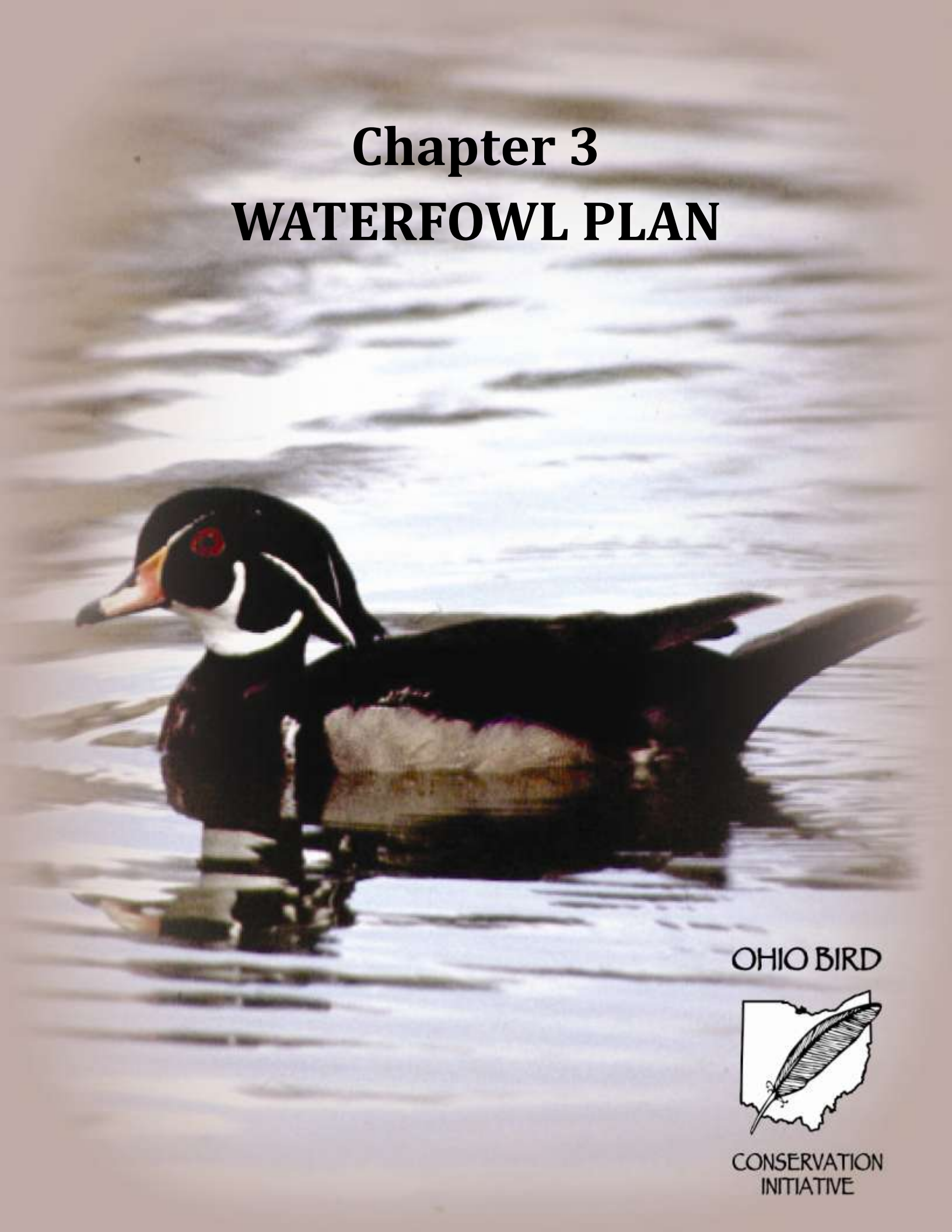
# Chapter 3
# WATERFOWL PLAN



OHIO BIRD
CONSERVATION
INITIATIVE

## SUMMARY

This chapter is based on the Upper Mississippi and Great Lakes Joint Venture (UMRGLRJV) Waterfowl Habitat Conservation Strategy (Soulliere et al. 2007): http://www.uppermissgreatlakesjv.org/docs/UMRGLR_JV_WaterfowlHCS.pdf

We have included information from the JV plan that is most applicable to Ohio, but also suggest reviewing the UMRGLRJV plan for detailed information on their biological models, methodologies, and species accounts for UMRGLRJV focal species. Here we summarize Joint Venture (JV) efforts to "step-down" continental waterfowl conservation priorities to the Joint Venture (JV) region, and we have initiated step-down to a smaller scale, the state of Ohio. This will ultimately provide conservationists guidance in effectively increasing landscape carrying capacity through the protection, restoration, and enhancement of waterfowl habitats. Using the UMRGLRJV planning, we have summarized where, what, when and how much habitat is needed to increase and sustain populations of priority waterfowl species at target levels.

