WATERFOWL PLAN

SECTION 2

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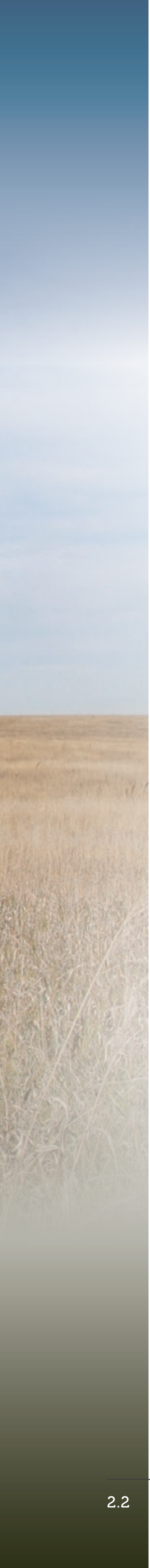

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Photo: Michael Szymanski

BACKGROUND AND CONTEXT

Since the North American Waterfowl Management Plan (NAWMP) was first adopted nearly 30 years ago, the Prairie Pothole Region (PPR) of the U.S. and Canada has been recognized as the most critical region to breeding ducks in North America. That recognition and prioritization of conservation resources (e.g. funding) continues to this day. The millions of wetlands that dot the U.S. PPR and its large areas of intact grassland make it one of the most unique and productive landscapes for waterfowl in the world. In 2013, the 8 duck species that composed 80% of the U.S. duck harvest were prairie obligate or prairie associated species (Kruse et al. 2014). The productivity of the prairies is largely determined by the dynamics of wet and dry cycles, influencing not only the number of wetlands ponding water, but also associated upland nesting cover as well. Hoekman et al. (2002) studied the relationship of variation in vital rate metrics including nest success, brood survival, and hen survival for the mid-continent mallard (*Anas platyrhynchos*) population. This research concluded that nearly 90% of the variation in population size was attributed to events that occurred on the breeding grounds, highlighting the importance of protection and restoration of waterfowl habitats in the PPR.

From the mid-1990s through 2016 ducks were extremely productive across the North American PPR, and in particular, within the PPJV administrative area. As one indicator, the survey strata that make up the eastern Dakotas portion of the U.S. Fish and Wildlife Service's Waterfowl Breeding Population and Habitat Survey (WBPHS) traditional survey area (Figure 1; Smith 1995) comprise only 7% of the land area surveyed, but supported nearly 22% of the breeding ducks in the entire survey area (Zimpfer et al. 2014). Breeding population estimates have averaged nearly 10 million ducks in the eastern Dakotas, almost twice the long-term average. These high breeding duck populations can largely be attributed to abundant ponded wetlands, and millions of acres of native grasslands and cropland idled under the U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP). Additionally, wetlands and grasslands protected under conservation easements, wetland protection under the "Swampbuster" provision of the U.S. Farm Bill, and nearly three decades of habitat work by PPJV partners all played important roles in realizing current elevated duck populations.

The value of the U.S. PPR goes far beyond breeding habitat for prairie nesting ducks. During spring migration, millions of ducks, geese, and swans travel through the U.S. PPR on their way to breeding grounds further north. Resources consumed in U.S. PPR wetlands, including invertebrates and aquatic plants, and agricultural waste grains are vital to these spring migrants. As wetlands have been drained, consolidated, and degraded, the quality and abundance of food resources have been reduced. This in turn may negatively influence the conditions of breeding females, and ultimately, reproductive success. As an example, research conducted by Anteau (2008) showed reduced body condition for female lesser scaup in areas with degraded wetlands and commensurately reduced amphipod abundance. Scaup body condition was substantially better in areas with quality wetlands with higher amphipod abundance, providing a possible explanation for this species' long-term decline.

These high breeding duck populations can largely be attributed to abundant ponded wetlands, and millions of acres of native grasslands and cropland idled under the U.S. Department of Agriculture (USDA) Conservation Reserve Program (CRP).

Arctic nesting geese also use the PPR's abundant wetland and agricultural resources during both spring and fall migration. Millions of Canada, cackling, greater white-fronted, lesser snow, and Ross's geese migrate through the PPR annually.

