2,046	165,192
RGJV	0	4,407	5,336	30,891	14,946	7,746	7,431	4,368	11,064	0	0	163,220
SFBJV	0	25,532	0	26,738	15,062	520	1,542	16,580	90,295	6,615	7,869	276,002
SJV	0	75,489	20,127	174,419	177,134	18,715	23,799	63,833	68,151	843	1,145	873,114
UMRGLRJV	37,173	1,445,622	130,598	75,825	71,562	28,192	42,441	44,833	209,106	17,884	46,246	2,739,661
WBA	0	1,357	0	66	74	118	63	0	0	0	0	2,009
TOTAL	1,176,228	13,659,816	1,868,890	5,228,965	2,533,491	845,575	1,871,500	1,307,478	6,657,081	1,863,984	5,409,561	60,831,659

Table 10. Continued.

[a] ABDU = American black duck, AGWT = American green-winged teal, AMWI = American wigeon, BAGO = Barrow's goldeneye, BUFF = bufflehead, BWTE = blue-winged teal, CANV = canvasback, CITE = cinnamon teal, COGO = common goldeneye, EIDR = common and king eider, GADW = gadwall, HOME = hooded merganser, LTDU = long-tailed duck, MALL = mallard, MERG = common and red-breasted merganser, NOPI = northern pintail, NSHO = northern shoveler, REDH = redhead, RNDU = ring-necked duck, SCAU = lesser and greater scaup, SCOT = surf, white-winged, and black scoter, WODU = wood duck.

[b] AMJV = Appalachian Mountains Joint Venture (JV), ACJV = Atlantic Coast JV, CDN IWJV = Canadian Intermountain West JV, CHJV = Central Hardwoods JV, CVJV = Central Valley JV, EGCPJV = East Gulf Coastal Plain JV, EHJV = Eastern Habitat JV, GCJV = Gulf Coast JV, US IWJV = United States Intermountain West JV, LMVJV = Lower Mississippi Valley JV, NGPJV = Northern Great Plains JV, NoJV = No JV exists, OPJV = Oaks and Prairies JV, PBHJV = Pacific Birds Habitat JV, PCJV = Pacific Coast JV (Canada only), PLJV = Playa Lakes JV, PHJV = Prairie Habitat JV, PPJV = Prairie Pothole JV, RBJV = Rainwater Basin JV, RGJV = Rio Grande JV, SFBJV = San Francisco Bay JV, SJV = Sonoran JV, UMRGLRJV = Upper Mississippi / Great Lakes JV, WBA = Western Boreal Area.

Table 11. Joint Venture population abundance objectives for the autumn planning period, corresponding to NAWMP 80th percentile continental objectives.

	Species[a]											
Joint Venture[b]	ABDU	AGWT	AMWI	BAGO	BUFF	BWTE	CITE	CANV	COGO	EIDR	GADW	HOME
AMJV	35,097	35,228	7,093	0	32,522	13,373	0	950	7,110	125	26,315	44,273
ACJV	305,487	508,832	148,310	7,162	332,283	131,482	0	6,081	216,633	1,545,221	80,883	362,563
CDN IWJV	35	3,981	27,993	0	3,700	629	0	304	0	0	3,235	0
CHJV	8,625	68,209	24,355	0	17,377	42,546	0	2,811	4,323	0	124,056	42,206
CVJV	0	332,784	423,557	2,749	15,338	2,947	2,563	63,952	16,803	0	148,189	4,679
EGCPJV	197	31,075	9,688	0	6,851	51,740	0	1,045	349	0	60,234	21,710
EHJV	955,859	434,613	164,589	0	244,109	39,453	0	35,077	0	1,129,908	44,456	0
GCJV	4,469	826,413	354,915	0	32,041	1,046,837	1,470	56,286	3,480	0	1,144,039	97,796
US IWJV	0	531,718	933,553	271,833	155,043	5,435	3,034	74,712	297,528	0	446,936	40,603
LMVJV	2,070	566,982	232,895	0	18,267	267,439	1	62,006	2,940	0	817,771	117,205
NGPJV	0	19,510	42,160	2,216	3,147	6,333	57	2,355	9,577	0	28,183	2,486
No JV	0	1,749	2,826	0	1,412	38	14	413	0	0	820	0
OPJV	0	202,747	250,395	0	5,573	89,747	306	30,352	4,792	0	339,458	32,925
PBHJV	0	245,914	735,526	39,927	87,525	198	152	20,281	23,662	0	53,334	44,267
PLJV	0	187,365	230,338	0	16,039	92,049	1,215	16,969	27,513	0	162,320	19,234
PHJV	1,359	87,631	232,804	0	73,782	90,732	0	150,130	0	380	278,118	0
PPJV	2,389	537,301	559,183	5,816	271,048	383,610	62	240,724	208,161	0	954,944	207,657
RBJV	1	98,235	73,083	0	6,027	49,299	18	5,203	7,298	0	58,255	5,764
RGJV	0	6,869	20,039	0	838	6,237	447	2,887	1,842	0	10,710	0
SFBJV	0	6,780	16,127	741	860	44	36	3,071	2,838	0	4,888	110
SJV	0	70,364	85,169	381	9,147	3,975	1,210	3,617	4,211	0	32,877	3,274
UMRGLRJV	146,869	1,046,344	502,278	4,965	986,725	423,464	0	261,909	859,662	0	752,587	523,553
WBA	449	37,820	56,024	0	58,802	17,736	0	56,100	0	330	26,333	0
TOTAL	1,462,905	5,888,465	5,132,900	335,791	2,378,458	2,765,344	10,586	1,097,237	1,698,722	2,675,964	5,598,941	1,570,305