Because estimates of waterfowl populations are typically uncertain and regularly refined, population estimates and objectives used in this strategy will be periodically adjusted. Nonetheless, science-based recommendations were developed to help managers efficiently and effectively increase landscape carrying capacity through waterfowl habitat protection, restoration, and enhancement.

Mallard, Photo: ODNR Div. of Wildlife

To link population and habitat objectives for this diverse bird group, several "JV focal species" were selected for waterfowl breeding habitat planning and monitoring (Soulliere et al. 2007. Each JV focal species represents a primary cover type and waterfowl guild, an assemblage of species that share similar life requisites. The assumption was that habitat actions designed for JV focal species would accommodate populations of other breeding waterfowl dependent on designated cover types. Likewise, foraging guilds that correspond to different cover types were selected for habitat planning during the non-breeding period. Migration and wintering habitat objectives for the JV region were developed by employing an energy-based carrying capacity model using continental estimates of spring population size, harvest and winter distribution (Soulliere et al 2007). A primary assumption of this strategy was that habitat carrying capacity established to accommodate spring migrating and winter populations also will suffice during fall migration.

Regional waterfowl population and habitat trends, in concert with population estimates and an assessment of habitat factors limiting populations, provide a biological planning foundation for conservation decision making. Planning steps included characterizing and assessing the landscape for JV focal species, modeling population response, identifying conservation opportunities, and developing an initial landscape design with capacity expected to sustain current waterfowl populations and eliminate population deficits. Much of the technical information, including habitat models and decision support maps, appears in breeding focal species and non-breeding guild accounts (see Appendix A, Soulliere et al. 2007). Sections regarding monitoring and research needs, measuring performance, adaptive management, and program coordination also are provided.

## BACKGROUND

### *History and Goals*

Migrating and winter waterfowl are commonly observed along Lake Erie and the Lake Erie marshes where more than 30 species of waterfowl can be seen using the wetland habitat. In fact, historically, Ohio marshes supported over a half million migrating waterfowl during fall migration. Also, the North American Waterfowl Management Plan (NAWMP 2004) recognizes Lake Erie as continentally significant for waterfowl.

Northern Pintail, Photo: ODNR Div. of Wildlife

There are a variety of waterfowl species that use Ohio for wintering, migrating and breeding. Ohio provides habitat for diving and dabbling ducks and some geese as well. Some diving ducks that are seen migrating and wintering in Ohio are: Lesser and Greater Scaup, Redhead, Long-tailed Duck, Bufflehead and White-winged Scoters. Some dabbling ducks that winter or migrate through Ohio include: American Black Duck, Mallard, American Wigeon and Wood Duck. The western Lake Erie Basin, historically has provided habitat for large concentrations of American Black Ducks and were considered to have the largest wintering groups in interior North America. Also, Canada Geese, and Snow Geese migrate and winter in Ohio. However, most waterfowl species primarily breed north of Ohio with some exceptions including: Wood Duck, Mallard, Canada Geese, Blue-winged Teal, Hooded Mergansers, and others (Table 1).

While some waterfowl species breed in the state, Ohio has a more important role in providing habitat for migratory and wintering waterfowl. Spring migration starts in late February and continues until the end of May with the largest numbers of waterfowl coming during March and early April. Fall migration lasts longer, with species concentrating at different times with some areas seeing migrants from August through December. Blue-winged Teal are the earliest migrants followed by Wood Duck, Northern Pintail, and American Wigeon. In October, Mallards, American Black Ducks, and Green-winged Teal concentrate in the area, followed by Scaup, Redhead, Canvasback and Canada Geese in late fall and Common Goldeneye appearing in late December. Harvest data from fall migration suggests that Lake Erie is very important for American Black Ducks and Canvasback. Also, it provides important habitat for wintering Scaup, Long-tailed Duck, Bufflehead, Common Goldeneye, and Common and Red-breasted Mergansers.