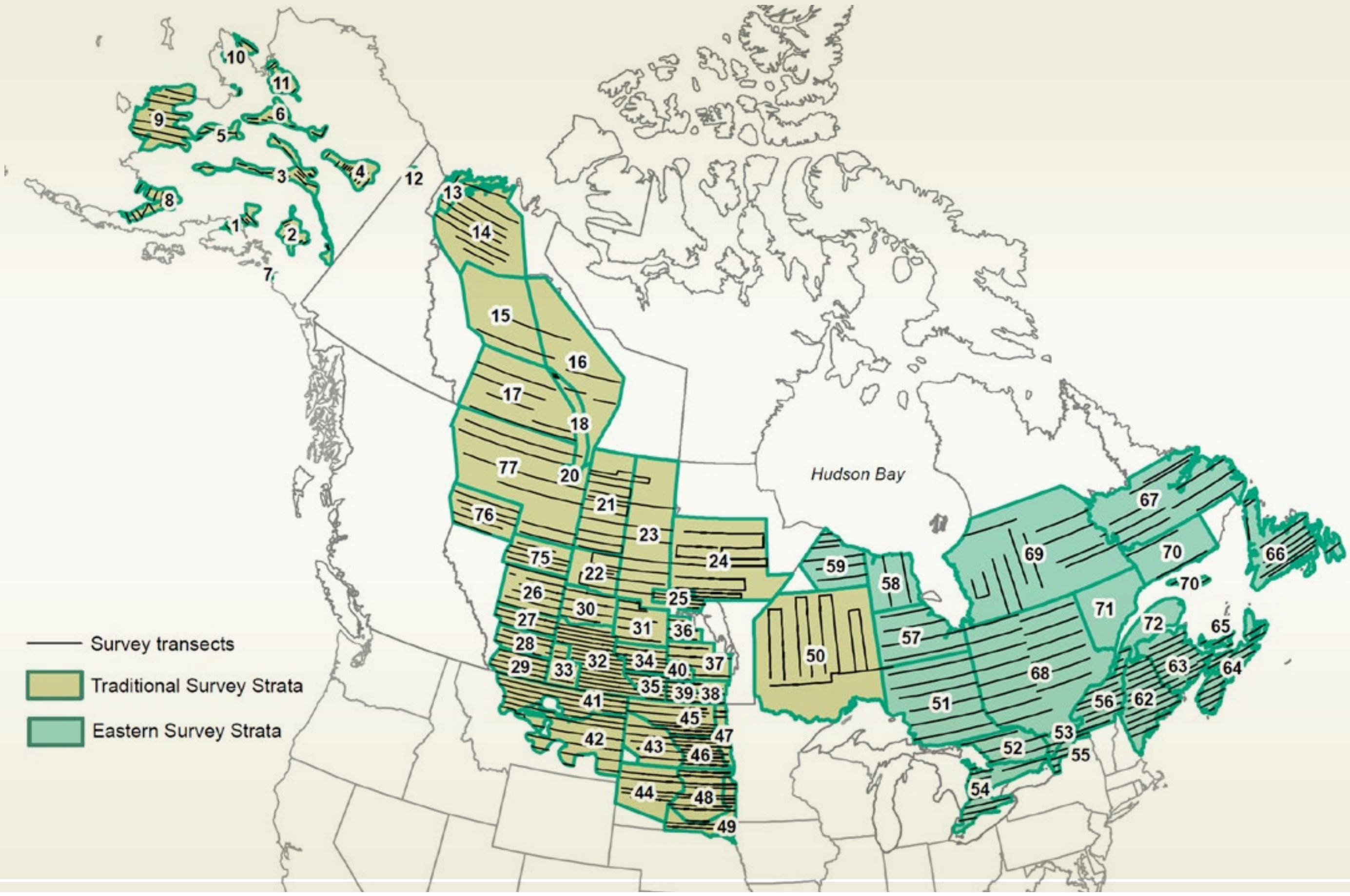


Figure 1. **Strata and transects of the Waterfowl Breeding Population and Habitat Survey (Smith 1995). Yellow shading depicts the "traditional" survey area; green shading denotes the "eastern" survey area. Other surveys conducted by federal, provincial, or state governments are not shown.**

Factors that Limit Duck Populations

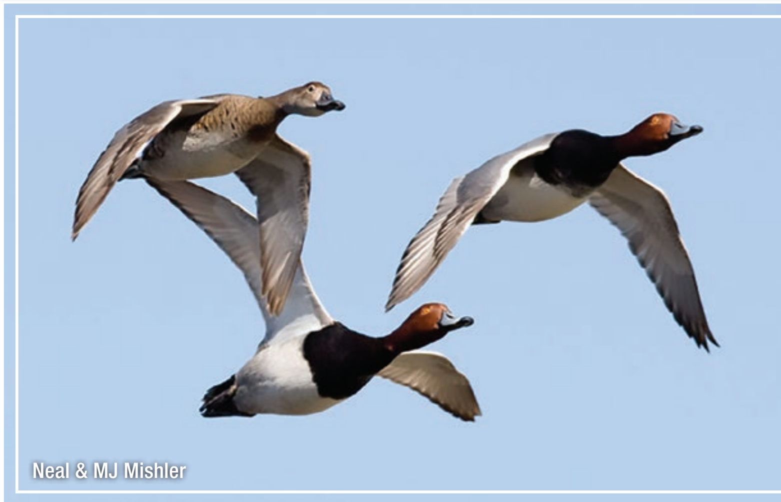
There are four primary factors limiting growth in duck abundance in the U.S. PPR: (1) wetland habitat, which limits the carrying capacity for breeding ducks; (2) nest success and (3) duckling survival, which limits recruitment and population growth; and (4) hen survival during the breeding season.

Wetland habitat—Availability of wetlands in a given landscape is the primary factor determining settling patterns of ducks in the PPJV administrative area (Johnson and Grier 1988, Kantrud et al. 1989). Wetland availability is determined by precipitation and numbers of wetlands that still function normally in an area. Recent work by Walker et al. (2013a) highlights the importance of maintaining functioning wetland complexes across as broad a landscape as possible. This strategy allows the prairie ecosystem to support pulses of landscape level productivity following dry periods. Wetlands that have been drained or filled for agriculture or development no longer function and do not attract breeding ducks. Wetland losses in the U.S. PPR vary geographically from about 35% in South Dakota to over 90% in Iowa (Dahl 1990). Wetlands degraded by disturbance to the basin or its associated watershed may also affect functionality and value to ducks. Management treatments that protect, restore, or enhance wetlands within the PPJV administrative area should be a priority to maximize duck carrying capacity.

Nest Success—Nest success for upland nesting ducks experienced a system-wide decline across the PPR of North America between the mid-1930s and the mid-1980s (Drever et al. 2002). Nest success has been identified as the most important reproductive limiting factor influencing mallard populations in the PPR (Johnson et al. 1992) and the single most important life cycle factor influencing population change in mid-continent mallards (Hoekman et al. 2002). Numerous studies have identified a positive relationship between nest success of upland nesting waterfowl and the amount of perennial cover in the surrounding landscape. Reynolds et al. (2001) identified this relationship for CRP cover in North Dakota, South Dakota, and northeast Montana. Stephens et al. (2005) found that nest success on the Missouri Coteau of North Dakota was positively correlated with the amount of landscape scale grassland habitat. Numerous studies have shown predator removal to be effective at increasing nest success on a local scale (Amundson et al. 2012, Perion and Rowher 2010). Walker et al. (2013a) emphasized the importance of wetland basins and wet-dry episodes to duck nest survival in the PPR, even in cropland-dominated landscapes. Management techniques intended to maintain or increase nest success (e.g., predator management, grassland restoration, grassland protection) should have the greatest impact on populations of prairie nesting ducks, particularly in areas where nest success is below 20%.