Table 11. Continued.

	Species[a]											
Joint Venture[b]	LTDU	MALL	MERG	NOPI	NSHO	REDH	RNDU	RUDU	SCAU	SCOT	WODU	TOTAL
AMJV	5,396	318,135	129,023	9,983	5,419	1,630	18,534	73,656	21,431	8,103	379,480	1,172,876
ACJV	562,897	1,075,203	386,032	281,103	125,021	14,453	336,842	222,814	665,966	1,284,072	1,247,019	9,846,360
CDN IWJV	0	67,959	1,983	26,023	8,126	720	1,791	471	8,185	171	238	155,544
CHJV	0	228,807	7,446	45,400	66,376	5,981	33,005	17,484	95,681	0	216,542	1,051,232
CVJV	0	588,954	1,626	1,086,110	839,966	19,806	57,465	19,813	41,687	1,615	89,187	3,759,793
EGCPJV	0	68,370	584	10,096	28,093	7,245	22,598	5,825	39,009	0	148,187	512,896
EHJV	236,421	1,435,265	1,014,966	462,699	42,310	79,528	396,936	112,112	1,359,406	585,516	658,179	9,431,405
GCJV	4,270	191,182	15,171	933,737	786,608	259,106	214,272	62,466	1,200,547	7,622	157,373	7,400,101
US IWJV	7,393	2,117,496	166,932	1,377,847	615,716	130,975	89,956	232,025	452,487	35,332	61,094	8,047,648
LMVJV	0	1,100,840	12,974	425,607	600,761	58,724	161,512	64,187	530,156	1,662	530,880	5,574,879
NGPJV	2	157,364	6,939	32,587	20,714	9,627	4,514	4,007	10,348	1,298	7,905	371,331
No JV	0	3,735	0	4,802	7,414	0	983	1,654	1,709	726	531	28,827
OPJV	0	228,331	2,011	152,698	143,118	80,681	116,849	25,810	243,336	0	68,513	2,017,638
PBHJV	9,216	862,005	44,374	1,007,345	215,959	4,611	46,120	7,450	308,631	101,640	52,494	3,910,631
PLJV	0	414,138	10,603	217,847	136,461	75,770	35,694	44,474	75,437	0	26,611	1,790,077
PHJV	82	2,178,012	3,725	1,220,744	395,655	133,004	40,340	41,776	462,010	1,955	9,530	5,401,767
PPJV	8,404	3,053,068	38,627	1,255,779	836,099	498,589	495,107	321,649	1,841,418	23,370	699,383	12,442,390
RBJV	0	258,213	3,105	103,390	53,562	20,612	10,320	6,142	32,874	1,239	18,013	810,653
RGJV	0	6,212	0	14,550	11,304	1,035	3,301	5,012	13,457	25	958	105,723
SFBJV	0	32,419	0	25,647	29,932	189	588	4,512	18,102	76	2,648	149,608
SJV	681	68,576	1,244	157,073	182,718	22,168	17,432	54,564	44,483	558	1,664	765,386
UMRGLRJV	590,542	5,119,956	428,935	1,308,259	677,082	436,331	924,566	429,311	3,271,693	187,237	2,181,251	21,063,520
WBA	3,228	378,384	3,222	222,152	38,885	88,467	46,199	13,084	380,854	3,972	8,872	1,440,914
TOTAL	1,428,532	19,952,626	2,279,520	10,381,478	5,867,299	1,949,251	3,074,926	1,770,299	11,118,907	2,246,189	6,566,553	97,251,198

Table 11. Continued.