Blue-winged teal, Photo: ODNR Div. of Wildlife

Factors affecting waterfowl populations include loss and degradation of wetlands and increases in housing and human population. Ohio has lost more than 80% of its wetlands since the 1800's. Only with partnership-based land conservation focused efforts can we help restore wetlands and grasslands for healthy waterfowl populations.

## PLANNING FRAMEWORK

The UMRGLRJV Landbird Habitat Conservation Strategy Plan used the Partners in Flight "five element process" to design landscapes (Will et al. 2005). The five elements include: 1) landscape characterization and assessment, 2) bird population modeling, 3) conservation opportunities assessment, 4) landscape design and 5) monitoring and evaluation. The UMRGLRJV produced population status and goals for all focal species to represent a variety of species using the same community type. Population estimates, population goals, and population deficits are given for each focal species for conservation planning. Using these goals, the UMRGLRJV set specific, biologically driven habitat goals that each state within the JV should try to reach, broken down by bird conservation region.

Table 1. Continental importance of Bird Conservation Regions (BCRs) in providing breeding (B) and non-breeding habitat (N) (migration or wintering habitat).[a] Adapted from UMRGLRJV Waterfowl Habitat Conservation Strategy (Soulliere et al. 2007). Data are largely from the North American Waterfowl Management Plan (NAWMP 2004). This table only contains information about BCRs found within Ohio; these data are not specific to Ohio and include portions of the BCRs in other states.

| | Bird Conservation Region[b] | | | |
|---|---|---|---|---|
| Species (population) | 13 | 22 | 24 | 28 |
| Greater Snow Goose | **N** | | | |
| Lesser Snow Goose (Mid-continent) | | **N** | | |
| Ross's Goose | | n | | |
| Atlantic Brant | N | | | |
| Cackling Goose (Tallgrass Prairie) | | N | n | |
| Canada Goose (Atlantic) | **N** | | | N |
| Canada Goose (Southern James Bay) | **N** | n | N | |
| Canada Goose (Mississippi Valley) | | **N** | **N** | |
| Canada Goose (Eastern Prairie) | | **N** | n | |
| Canada Goose (Tallgrass Prairie) | | n | | |
| Canada Goose (Mississippi Flyway Giant) | N | **B**, N | B, N | |
| Mute Swan | B, N | b, N | N | |
| Trumpeter Swan (Interior) | | | | |
| Tundra Swan (Eastern) | N | | | |
| Wood Duck | B | B, N | B, n | b, n |
| Gadwall | N | b, n | N | N |
| American Wigeon | B | n | N | |
| American Black Duck | B, N | N | N | N |
| Mallard | B, n | b, N | N | n |
| Blue-winged Teal | B | B, N | n | |
| Northern Shoveler | | N | n | |
| Northern Pintail | N | | N | |
| Green-winged Teal | b, n | n | | |
| Canvasback | b, N | N | n | N |
| Redhead | b, n | n | | |
| Greater Scaup | N | n | n | |
| Lesser Scaup | **N** | N | n | |
| Common Eider | N | | | |
| Surf Scoter | N | | | |
| White-winged Scoter | N | | | |
| Black Scoter | N | | | |
| Long-tailed Duck | **N** | | | |
| Bufflehead | b, n | N | N | n |
| Common Goldeneye | b, **N** | N | N | n |
| Common Merganser | N | N | | |
| Hooded Merganser | **B** | N | N | |
| Common Merganser | N | N | | |
| Red-breasted Merganser | b, **N** | | | |
| Ruddy Duck | N | N | n | |

[a] Importance was determined by the UMRGLRJV by using relative abundance and distribution estimates based on continental breeding and harvest surveys.

[b] B/b = breeding season, M/m = non-breeding season (migration or wintering); **B, M** = high importance relative to other regions, and high concentrations; B, M = common or locally abundant. Area is moderate or moderately high importance to species; b, m = uncommon to fairly common, species occurs in low abundance.

## *Population and Habitat Trends*

Populations of breeding waterfowl are not easily surveyed, making it difficult to assess population trends. However, the Breeding Bird Survey (BBS) does record some waterfowl and this can provide an index over time for some species. Within the UMRGLRJV, the BBS shows some species decreasing tremendously such as the American Black Duck, and other species increasing such as Ring-necked Duck (Table 2).