Brood Survival— Hoekman et al. (2002) found that duckling survival was an important component to explain variation in the size of the mallard population originating from the PPR. However, the logistical difficulties of studying duck broods coupled with the natural environmental variation inherent within the PPR made drawing conclusive generalizations about the factors impacting brood survival difficult in the past. Krapu et al. (2000) found that variation in survival of mallard broods was influenced by weather and the availability of seasonal wetlands. Pietz et al. (2006) also found a positive relationship between seasonal wetland availability and gadwall brood survival. Pearse and Ratti (2004) demonstrated an increase in duckling survival in areas with experimental predator removal, contrary to findings by Amundson and Arnold (2011) indicating no effect of nest predator removal on duckling survival. More recent research has indicated that the conservation of shallow wetlands at high risk of draining and treatments to increase brood survival should continue to be a priority within the PPJV to maximize production (as demonstrated in Walker et al. 2013b).

Hen Survival— Hoekman et al. (2002) reported that survival of mallard hens during the breeding season was second to nest success in explaining the variation in annual population size of mid-continent mallards. Hens are at increased risk to predation during egg laying and incubation (Cowardin et al. 1985, Sargeant et al. 1984), and re-nesting efforts have been associated with decreased mallard hen survival in the PPR. Management treatments that increase nest success (e.g., predator management, grassland restoration, grassland enhancement) can be expected to increase mallard hen survival during the breeding period.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Biological Models

In the early years of the North American Waterfowl Management Plan (NAWMP), the PPJV adopted a biological model-based approach to decision support for waterfowl programs in the Joint Venture administrative area. Selected models are based on research that demonstrates a strong linkage between habitat characteristics and changes in demographics.

The Four-Square-Mile Survey (FSMS), designed by the Northern Prairie Wildlife Research Center (NPWRC) is the primary PPJV tool for monitoring waterfowl populations and for developing models that are used to predict the results of landscape level changes in the relationship of breeding waterfowl to habitat quantity and quality. This survey began in 1987 (2008 in north central Montana) and was originally developed to assess the impact of the U.S. Fish and Wildlife Service (USFWS) Small Wetlands Acquisition Program in the U.S. Prairie Pothole Region. The survey is designed to monitor temporal and geographic variation in wetland and upland habitats and to measure relationships between breeding waterfowl and habitat characteristics. The survey is coordinated by the USFWS Habitat and Population Evaluation Team (HAPET) office and is conducted by USFWS National Wildlife Refuge System personnel in the PPR of Montana, North Dakota, South Dakota, and Minnesota, and by Iowa Department of Natural Resources personnel in Iowa. Details of this survey can be found in Cowardin et al. (1995).

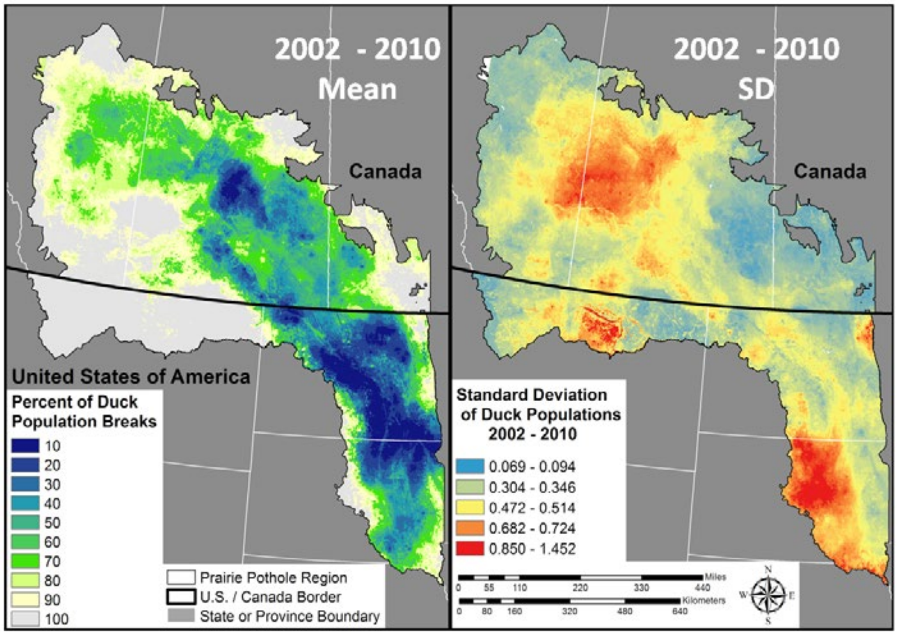

Figure 2. Mean and standard deviation of breeding duck populations surveyed in the WBPHS portion of the Prairie Pothole Region (Doherty et al. 2015).

Duck productivity models developed by the NPWRC are key tools used to monitor duck population performance, establish population objectives, and develop treatment prescriptions for the PPJV (Cowardin and Johnson 1979, Cowardin et al. 1988, Cowardin et al. 1995). These models follow two forms: (1) deterministic models for five upland nesting duck species (mallard, gadwall [*Anas strepera*], blue-winged teal [*Anas discors*], northern shoveler [*Anas clypeata*], and northern pintail [*Anas acuta*]); and (2) a stochastic model for mallards. Deterministic models are used primarily to estimate annual duck recruitment in the PPJV administrative area (Cowardin et al. 1995) and the stochastic mallard model is used in planning exercises to simulate the effect of applying various treatments to the landscape (e.g., restoring cover, creating nesting islands).

Both model types have been used extensively throughout the history of the PPJV to support research, planning, and assessment. Recently, Walker et al. (2013b) demonstrated the utility of new analytical and survey methods which allow broad-scale, rigorous estimation of brood occupancy and can be used to answer questions about variation in this parameter (see Duck Recruitment section below). Since no single method to assess annual duck recruitment has been implemented in all PPJV states, both will continue to be used by partners in different areas of the U.S. PPR. These models provide a critical and measurable link between biological performance and landscape/habitat characteristics that can be at least partially controlled by managers and agencies responsible for the success of the plan (Reynolds et al. 1996).

Productivity models have always been considered integral to address the dynamic temporal and geographic nature of the land area and are used in an adaptive process for plan implementation in the PPJV administrative area. Traditional surveys of spring abundance and productivity, such as those conducted by the WBPHS, are valuable for tracking PPR-wide population trends, but are too coarse-grained to be useful for assessing how management actions affect biological responses by the birds. Recent analysis by Doherty et al. (2015) used the WBPHS results to develop seamless spatially explicit models of waterfowl abundance across the majority of the PPR (Figure 2) and represents an initial step toward joint conservation planning between the PPJV and Prairie Habitat Joint Venture. The models elucidate the important linkages between spatial and temporal variation in population size, and distribution relative to habitat quantity and quality when linking habitat and population goals across this important region.