[a] ABDU = American black duck, AGWT = American green-winged teal, AMWI = American wigeon, BAGO = Barrow's goldeneye, BUFF = bufflehead, BWTE = blue-winged teal, CANV = canvasback, CITE = cinnamon teal, COGO = common goldeneye, EIDR = common and king eider, GADW = gadwall, HOME = hooded merganser, LTDU = long-tailed duck, MALL = mallard, MERG = common and red-breasted merganser, NOPI = northern pintail, NSHO = northern shoveler, REDH = redhead, RNDU = ring-necked duck, SCAU = lesser and greater scaup, SCOT = surf, white-winged, and black scoter, WODU = wood duck.

[b] AMJV = Appalachian Mountains Joint Venture (JV), ACJV = Atlantic Coast JV, CDN IWJV = Canadian Intermountain West JV, CHJV = Central Hardwoods JV, CVJV = Central Valley JV, EGCPJV = East Gulf Coastal Plain JV, EHJV = Eastern Habitat JV, GCJV = Gulf Coast JV, US IWJV = United States Intermountain West JV, LMVJV = Lower Mississippi Valley JV, NGPJV = Northern Great Plains JV, NoJV = No JV exists, OPJV = Oaks and Prairies JV, PBHJV = Pacific Birds Habitat JV, PCJV = Pacific Coast JV (Canada only), PLJV = Playa Lakes JV, PHJV = Prairie Habitat JV, PPJV = Prairie Pothole JV, RBJV = Rainwater Basin JV, RGJV = Rio Grande JV, SFBJV = San Francisco Bay JV, SJV = Sonoran JV, UMRGLRJV = Upper Mississippi / Great Lakes JV, WBA = Western Boreal Area.

Table 12. Joint Venture population abundance objectives for the winter planning period, corresponding to NAWMP 80th percentile continental objectives.

	Species[a]											
Joint Venture[b]	ABDU	AGWT	AMWI	BAGO	BUFF	BWTE	CITE	CANV	COGO	EIDR	GADW	HOME
AMJV	119,616	25,571	25,237	0	79,795	639	0	33,019	25,608	0	173,968	61,986
ACJV	688,535	290,985	201,421	5,719	1,021,421	130,620	0	128,040	285,083	1,074,216	152,993	576,544
CDN IWJV	0	137	686	0	397	0	0	0	0	0	254	0
CHJV	79,176	80,717	71,219	0	53,973	1,363	0	17,640	61,199	0	349,970	96,605
CVJV	0	999,982	961,706	9,309	71,947	3,741	2,395	128,471	70,483	0	217,653	7,912
EGCPJV	19,934	125,732	71,619	0	38,434	5,792	0	25,874	11,746	0	232,482	121,152
EHJV	197,657	2,994	2,588	0	45,791	86	0	10,128	0	1,128,777	3,703	0
GCJV	3,334	895,498	298,439	0	59,822	253,731	189	98,892	24,946	0	921,639	54,671
US IWJV	0	145,472	340,547	208,103	96,598	141	72	46,429	550,176	0	115,655	25,215
LMVJV	16,561	898,042	320,363	0	46,991	48,404	0	156,599	20,405	0	1,298,222	201,987
NGPJV	0	348	1,828	2,213	1	0	0	0	17,496	0	678	79
No JV	0	8,318	3,986	0	5,573	81	21	3,534	679	0	1,782	0
OPJV	216	237,512	395,396	0	25,568	2,411	5	83,945	13,150	0	512,635	48,656
PBHJV	0	236,872	636,267	63,577	251,991	38	25	27,887	51,082	0	29,873	34,406
PLJV	73	61,512	150,803	723	15,794	652	13	17,967	55,305	0	95,637	13,228
PHJV	0	314	71	0	100	65	0	157	0	0	74	0
PPJV	0	1,597	536	1,769	998	87	0	0	13,041	0	1,947	1,502
RBJV	0	4,729	7,388	0	511	35	0	391	9,419	0	3,634	649
RGJV	0	14,040	34,999	0	4,856	3,306	59	11,469	3,061	0	24,681	481
SFBJV	0	14,853	35,487	259	11,910	60	33	17,856	14,443	0	5,430	0
SJV	0	128,404	87,403	978	17,842	3,009	715	18,433	6,806	0	45,944	1,649
UMRGLRJV	79,900	57,487	40,461	0	111,924	761	0	30,424	164,225	0	166,197	46,836
WBA	0	128	64	0	43	17	0	117	0	0	33	0
TOTAL	1,205,001	4,231,243	3,688,516	292,651	1,962,280	455,039	3,528	857,272	1,398,355	2,202,992	4,355,086	1,293,559