Table 2. Long term (1966-2005) and short term (1995-2005) estimates of population trends (annual % change) for waterfowl species that breed within USFWS Region 3[a] and are recorded during the North American Breeding Bird Survey (BBS, Sauer et al. 2006).

| | 1966-2006 | | | 1997-2006 | | |
|---|---|---|---|---|---|---|
| Species | Trend | p-value[b] | n[c] | Trend | p-value | n |
| Blue-winged Teal | -4.21 | 0.00 | 136 | -4.30 | 0.12 | 54 |
| American Black Duck | 1.40 | 0.54 | 16 | na[d] | na | 3 |
| Mallard | 1.17 | 0.02 | 476 | -3.64 | 0.00 | 340 |
| Wood Duck | 2.61 | 0.00 | 376 | 1.70 | 0.48 | 217 |
| Redhead | -13.56 | 0.04 | 9 | na | na | 2 |
| Ring-necked Duck | 5.48 | 0.38 | 26 | 3.29 | 0.58 | 10 |
| Common Goldeneye | -10.31 | 0.63 | 5 | na | na | na |
| Canada Goose (resident population) | 11.36 | 0.00 | 406 | 6.87 | 0.01 | 326 |

[a]USFWS Region 3 includes Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.

[b]p-values represent confidence in trend direction with values closer to 0.0 reflecting a greater degree of confidence in the trend; for example, values <0.05 reflect >95% confidence in trend direction.

[c]n = number of BBS routes used for regional trend average.

[d]na = inadequate survey data to generate a trend estimate.

Wintering populations of waterfowl are increasing for some species in the UMRGLRJV due to warmer winters and the availability of important high-energy foods. The increase of agricultural fields has helped numerous species including: Mallards, Swans, and Canada Geese. However, the losses of shallow seasonal wetlands are threatening migrating populations of Northern Pintail and Blue-winged Teal. Diving ducks are also threatened on their wintering grounds in Ohio and throughout the JV because of loss of important foods, increased sedimentation, invasive plants, and changes in hydrology.

## *Focal Species and Population Goals*

The UMRGLRJV has provided population goals for focal species within the region (Table 4) and the typical habitat that each focal species is found in. Focal species are representative of a certain habitat type, with the assumption that they would represent other species found in the same habitat. The UMRGLRJV chose species that are less sensitive to habitat structure, landscape, and habitat management. Also, these species have well known life histories and are dependent on the area. A summary of information of UMRGLRJV waterfowl focal species that occur

within Ohio is given in Appendix D; for more detailed information on these focal species see Appendix A in Soulliere et al. (2007). Blue-winged Teal, Wood Duck and American Black Duck all have very different nesting habitat requirements, while Mallards are more generalists. Mallards were chosen because of their importance in recreation for duck hunters but also because of the abundance of available data.

Table 3. Upper Mississippi River and Great Lakes Region Joint Venture (JV) waterfowl focal species selected for monitoring and habitat planning. These species were identified as having a high JV region "habitat need" in the North American Waterfowl Management Plan (2004).

| Breeding habitat | Non-breeding habitat | |
|---|---|---|
| Mallard | Mallard | |
| Blue-winged Teal | Blue-winged Teal | Lesser Scaup |
| Wood Duck | Wood Duck | Canvasback |
| American Black Duck | American Black Duck | Tundra Swan |

For non-breeding habitat, the same dabbling ducks were chosen because they use a variety of habitat. Canvasback, an herbivore, and Lesser Scaup, mostly a carnivore, were selected to get a broad habitat representation for diving ducks. Tundra Swans were chosen for migratory habitat because the UMRGLRJV provides critical stopover habitat and their use of submerged aquatic vegetation in open water and their use of agricultural fields.

Breeding goals were developed via a variety of methods by the UMRGLRJV. Unlike other states, Ohio does not have an annual survey for breeding ducks so the UMRGLRJV used an interpolation technique for our BCR population goals. Wisconsin, Michigan and Minnesota all have state aerial surveys making population goals easier to estimate. Goals were established for each BCR (Table 4). For more specific information on how goals were established, please see the UMRGLRJV Waterfowl Conservation Strategy Plan.