POPULATION TRENDS

Duck Abundance

Two surveys are used to monitor changes in duck abundance in the PPJV. The WBPHS is conducted annually in part of the PPJV administrative area by USFWS, Canadian Wildlife Service, and cooperating state agencies. Since this survey began in 1955, duck abundance in major breeding areas of the U.S. and Canada has exhibited four "peaks" and three "valleys," with indices ranging from about 25 million to 50 million birds. Given the extensive landscape changes that have occurred throughout most of the PPR, the all-time record populations of the past four years are surprising, and indicate that landscapes with intact wetlands continue to produce large numbers of ducks during wet periods (Figure 3).

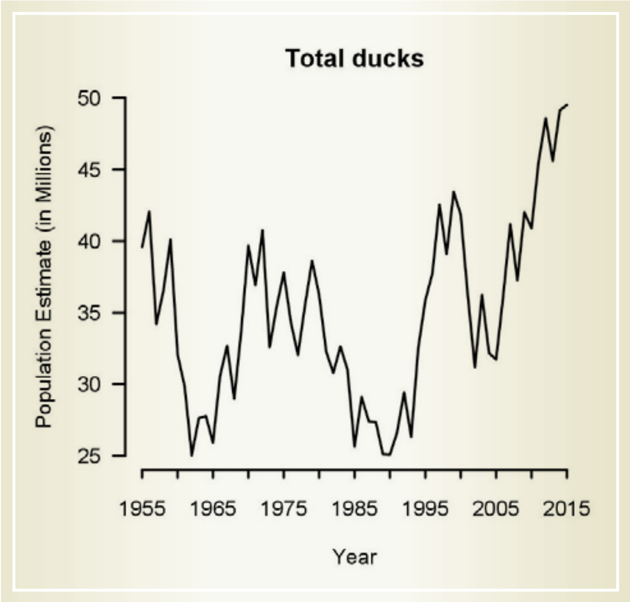

Figure 3. Breeding duck indices for the Waterfowl Breeding Pair and Habitat Survey traditional survey area, 1955–2015 (see Zimpfer et al. 2015).

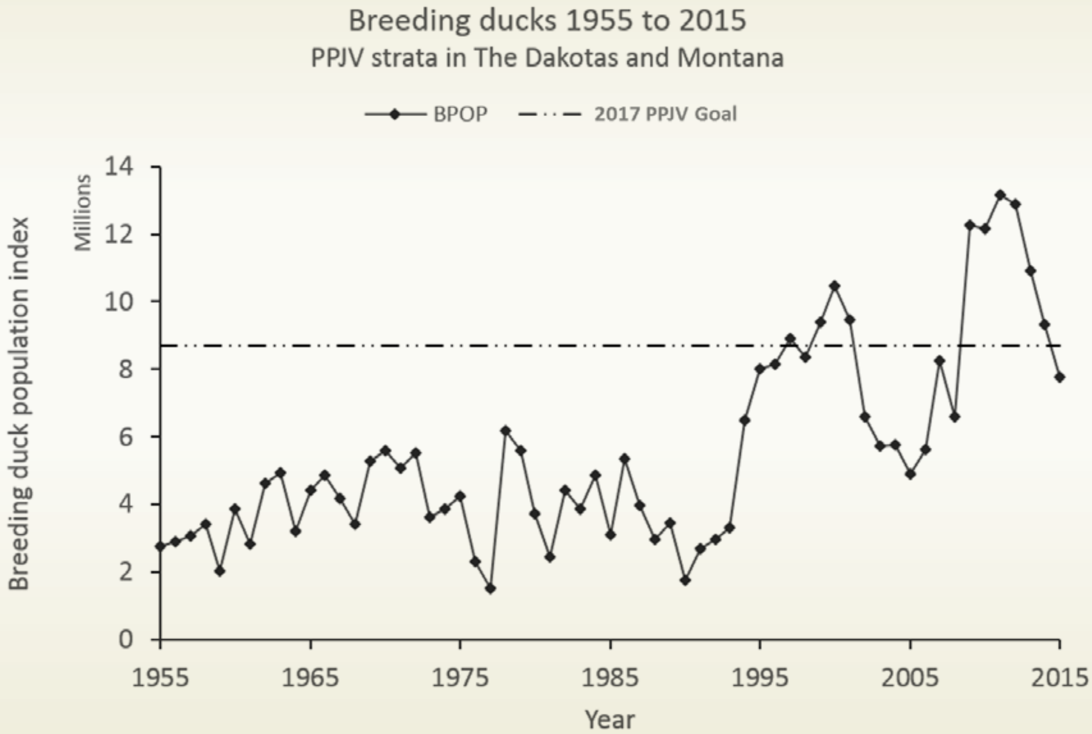

Figure 4. Breeding population index for the ten most abundant species of ducks in the PPJV survey strata of the Waterfowl Breeding Pair and Habitat Survey.

The goal of the 2005 PPJV Implementation Plan was to sustain the overall duck production capacity that existed in the PPJV during 1994-2003. Over that time period, the WBPHS estimated the breeding duck population to have been 8.2 million for the 10 most common duck species (Appendix A). That breeding population was equaled or exceeded during six consecutive years (2009–2014) in the following 11 years. Within the PPJV (survey strata 41 and 45–49), several elements converged to produce a period of rapid growth in duck abundance and all-time record populations, from 4.9 million ducks in 2005 to 13.2 million in 2011, a 168% increase (Figure 4). During 2005–2015, precipitation was well above the long-term average and, despite substantial loss of both native and restored grasslands, duck populations were highly productive in landscapes with abundant wetlands.

A second source of duck abundance information, the Four-Square-Mile Survey (FSMS; Cowardin et al. 1995) is also used for evaluating the number of breeding ducks and species composition in the PPJV area (Table 1). FSMS data provide finer-resolution spatial information for evaluating distribution while tracking the same overall trends as the WBPHS.