Table 12. Continued.

	Species[a]											
Joint Venture[b]	LTDU	MALL	MERG	NOPI	NSHO	REDH	RNDU	RUDU	SCAU	SCOT	WODU	TOTAL
AMJV	6,180	568,888	131,017	29,303	23,759	23,514	59,898	86,762	137,590	15,452	191,024	1,818,826
ACJV	1,027,383	1,281,634	886,467	286,683	128,522	154,593	751,372	620,177	2,775,739	1,565,430	1,837,484	15,871,063
CDN IWJV	0	13,389	99	267	52	0	62	0	418	0	85	15,845
CHJV	0	1,105,836	27,222	114,319	103,573	26,303	88,087	32,300	244,422	9,008	174,113	2,737,043
CVJV	523	868,267	16,814	2,236,390	830,457	44,266	91,959	111,341	214,307	6,794	146,367	7,041,084
EGCPJV	0	941,365	14,699	168,795	96,951	22,047	118,686	36,159	166,348	5,947	842,538	3,066,300
EHJV	90,558	143,995	301,399	8,324	518	12,994	2,639	3,524	89,298	70,860	3,232	2,119,066
GCJV	0	354,916	80,798	1,277,700	589,314	468,949	304,918	70,771	1,417,233	2,396	327,348	7,505,504
US IWJV	1,896	1,886,013	135,140	369,602	148,288	62,166	64,755	93,076	337,296	590	33,720	4,660,949
LMVJV	0	4,874,923	4,204	1,042,170	956,446	91,597	333,775	81,212	877,728	1,405	1,619,200	12,890,234
NGPJV	0	87,762	4,793	1,913	268	307	504	0	1,202	0	210	119,605
No JV	0	3,929	0	5,191	5,837	0	298	3,208	24,430	4,242	1,613	72,723
OPJV	0	719,297	6,756	336,461	142,713	97,415	214,976	17,092	284,595	8	121,943	3,260,751
PBHJV	11,499	882,921	76,238	1,000,804	143,362	7,169	74,624	20,385	861,238	155,710	47,784	4,613,752
PLJV	678	575,606	24,589	151,290	46,437	21,335	38,254	892	40,035	800	5,366	1,316,991
PHJV	0	16,776	0	1,287	337	445	102	0	0	0	0	19,728
PPJV	0	84,018	447	1,357	1,833	473	282	2	2,314	0	227	112,429
RBJV	339	159,791	2,147	2,395	1,585	1,349	164	962	1,002	0	2,046	198,536
RGJV	0	5,303	5,336	44,157	21,347	10,144	8,876	4,368	13,173	0	0	209,654
SFBJV	0	30,723	0	38,220	21,512	681	1,842	16,580	107,506	6,615	7,869	331,880
SJV	0	90,839	20,127	249,320	252,988	24,508	28,424	63,833	81,141	843	1,145	1,124,351
UMRGLRJV	37,173	1,739,573	130,598	108,386	102,207	36,919	50,690	44,833	248,964	17,884	46,246	3,261,688
WBA	0	1,633	0	94	106	155	76	0	0	0	0	2,465
TOTAL	1,176,228	16,437,395	1,868,890	7,474,429	3,618,410	1,107,328	2,235,263	1,307,478	7,925,979	1,863,984	5,409,561	72,370,467

Table 12. Continued.