American black ducks, Photo: ODNR Div. of Wildlife

Table 4. Breeding population estimates, goals, and deficits for priority duck species by Bird Conservation Region (BCR) in Ohio. These species represent JV focal species for breeding habitat planning.

| Species and BCR | Current population[a] | Population goal | Population deficit | Deficit recovery distribution |
|---|---|---|---|---|
| Mallard | | | | |
| BCR 13 | 21,700 | 26,040 | 4,340 | 2 |
| BCR 22 | 215,300 | 258,360 | 43,060 | 20 |
| BCR 24 | 12,700 | 15,240 | 2,540 | 1 |
| BCR 28 | 8,700 | 10,440 | 1,740 | 1 |
| Total | 258,400 | 310,080 | 51,680 | 24 |
| Blue-winged Teal | | | | |
| BCR 22 | 31,300 | 37,560 | 6,260 | 10 |
| Total | 31,300 | 37,560 | 6,260 | 10 |
| Wood Duck | | | | |
| BCR 13 | 4,800 | 5,760 | 960 | 1 |
| BCR 22 | 197,600 | 237,120 | 39,520 | 32 |
| BCR 24 | 24,500 | 29,400 | 4,900 | 5 |
| BCR 28 | 4,900 | 5,880 | 980 | 1 |
| Total | 231,800 | 278,160 | 46,360 | 34 |

[a] Current populations = 1996-2005 mean estimate. BCR 12 and 23 estimates were based on average densities, determined from the Spring Waterfowl Population and Habitat Survey (MN, WI, and MI), multiplied by the area in the BCR; BCR 22, 13, 24 and 28 estimates were based on N.A. Breeding Bird Survey relative abundance adjusted to density estimates from aerial survey data (see Appendix D, Soulliere et al. 2007).

The UMRGLRJV also established migration and wintering population goals for the JV in waterfowl use days (Table 5). The JV used information from the continental spring estimates and harvest data to calculate the goals. Winter population goals were calculated in a similar manner, but they used the Mid-winter Inventory. Please see the UMRGLRJV plan for more information. These goals were not stepped down to each BCR region. While habitat preferences can be broadly categorized, habitat requirements may change throughout the life cycle of a bird. Waterfowl may need a different type of cover for nesting, brooding, post-breeding molt, staging for migration, and wintering. However, to help give broad habitat preferences for focal species, the JV has provided community types in Table 6.

## HABITAT GOALS

Habitat objectives are linked to population goals for waterfowl focal species. The main goal for this strategy is to not only maintain waterfowl breeding populations, but also to increase the health of migrating and wintering waterfowl, which will productively affect survivorship and recruitment. The focal species approach to derive habitat goals assumes that protecting and enhancing habitat for focal species will also enhance populations for other waterfowl species. Habitat objectives derived by the UMRGLRJV will be refined as more information about focal species becomes available.

Table 5. Migration and winter population and use-day goals (1,000s) in the Upper Mississippi River and Great Lakes Joint Venture (JV) region for JV focal species used in migration habitat conservation planning. Numbers are based on continental population estimates (average for 1994-2003) and estimates of the proportion of each population occurring in the JV region during spring, fall, and winter.

| | Migration | | | |
|---|---|---|---|---|
| Guild and species | Spring | Fall | Winter | Total |
| *Population goals* | | | | |
| Dabblers | | | | |
| Mallard | 2,860 | 3,718 | 1,820 | 0 |
| Wood Duck | 1,276 | 1,659 | 0 | 0 |
| Blue-winged Teal | 1,520 | 1,977 | 0 | 0 |
| American Black Duck | 155 | 201 | 100 | 0 |
| Tundra Swan | 40 | 9 | 0 | 0 |
| Divers | | | | |
| Lesser Scaup | 1,124 | 1,461 | 267 | 0 |
| Canvasback | 220 | 286 | 111 | 0 |
| | | | | |
| *Use-day goals* | | | | |
| Dabblers | | | | |
| Mallard | 42,900 | 55,770 | 163,800 | 262,470 |
| Wood Duck | 19,140 | 24,882 | 0 | 44,022 |
| Blue-winged Teal | 22,806 | 29,648 | 0 | 52,454 |
| American Black Duck | 2,320 | 3,017 | 9,009 | 14,346 |
| Subtotal | 87,166 | 113,317 | 172,809 | 373,292 |
| Tundra Swan | 1,200 | 180 | 0 | 1,380 |
| Diving ducks | | | | |
| Lesser Scaup | 16,852 | 43,816 | 24,075 | 84,743 |
| Canvasback | 4,400 | 8,580 | 9,990 | 22,970 |
| Subtotal | 21,252 | 52,396 | 34,065 | 107,713 |
| Total | 109,618 | 165,893 | 206,874 | 482,385 |

## *Maintenance and Protection Objectives*

Waterfowl habitat maintenance and protection objectives were based on habitat needs of the waterfowl bird focal species in the UMRGLRJV (Soulliere et al. 2007). While some habitat may already be protected within state and federal lands, there is a need to increase wetland conservation in Ohio. Maintenance objectives are the goals to maintain and protect habitats that are already on the landscape through acquisition and conservation easement. The UMRGLRJV has broken down waterfowl maintenance and protection objectives by BCR within Ohio and other states in the JV (Soulliere et al. 2007; Table 6).