Based on the FSMS, the PPJV supported an average of nearly 5 million breeding duck pairs, or 10 million breeding ducks, during 1987–2012. Discrepancy between breeding duck estimates derived from the WBPHS as compared with the FSMS reflects a different sampling frame and statistical methodology; however, both surveys affirm the large duck populations observed during 1994–2012.

Duck Recruitment Rates

In past iterations of the PPJV Implementation plan, partners have projected estimates of management and conservation plan impacts on recruitment using the NPWRC deterministic and stochastic models described above. These models require input data for random variables including the proportion of wetland basins containing water, nest hatching probability, brood survival probability, and average brood size at fledging (Figure 5 & Table 2). Although these recruitment estimates provide valuable insight to potential population responses resulting from conservation actions, several assumptions are required and the estimates are extremely difficult to validate.

Table 1. Average number and distribution of breeding duck pairs in PPJV states during 1987–2014, based on Four-Square-Mile Survey data.

	State					
Species[a]	Iowa	Minnesota	Montana	North Dakota	South Dakota	Total
Mallard	23,246	249,389	260,884	563,991	283,581	1,381,090
Blue-winged Teal	21,691	201,472	65,837	839,332	526,877	1,655,209
Gadwall	683	10,631	84,718	494,696	303,443	894,171
Northern Shoveler	799	7,635	60,549	267,866	140,987	477,837
Northern Pintail	226	6,509	108,968	281,130	172,931	569,764
Wood Duck	4,700	44,400	NA	NA	NA	NA
Total	51,345	520,036	580,958	2,447,015	1,427,818	5,027,171

[a]*Note: The PPJV partners assume that habitat protection efforts sufficient to achieve population objectives for these abundant species will be sufficient to conserve populations of other less-abundant species that breed in the PPJV administrative area.*

Table 2. Average recruitment rate for each wetland management district in the PPJV (2007 - 2014). Estimates from NPWRC models. Eastern districts (shaded) were averaged together to produce one estimate.

Wetland Management District	Recruitment Estimate
Arrowwood	0.71
Audubon	0.75
Chase Lake	0.71
Devils Lake	0.66
Huron	0.56
J. Clark Salyer	0.69
Kulm	0.72
Lacreek	0.56
Long Lake	0.67
Madison	0.57
Northeast Montana	0.74
Sand Lake	0.64
Tewaukon	0.72
Valley City	0.68
Waubay	0.77
Detroit Lakes	0.53
Fergus Falls	0.53
Iowa	0.53
Litchfield	0.53
Morris	0.53
Big Stone	0.53
Windom	0.53

A 2012 evaluation spearheaded by PPJV partners examined the validity of new survey methods and modeling techniques and also looked at the relationship of the resulting predictions of brood abundance to traditional recruitment projections. This evaluation found that the new methods, which included repeat-visit surveys and hierarchical modeling techniques, provided viable estimates of abundance. R-squared values of 0.9 or greater were calculated between estimated and observed brood counts. When comparing the brood abundance estimates to traditional estimates of recruit numbers obtained via NPWRC models however, the evaluation revealed a relatively low level of correlation (R-squared values of 0.37 – 0.61). These results suggested NPWRC model estimates were likely not capturing as many levels of spatial, temporal, and environmental variation as the newer methods.

Further studies expanding upon the 2012 evaluation have underscored the usefulness and applicability of the new survey methods as a landscape-scale conservation planning tool. Brood count data from 2007–2013 is being used currently to learn more about the broad distribution and abundance of broods in the Prairie Pothole Region. Results could lead to a better understanding of the presence of “sink” landscapes that attract large numbers of breeding pairs but produce relatively few broods, and thus improve PPJV partners’ conservation targeting efficiency. Preliminary results from this study indicate that, similar to USFWS productivity models, wetlands are a strong driver of brood abundance (Figure 6). Large confidence intervals indicate support for high levels of environmental variation not captured in the models (average population size across the ND, SD, MT PPR area referenced by recruit estimates: 2,251,147 duck broods with 100,000 bootstrapped 95% confidence intervals of [2,107,115: 2,408,974]). This variation might be accounted for in conservation planning via the addition of supplemental wetland habitat deemed necessary to achieve the desired waterfowl population levels. The requirements for this "buffer" habitat might prove to be vastly different between pairs and broods as by late summer many temporary and seasonal basins on the landscape lack water due to dry conditions.

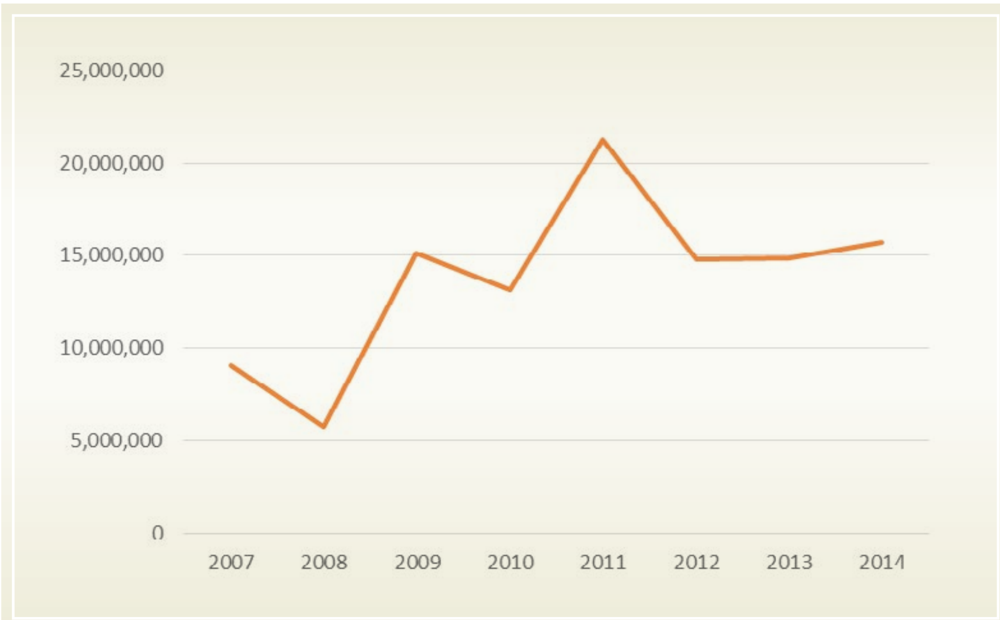

Figure 5. Predicted number of recruits across five major dabbling duck broods (mallard, northern pintail, blue-winged teal, northern shoveler, and gadwall) across wetland management district in ND, SD, and northeast MT according to NPWRC productivity models.