[a] ABDU = American black duck, AGWT = American green-winged teal, AMWI = American wigeon, BAGO = Barrow's goldeneye, BUFF = bufflehead, BWTE = blue-winged teal, CANV = canvasback, CITE = cinnamon teal, COGO = common goldeneye, EIDR = common and king eider, GADW = gadwall, HOME = hooded merganser, LTDU = long-tailed duck, MALL = mallard, MERG = common and red-breasted merganser, NOPI = northern pintail, NSHO = northern shoveler, REDH = redhead, RNDU = ring-necked duck, SCAU = lesser and greater scaup, SCOT = surf, white-winged, and black scoter, WODU = wood duck.

[b] AMJV = Appalachian Mountains Joint Venture (JV), ACJV = Atlantic Coast JV, CDN IWJV = Canadian Intermountain West JV, CHJV = Central Hardwoods JV, CVJV = Central Valley JV, EGCPJV = East Gulf Coastal Plain JV, EHJV = Eastern Habitat JV, GCJV = Gulf Coast JV, US IWJV = United States Intermountain West JV, LMVJV = Lower Mississippi Valley JV, NGPJV = Northern Great Plains JV, NoJV = No JV exists, OPJV = Oaks and Prairies JV, PBHJV = Pacific Birds Habitat JV, PCJV = Pacific Coast JV (Canada only), PLJV = Playa Lakes JV, PHJV = Prairie Habitat JV, PPJV = Prairie Pothole JV, RBJV = Rainwater Basin JV, RGJV = Rio Grande JV, SFBJV = San Francisco Bay JV, SJV = Sonoran JV, UMRGLRJV = Upper Mississippi / Great Lakes JV, WBA = Western Boreal Area.

Table 13. Population abundance objectives for the winter planning period in the Mexico portions of the Rio Grande and Sonoran Joint Ventures, corresponding to NAWMP long-term average continental objectives.

	Species[a]													
Joint Venture[b]	AGWT	AMWI	BCTE	CANV	GADW	GOLD	MALL	NOPI	NSHO	REDH	RNDU	RUDU	SCAU	TOTAL
RGJV	46,825	128,983	32,214	9,311	54,878	520	7,016	115,701	70,066	342,833	14,212	56,489	95,190	974,238
SJV	306,994	208,350	796,523	1,330	50,958	1,750	1,616	541,837	602,039	31,502	4,576	53,803	327,031	2,928,309
TOTAL	353,819	337,333	828,737	10,641	105,836	2,270	8,632	657,538	672,105	374,335	18,788	110,292	422,221	3,902,547

[a] AGWT = American green-winged teal, AMWI = American wigeon, BCTE = blue-winged and cinnamon teal, CANV = canvasback, GADW = gadwall, GOLD = goldeneye species, MALL = mallard, NOPI = northern pintail, NSHO = northern shoveler, REDH = redhead, RNDU = ring-necked duck, SCAU = lesser and greater scaup.

[b] RGJV = Rio Grande JV, SJV = Sonoran JV.

Table 14. Population abundance objectives for the winter planning period in the Mexico portions of the Rio Grande and Sonoran Joint Ventures, corresponding to NAWMP 80th percentile continental objectives.

	Species[a]													
Joint Venture[b]	AGWT	AMWI	BCTE	CANV	GADW	GOLD	MALL	NOPI	NSHO	REDH	RNDU	RUDU	SCAU	TOTAL
RGJV	59,834	151,440	40,757	11,074	85,046	593	8,441	165,385	100,072	448,963	16,975	56,489	113,333	1,258,402
SJV	392,279	244,626	1,007,740	1,581	78,969	1,995	1,944	774,520	859,853	41,249	5,465	53,803	389,365	3,853,389
TOTAL	452,113	396,066	1,048,497	12,655	164,015	2,588	10,385	939,905	959,925	490,212	22,440	110,292	502,698	5,111,791

[a] AGWT = American green-winged teal, AMWI = American wigeon, BCTE = blue-winged and cinnamon teal, CANV = canvasback, GADW = gadwall, GOLD = goldeneye species, MALL = mallard, NOPI = northern pintail, NSHO = northern shoveler, REDH = redhead, RNDU = ring-necked duck, SCAU = lesser and greater scaup.

[b] RGJV = Rio Grande JV, SJV = Sonoran JV.