Table 6. Upper Mississippi River and Great Lakes Joint Venture (UMRGLRJV) waterfowl habitat maintenance and protection objectives (ha) by Bird Conservation Region (BCR) for breeding (B) and migrating/wintering (N) season population goals for Ohio (Soulliere et al. 2007). See Table 1 in Chapter 5 for habitat descriptions.

| State(s) | BCR | Wet meadow with open water | Wet mudflat/ moist soil plants | Shallow semi-permanent marsh, hemi-marsh | | Deep water marsh | Marsh with associated shrub/forest | Extensive open water |
|---|---|---|---|---|---|---|---|---|
| | | B | N | B | N | N | B | N |
| Ohio | 13 | 4 | 239 | 10,841 | 13,324 | 2,079 | 1,198 | 10,221 |
| | 22 | 0 | 850 | 20,735 | 25,194 | 1,222 | 4,590 | 10,384 |
| | 24 | 0 | 0 | 209 | 457 | 24 | 87 | 282 |
| | 28 | 0 | 31 | 4,326 | 11,146 | 477 | 1,224 | 5,212 |
| | Total | 4 | 1,121 | 36,111 | 50,121 | 3,802 | 7,099 | 26,099 |
| All States | 13 | 4 | 239 | 10,841 | 13,324 | 2,079 | 1,198 | 10,221 |
| | 22 | 39,104 | 8,329 | 107,667 | 333,195 | 11,101 | 49,402 | 57,422 |
| | 24 | 519 | 284 | 6,349 | 22,494 | 607 | 6,129 | 4,118 |
| | 28 | 0 | 31 | 4,326 | 11,146 | 477 | 1,224 | 5,212 |
| | Total | 39,627 | 8,883 | 129,183 | 380,159 | 14,264 | 57,953 | 76,973 |

The UMRGLRJV suggests maintaining/protecting total of 88,246 hectares for breeding and non-breeding waterfowl in Ohio. Shallow semi-permanent marsh/hemi-marsh has the highest need for protection, with the statewide goal set at 50,121 ha for non-breeding waterfowl (36,111 for breeding waterfowl). Ohio objectives include protecting and maintaining approximately 3,800 ha of deep water marsh, 7,100 ha of marsh associated with forest, and about 26,100 ha of open water.

## *Restoration and Enhancement Objectives*

The UMRGLRJV restoration and enhancement goals were based on focal species population deficits and habitat models. The term "restoration" implies converting a human altered landscape to a community type that would benefit the focal or target species. With any restoration or enhancement work, landscape context and capabilities are always important considerations including: current cover, hydrology, and historical vegetation. For waterfowl, restoring surrounding uplands around a wetland would improve habitat for species that rely on uplands for breeding and foraging. Also, this may be especially important around degraded river systems as this may help to restore water quality and food resources.

The JV has broken down waterfowl restoration and enhancement goals by BCR within each state (Table 7). Ohio needs to restore/enhance approximately 14,400 ha to meet carrying capacity objectives for breeding, migrating, and wintering waterfowl. In terms of area, Ohio's largest goals will be to restore approximately 7,200 ha of shallow semi-permanent marsh and hemi-marsh, 5,500 ha of open water, and 1,400 ha of marsh associated with forest.

Table 7. Upper Mississippi River and Great Lakes Region Joint Venture (UMRGLRJV) waterfowl habitat restoration/enhancement objectives (ha) by Bird Conservation Region (BCR) to meet carrying capacity goal for breeding (B) and migrating/wintering (N) populations for Ohio and the UMRGLRJV (Soulliere et al. 2007). See Table 1 in Chapter 5 for habitat descriptions.