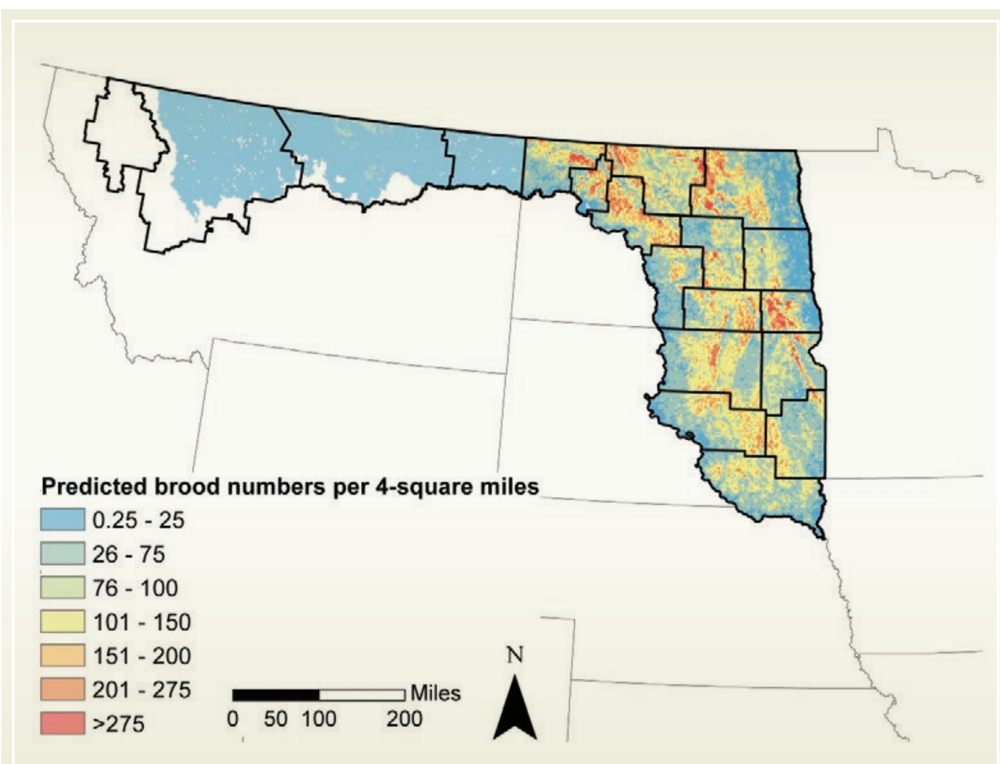

Figure 6. Predicted duck brood density in the PPR portions of North Dakota, South Dakota, and Montana.

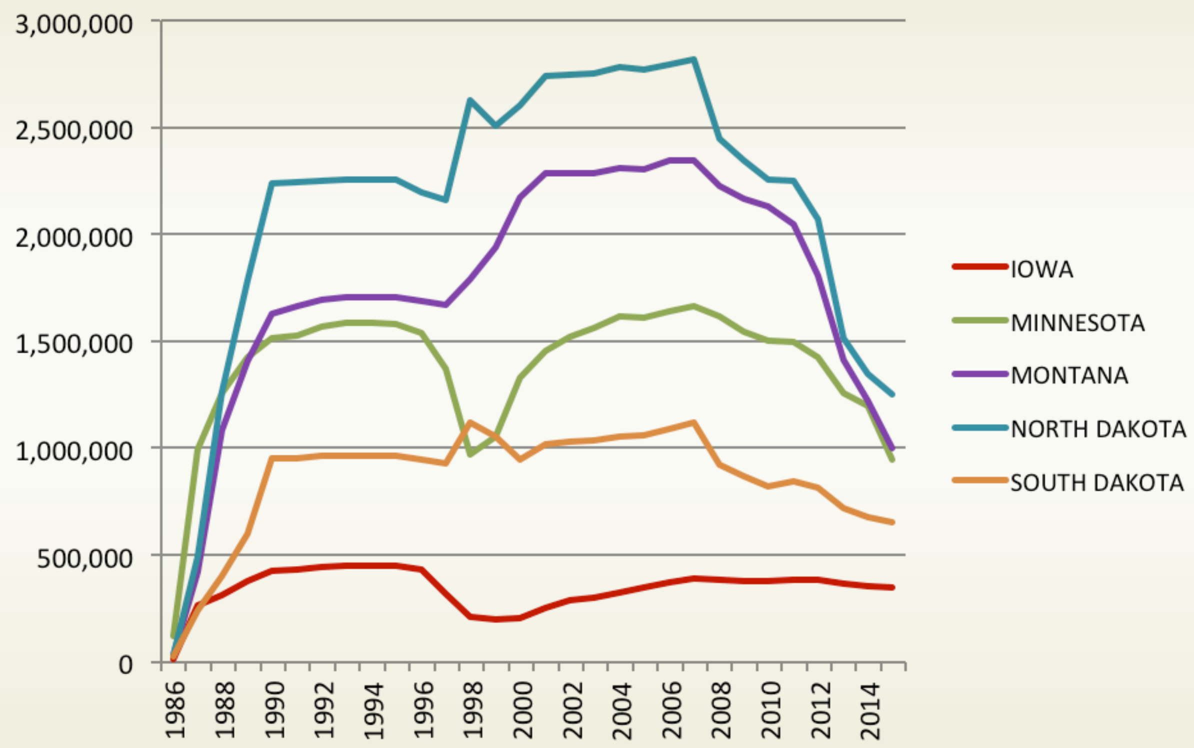

Figure 7. Conservation Reserve Program (CRP) acres for Prairie Pothole Joint Venture counties 1986–2015. Acres include all CRP parcels for all Conservation Practice Types (USDA 2014; FSA unpublished data)

BIOLOGICAL FOUNDATION

The 2005 PPJV Implementation Plan outlined a significant departure from the original population objectives set by NAWMP. The high breeding population years of 1994-2004 provided a new perspective on the potential of the area to support and recruit ducks. During this time period the U.S. PPR far exceeded goals established by the 1995 PPJV Implementation Plan. The increased capacity of the region to support breeding ducks stemmed largely from changes in landscape condition, particularly grassland restoration associated with the CRP during the late 1980s and 1990s (Figure 7), and the sequence of wet years that began in 1994. Since then, the U.S. PPR has again seen a series of high population years from 2007-2014, fueling the highest continental breeding waterfowl populations ever recorded by the WBPHS. Similar to 1994-2004, the increased populations most likely resulted from very wet conditions.