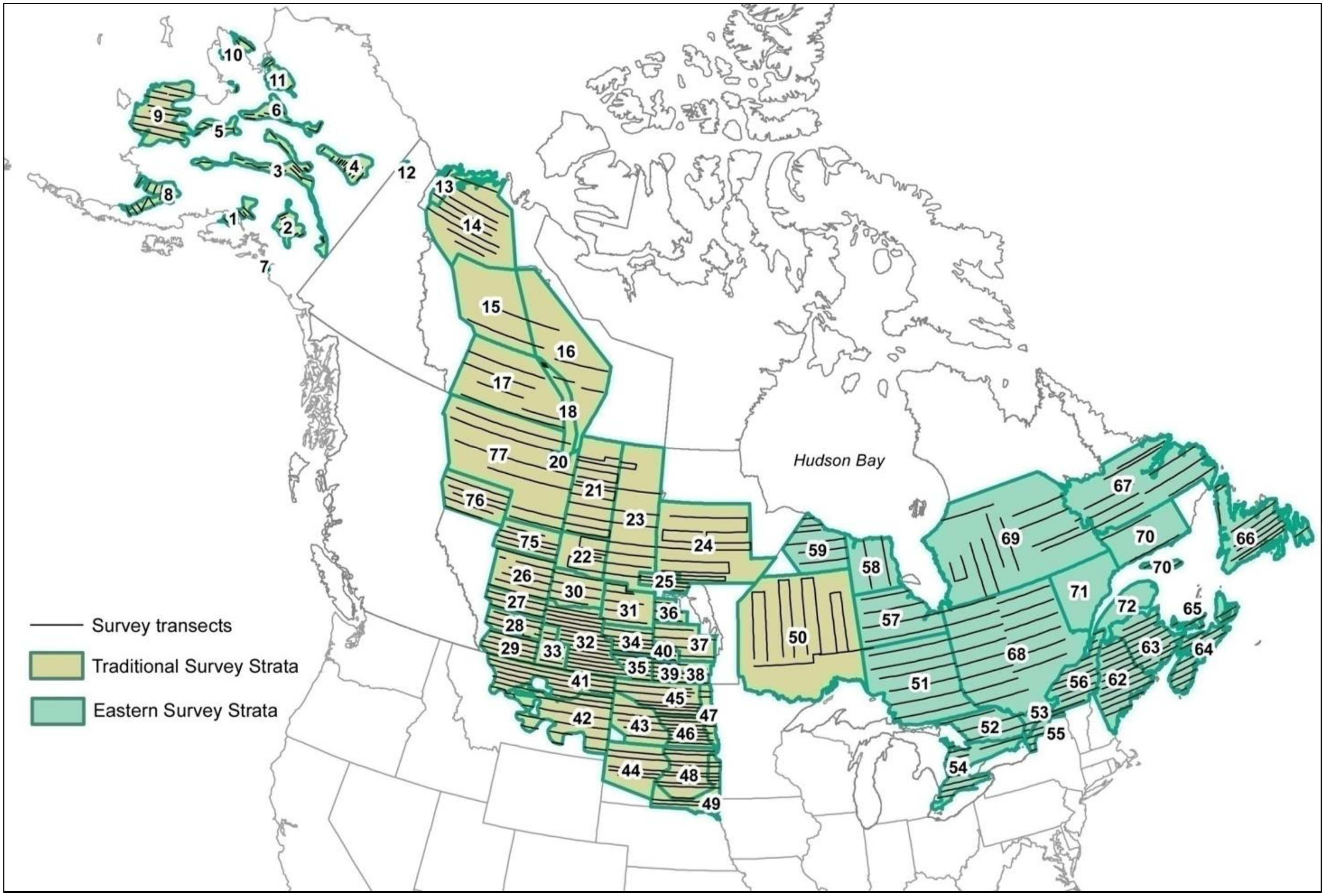

Figure 1. Traditional and Eastern Survey Areas of the Waterfowl Breeding Population and Habitat Survey in North America.

Figure 2. North American Migratory Bird Joint Venture regions used for stepping-down continental waterfowl populations objectives to regional levels.

Appendix A. Table 1 from the 2012 NAWMP (NAWMP Committee 2012).

Table 1. Breeding duck population estimates (2002-2011 mean) and objectives for North America (1,000s of ducks).