| State(s) | BCR | Wet meadow with open water | Wet mudflat/ moist soil plants | Shallow semi-permanent marsh, hemi-marsh | | Deep water marsh | Marsh with associated shrub/forest | Extensive open water |
|---|---|---|---|---|---|---|---|---|
| | | B | N | B | N | N | B | N |
| Ohio | 13 | 1 | 54 | 2,168 | 1,316 | 0 | 240 | 2,849 |
| | 22 | 0 | 177 | 4,147 | 1,700 | 0 | 918 | 1,806 |
| | 24 | 0 | 0 | 42 | 52 | 0 | 17 | 44 |
| | 28 | 0 | 7 | 865 | 1,025 | 0 | 245 | 818 |
| | Total | 1 | 239 | 7,222 | 4,092 | 0 | 1,420 | 5,516 |
| All States | 13 | 1 | 54 | 2,168 | 1,316 | 0 | 240 | 2,849 |
| | 22 | 7,821 | 1,738 | 21,533 | 4,114 | 0 | 9,880 | 7,118 |
| | 24 | 104 | 58 | 1,270 | 882 | 0 | 1,226 | 294 |
| | 28 | 0 | 7 | 865 | 1,025 | 0 | 245 | 818 |
| | Total | 7,926 | 1,857 | 25,836 | 7,337 | 0 | 11,591 | 11,079 |

To help with our restoration efforts the JV has provided maps showing the areas of greatest restoration value (Figure 2). The figure indicates that most high restoration value habitat can be found in the western Lake Erie basin and in BCR 22. Other important areas for restoration are found in Southwestern Ohio and Northeastern Ohio close to Lake Erie.

## *Monitoring Needs*

The UMRGLRJV described a variety of important monitoring needs that will help with future conservation planning.

- Abundance. Expand, enhance, or revise surveys that provide the primary means of tracking changes in waterfowl abundance to enable assessment of status and the development of abundance objectives.
- Coordinated Environmental Monitoring. Expand and integrate environmental monitoring with surveys that estimate abundances and vital rates to test hypotheses about factors limiting growth, test assumptions underlying habitat conservation objectives, and evaluate conservation actions.
- Cross-scale Integration. Integrate and coordinate bird and environmental monitoring at continental, regional, and local scales so that patterns of change in bird demographics or habitat at one scale are informative of ecological processes responsible for patterns at other scales.

## RESEARCH NEEDS

The UMRGLRJV provided research needs that will help refine models that were designed for habitat planning (Soulliere et al. 2007). OBCI can in the future make this list more specific to Ohio. OBCI partners should contribute towards these UMRGLRJV goals to the extent possible.

- An ability to identify landscape-level factors limiting priority breeding, migrating, and wintering waterfowl populations in the region (similar to study of vital rates completed on Great Lakes breeding mallards) and how current landscape cover-type trends will influence these factors.
- An ability to quantify the capacity of the region to produce waterfowl and accommodate migrating and wintering birds, plus be able to predict how habitat quality and carrying capacity will likely change with natural precipitation cycles and predicted climate change.
- An understanding of migration corridors and movement chronology for migrating and wintering waterfowl to better predict habitat needs and target conservation areas.
- Determining optimum spatial arrangement of wetland types within and between breeding waterfowl habitat, including 1) inter-wetland distances, and 2) juxtaposition with upland cover types such as cropland, urban areas, other human developments, and permanent grassland and forest.
- An understanding of how human-induced limiting factors (e.g., disturbance, water quality, pollutants, contaminants, and sedimentation) can be most effectively and efficiently mitigated (Soulliere et al. 2007).

### LITERATURE CITED


North American Waterfowl Management Plan. 2004. North American Waterfowl Management Plan: strengthening the biological foundation (Implementation Framework). U.S. Fish and Wildlife Service, Fort Snelling, Minnesota, Canadian Wildlife Service, Ottawa, Canada.

Sauer, J. R., J. E. Hines, and J. Fallon. 2006. The North American breeding bird survey, results and analysis 1966-2005. Version 2004.2. U.S. Geological Survey, 37 Pautuxent Wildlife Research Center, Laurel, MD. Website: www.mbr-pwrc.usgs.gov/bbs/bbs.html

Soulliere, G. J., B. A. Potter, J. M. Coluccy, R. C. Gatti, C. L. Roy, D. R. Luukkonen, P. W. Brown, and M. W. Eichholz. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Waterfowl Habitat Conservation Strategy. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

Will, T. C, J. M. Ruth, K. V. Rosenberg, D. Krueper, D. Hahn, J. Fitzgerald, R. Dettmers, C. J. Beardmore. 2005. The five elements process: designing optimal landscapes to meet bird conservation objectives. Partners in Flight Technical Series No. 1.