The dramatic changes in abundance of ducks underscores the dynamic nature of the PPR and suggests that setting objectives based on "average environmental conditions" may be inconsistent with the prairie environment and how duck populations respond to the dynamic conditions that occur there. Indeed, over 50 years ago Lynch (1984) and others recognized the boom and bust nature of prairie duck populations. A more appropriate paradigm for the PPJV is one that acknowledges that precipitation will fluctuate, at times dramatically (both spatially and temporally), and those changes are beyond human control.

Consistent with the 2005 Plan, the foundation of the 2017 Implementation Plan is maintaining and restoring the prairie ecosystem to support pulses of landscape level productivity following dry periods to maximize the carrying capacity and productivity for breeding waterfowl. Providing habitats that are diverse in both structure and location will also minimize effects of dry periods on breeding populations and their productivity. The PPJV proposes to do this through a focus on maintaining the integrity and health of the wetland basins and grasslands, complemented by restoration and enhancement projects across the PPJV landscape that improve duck recruitment potential and offset potential losses due to future degradations of the landscape.

While this foundation underscores the importance of habitat protection, it also recognizes the need and opportunity for restoration and enhancement (R&E) of habitat, including term-limited programs such as CRP. In all likelihood, habitat loss will continue in many parts of the U.S. PPR, and proactive habitat R&E can be applied to counteract these losses. Moreover, some jurisdictions of the PPJV administrative area have substantial R&E potential and far less opportunity for habitat protection. The ability of the PPJV to capitalize on these opportunities whenever possible is important to the success of this plan.

in grasslands and wetlands) as one way to gauge progress towards long-term conservation objectives.

There are several advantages to continuing this approach to measure progress. Most important, it affords the opportunity to avoid relying on breeding population estimates as a primary performance metric. Populations vary annually due to forces beyond human control (e.g., water conditions, regional duck distributions, and continental duck population size) in addition to factors that the PPJV attempts to influence programmatically (e.g., wetland basins, nesting habitat, public policies, and various R&E projects). Also, by monitoring the change in the capacity to attract breeding pairs and produce recruits due to changes in the amount, location, and configuration of wetlands and grasslands, the PPJV can begin to quantify the *net* impact of change in habitat (i.e., conservation gains minus losses from other causes), as opposed to tallying acreage gains without explicit acknowledgement of the losses that have occurred.

The ability of the PPJV to capitalize on these opportunities whenever possible is important to the success of this plan.

The other fortunate circumstance related to the high breeding population years of 1994-2004 is that the event occurred at a time when: (1) scientists were acquiring new insights into duck breeding biology, particularly with regard to relationships between landscape characteristics and duck recruitment rates; (2) new digital, spatial databases were being developed; and (3) the hardware and software (Geographic Information Systems, or GIS) needed to manipulate these spatial databases were becoming available. For example, upland landcover and wetland databases, along with models that predict breeding pair densities, were developed and in widespread use during 1994-2004. Consequently, the PPJV has a record and understanding of the landscape configuration that existed to support the duck population boom—a "habitat baseline." That baseline was updated in 2016, and the current landscape condition as measured by the PPJV is the foundation of this plan. The PPJV, therefore, has an unprecedented opportunity to use the change in the PPR's potential to produce ducks (i.e., change

Lastly, focusing on the potential of the habitat to attract pairs and produce ducks enables indirect, yet critical, PPJV activities, such as public policy work, to be incorporated under the same performance umbrella as direct programs.

Implementing an effective conservation program based on this biological foundation requires several elements. First, the PPJV must be able to relate important habitat features—wetlands and nesting habitat—to an appropriate measure of population performance, and develop spatial models that quantify how those performance measures vary over time and space. This requires periodic and efficient reassessment of the state of the landscape and relating any changes in the PPR's duck population and recruitment potential to landscape changes. The PPJV may also choose to monitor some performance measures directly (e.g., nesting success, brood survival) for independent assessment of the validity of models, which in turn will influence the efficacy of management decisions.

Base Assumptions and Key Uncertainties

Our most fundamental assumption is that nesting ducks respond to habitat characteristics at the local (field or cover type) as well as landscape (percent grassland cover) level (Stephens et al. 2003, Horn et al. 2005). Typically, neither metric, either alone or in combination, accounts for a large portion of the variation in observed nesting success. Interestingly, research conducted in the Drift Prairie region consistently identifies "local" metrics (i.e., height and density of cover) as important covariates related to nesting success, whereas models based on research in the Missouri Coteau region generally do not suggest that these local factors are important, instead pointing to landscape composition (wetland density, percentage grassland) and fragmentation (amount of edge) as significant covariates. This warrants further investigation. It may be that both findings are correct, and the discrepancy reflects different relationships between birds and available habitats in the two regions and across the entire PPJV landscape.

Temporal (year-to-year) variation in duck nesting success is as large as or larger than spatial variation. The few long-term studies to date indicate that on a landscape that outwardly appears unchanged, nesting success may vary by as much as 30% from year to year. The causes of this annual variation are largely unexplained, and potentially important to management programs. If the forces that drive temporal variation are subject to management intervention, it may be possible to greatly enhance our management effectiveness. Even if the causes are not subject to management intervention, if they are understandable and predictable, they may lead to improved targeting of our programs to match appropriate treatments to specific landscapes.