Species/Subspecies/Subpopulation[b]	Population size[a] (objectives where established)		
	Continental	Traditional Survey Area[c,d]	Other Survey Areas
Mallard	11,900	7,910 (8,200)	2,350
Mexican duck[e]	56	Not Applicable	Not Applicable
Northern pintail	3,780	2,960 (5,600)	220
American black duck	1,200	36	884 (830[f])
Mottled duck	260	Not Applicable	230
Florida subspecies[e]	60	Not Applicable	59 (42)
Western Gulf Coast subspecies	200	Not Applicable	172 (106[g])
Gadwall	3,650	2,770 (1,500)	220
American wigeon	2,780	2,350 (3,000)	67
Green-winged teal	4,380	2,790 (1,900)	550
Blue-winged and cinnamon teal	7,690	6,030 (4,700)	320
Blue-winged teal	7,390	Not Differentiated	230
Cinnamon teal	300	Not Differentiated	90
Northern shoveler	4,260	3,720 (2,000)	74
Hawaiian duck[e,h]	2.5	Not Applicable	2.5 (5)
Laysan duck[e,h]	0.5	Not Applicable	0.5 (10.5)
White-cheeked pintail[e]	1.4	Not Applicable	1.4
Wood duck	4,600	Not Applicable	670
Eastern population	4,400	Not Applicable	660
Western population	200	Not Applicable	7
Muscovy duck[e]	30	Not Applicable	Not Applicable
Whistling ducks	220	Not Applicable	Not Applicable
Fulvous whistling duck	Unknown	Not Applicable	Not Applicable
Black-bellied whistling duck	Unknown	Not Applicable	Not Applicable
West Indian whistling duck[e]	0.1	Not Applicable	0.1
Redhead	1,310	880 (640)	25
Canvasback	690	620 (540)	6
Scaup	4,900	3,760 (6,300)	330
Lesser scaup	4,100	3,160[i]	13
Greater scaup	800	610[i]	62
Ring-necked duck	2,060	1,130	720
Ruddy duck	1,242	630	33
West Indian subspecies[e]	1.5	Not Applicable	1.5
Continental subspecies	1,240	630	33
Masked duck[e]	6	Not Applicable	Not Applicable
Harlequin duck	254	Not Applicable	25
Eastern population	4	Not Applicable	2 (3[j])
Western population	250	Not Applicable	25
Long-tailed duck	1,000	170	100
Eiders	1,700	18	160
King eider	600	Not Differentiated	150
Eastern population	200	Not Differentiated	Not Applicable
Western population	400	Not Differentiated	150

Appendix A, continued.

Species/Subspecies/Subpopulation[b]	Population size[a] (objectives where established)		
	Continental	Traditional Survey Area[c,d]	Other Survey Areas
Common eider	1,100	Not Differentiated	9
American subspecies	300	Not Differentiated	100 (165[k])
Northern subspecies[e]	550	Not Differentiated	180 (400[j])
Hudson Bay subspecies[e]	260	Not Differentiated	260 (275[j])
Pacific subspecies	150	Not Differentiated	9
Steller's eider[e]	1	Not Differentiated	1
Spectacled eider[e]	17	Not Differentiated	6
Scoters	1,600	1,060	140
Black scoter	500	Not Differentiated	11
Pacific population	200	Not Differentiated	160 (160)
Atlantic population	300	Not Differentiated	110[l]
Surf scoter	700	Not Differentiated	120
White-winged scoter	400	Not Differentiated	13
Goldeneyes	1,480	710	740
Common goldeneye	1,200	Not Differentiated	290
Barrow's goldeneye	260	Not Differentiated	32
Eastern population	7.5	Not Differentiated	7.4 (7.5[j])
Western population	250	Not Differentiated	25
Bufflehead	1,670	1,140	120
Mergansers	2,700	790	730
Hooded merganser	1,100	Not Differentiated	220
Red-breasted merganser	400	Not Differentiated	19
Common merganser	1,200	Not Differentiated	280

a Traditional Survey Area estimates were derived from the Waterfowl Breeding Population and Habitat Survey (WBPHS), strata 1-18, 20-50, 75-77. Other Survey Areas estimates were derived from some combination of WBPHS strata (51-57, 62-69), the Breeding Waterfowl Plot Survey also conducted in eastern Canada, and concurrent state, provincial, or regional breeding waterfowl surveys in British Columbia, California, Connecticut, Delaware, Florida, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Utah, Vermont, Virginia, Washington, and Wisconsin. In cases where a survey was not completed every year, or when data were unavailable, mean estimates were computed using available estimates for that time period. Continental estimates include the surveyed area estimates as well as rough estimates of populations outside of surveyed areas based on harvest derivation studies, expert opinion, winter survey data, or special purpose research surveys. Continental estimates for species such as the muscovy duck, whistling ducks, masked duck, and many sea ducks are based on few data and are particularly speculative.

b Sub-populations are identified distinctly when there is significant evidence for allopatry. Races are also distinguished according to current taxonomic classification and refer to genetically distinct sub-species. The taxonomic delineation presented in this table is intended to aid in development of regional habitat conservation strategies and is not intended to supersede other international agreements regarding the appropriate organizational level for species management.

c Duck objectives in the Traditional Survey Area are based on the WBPHS strata 1-18, 20-50, 75-77 and represent average population estimates from 1970-1979.

d "Not differentiated" indicates the survey protocol does not enable discrimination to a particular taxonomic level. "Not applicable" indicates the species, race, or sub-population is not recorded in the WBPHS Traditional Survey Area or in surveys represented by the Other Survey Areas category.

e Not shared among two or more signatory nations. Management is the responsibility of that nation whose boundary coincides with the range of the species, sub-population, or race.

f The American black duck population objective was developed from predictions of a model relating Mid-winter Waterfowl Survey counts to population estimates derived from the WBPHS Eastern Survey Area (USFWS strata 51, 52, 63, 64, 66, 67, 68, 70-72). Note: Objective is not directly comparable to the black duck population estimate for Other Survey Areas since the Other Survey Areas estimate encompasses a wider region with survey strata not included in the black duck objective.

g Objective currently based on the mid-winter index for Texas, Louisiana, Mississippi, and Alabama, with an index of at least 70,000 in LA and 35,000 in TX. This index is not directly comparable with the Other Survey Areas estimate presented which is based on a range-wide breeding population survey.

h Hawaiian and Laysan ducks are monitored by the Annual Hawaiian Waterbird Survey.

i Estimate of lesser scaup in the Traditional Survey Area was computed from nontundra WBPHS strata 1-7, 12, 14-18, 20-50, 75-77. Estimate of greater scaup in the Traditional Survey Area was computed from tundra strata 8-11 and 13. These should be considered only crude estimates since some mixing of lesser and greater scaup occurs in tundra and northern boreal strata.

j Population objective based on winter index. Note: Objective for the northern subspecies of common eider is 400,000 (Canada only, where survey established) and for the Hudson Bay subspecies of common eider is 275,000-300,000.

k Population objective is breeding pairs.

l Population estimate based on molting male index.

Appendix B. Revised population abundance objectives from the 2012 NAWMP Addendum (NAWMP Committee 2014).

Average breeding populations (thousands) of ducks over the long-term (LTA) in the Traditional Survey Area (TSA, 1955-2014) and the Eastern Survey Area (ESA, 1990-2014)and duck species composition over the long-term, during the 1970s, and 1997-2014[2].

Species / species group	Long-term average	80th percentile of the LTA	Average during 1970s	Percent of average total ducks 1955-2014	1970s	1997-2014
TSA (1955-2014)						
Mallard	7,726	9,297	8,199	22.3%	22.5%	22.0%
Gadwall	1,921	2,977	1,518	5.5%	4.2%	7.7%
American Wigeon	2,596	3,048	2,974	7.5%	8.2%	6.3%
Green-winged Teal	2,059	2,631	1,858	5.9%	5.1%	7.1%
Blue-winged Teal	4,949	6,329	4,653	14.3%	12.8%	16.5%
Northern shoveler	2,515	3,592	1,990	7.2%	5.5%	9.7%
Northern Pintail	4,003	5,722	5,596	11.5%	15.4%	7.6%
Redhead	701	918	639	2.0%	1.8%	2.4%
Canvasback	581	691	542	1.7%	1.5%	1.6%
Scaup	5,026	5,984	6,302	14.5%	17.3%	9.9%
Total Breeding Ducks (TSA)	34,703	40,748	36,364			
ESA (1990-2014)						
Mallard	409	426				
American Black Duck	628	648				
Green-winged Teal	263	281				
Ring-necked Duck	515	529				
Goldeneyes	433	449				
Mergansers	436	462				
Total Breeding Ducks (ESA)	2,685	2,783