Another key uncertainty is the form of the relationship between percent grassland in the landscape (as defined by the home range size of a breeding hen, 4 mi2 for a mallard) and duck nesting success. Currently, this is modeled as a linear function (Greenwood et al. 1995, Reynolds et al. 2001), although research suggests it may take a non-linear form (Horn et al. 2005), or that there may be a threshold above which the probability of nesting successfully increases markedly (Stephens et al. 2005). There is even evidence that below a certain amount of grassland, nesting success increases as the predator community becomes suppressed due to poor habitat conditions (G. Zenner, Iowa Department of Natural Resources, personal communications). Additionally, Walker et al. (2013a) highlighted the importance of wetland basins and wet-dry episodes to duck nest survival in the PPR and suggested future conservation efforts should focus on preserving high-density wetland complexes across as large a geographic extent as possible, even in cropland-dominated landscapes. We presume a great deal based on data from studies of dabbling ducks, particularly the mallard. With certain exceptions, it is reasonable to assume that upland-nesting dabbling ducks respond similarly to environmental and ecological relationships that affect their vital rates. However, even though we have a good understanding of diving duck biology, management targeted specifically toward this group of species is rare. Because diving ducks are so heavily dependent on wetlands, which themselves are sensitive to degradation, it is important that we not assume that management actions directed toward dabbling ducks will also meet the conservation needs of diving ducks.


Chuck Loesch

Not all important assumptions and uncertainties are biological. PPJV programs are delivered in a dynamic socio-political environment. As others envision alternative uses for the land, conflicts can arise that impact our ability to deliver conservation programs. For example, how much land does society feel should be dedicated for conservation purposes, and is that amount consistent with our conservation objectives? These are also uncertainties that should be addressed pro-actively.

Research Needs Related to Biological Foundation

A closer examination of the key components in the reproductive success of ducks across the PPJV landscape needs to be conducted to have confidence in predictions from productivity models. These key components include: (1) nest site selection in various landscapes; (2) nest success in major nesting covers, including cropland and cover configurations; (3) re-nesting propensity; and (4) brood survival. Studies conducted to address these reproductive components should be done within a spatially explicit landscape context. Following are brief descriptions of key information needs for assessing waterfowl recruitment. Additional information about waterfowl research priorities can be found in **Waterfowl Plan, Appendix B**.

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Determine Mechanisms that Influence Variation in Key Components of Reproductive Rates. – Large variation exists in estimates of most reproductive parameters. Understanding mechanisms that influence variation should improve the predictability of outcomes from management actions. Studies that focus on survival rates of nests, broods, and adult hens should yield the greatest benefit.

Alternative Indices to Recruitment Rates. – Indices such as duckling counts can be informative about reproductive success especially when spatially referenced. Walker et al. (2013b) developed an extensive, multiple-visit brood survey of wetlands in North Dakota and South Dakota, and applied occupancy models that corrected for incomplete detection to the resulting data. Extending those survey methods across the entire U.S. PPR and using brood abundance models will provide a foundation for the PPJV to validate recruitment rate estimates from NPWRC productivity models.

Brood/Duckling Survival. – After nest success, survival of ducklings is the next most important component of the reproductive cycle determining recruitment rate. Studies by Krapu et al. (2000) provide evidence of landscape-level wetland factors that affect brood survival. Walker et al. (2013b) investigated the distributions of duck broods relative to habitat characteristics in the Dakotas. Their results indicated that most broods of the study species were more likely to be found in landscapes with greater densities of small- to mid-sized wetland basins and a greater proportion of herbaceous perennial vegetation. Further expansion of their work to incorporate estimates of brood abundance provided similar results (K. Carrlson, Ducks Unlimited, personal communication).

Four-Square-Mile Survey. – Within the PPJV, the FSMS is critically important for understanding the relationships between habitat and waterfowl population size/distribution characteristics. Virtually all partners in the PPJV use the results of this survey in planning and targeting their conservation programs. An example is the extensive use of the breeding-pair upland accessibility and distribution maps (i.e., "thunderstorm maps") developed for several species, which are used daily in decisions about program delivery. Results from the FSMS have been used to evaluate USDA Farm Bill conservation programs such as the CRP, Wetlands Reserve Program (WRP), and disincentives like the "Swampbuster" provision. The U.S. Congress has used data from the FSMS in developing proposed modifications to the Clean Water Act. The need to continue the FSMS throughout the PPJV area cannot be over-emphasized.

Other Directed Research. – Several information gaps exist in our knowledge of waterfowl biology and the relationship of landscapes to vital rates. In addition, some conservation actions used to restore habitat or enhance duck recruitment have not been fully evaluated. Several of these research needs are described in Waterfowl Plan Appendix B at the conclusion of this section. The list of research needs will continue to evolve as new programs are implemented and old programs are examined for efficacy.

PRIORITY SPECIES

The mallard has been the traditional priority species for which management programs are designed. The reasons for selecting this species are twofold. First, extensive research has been conducted on mallards, and vital rates, habitat selection, and response to management techniques are generally well known. Second, the mallard is considered representative of an upland-nesting duck insofar as this species selects nest sites in a variety of wetland and upland habitats, depends on both aquatic invertebrates and plant foods during the breeding season, responds to the presence of water (wetlands) and uplands in a manner similar to many other duck species, and is subject to predation rates and pressures typical of those experienced by other upland-nesting ducks.

In addition to mallards, sufficient information exists to model the distribution and abundance of four other common duck species (northern pintail, gadwall, northern shoveler, and blue-winged teal) across the PPJV administrative area. When possible—and as appropriate—these may also be considered priority species. Additionally, the wood duck is an important species, especially in the eastern U.S. PPR where it ranks second behind the mallard in hunter harvest numbers. Modelling efforts have been initiated by the HAPET office to develop a wood duck distribution and abundance model for the PPJV administrative area to guide conservation efforts.

Recently, NPWRC analyzed the FSMS data to develop distribution and abundance models for 5 species of diving ducks (*Aythya* spp.): lesser scaup, canvasback, redhead, ruddy duck and ringed-neck duck. The first three species in the group are of management concern, and clearly have habitat requirements and conservation concerns quite different from dabbling ducks. These models provide a decision support tool to guide conservation actions for this group of species (Figure 8). Any of these may also be considered priority species in regional or state PPJV conservation planning initiatives.

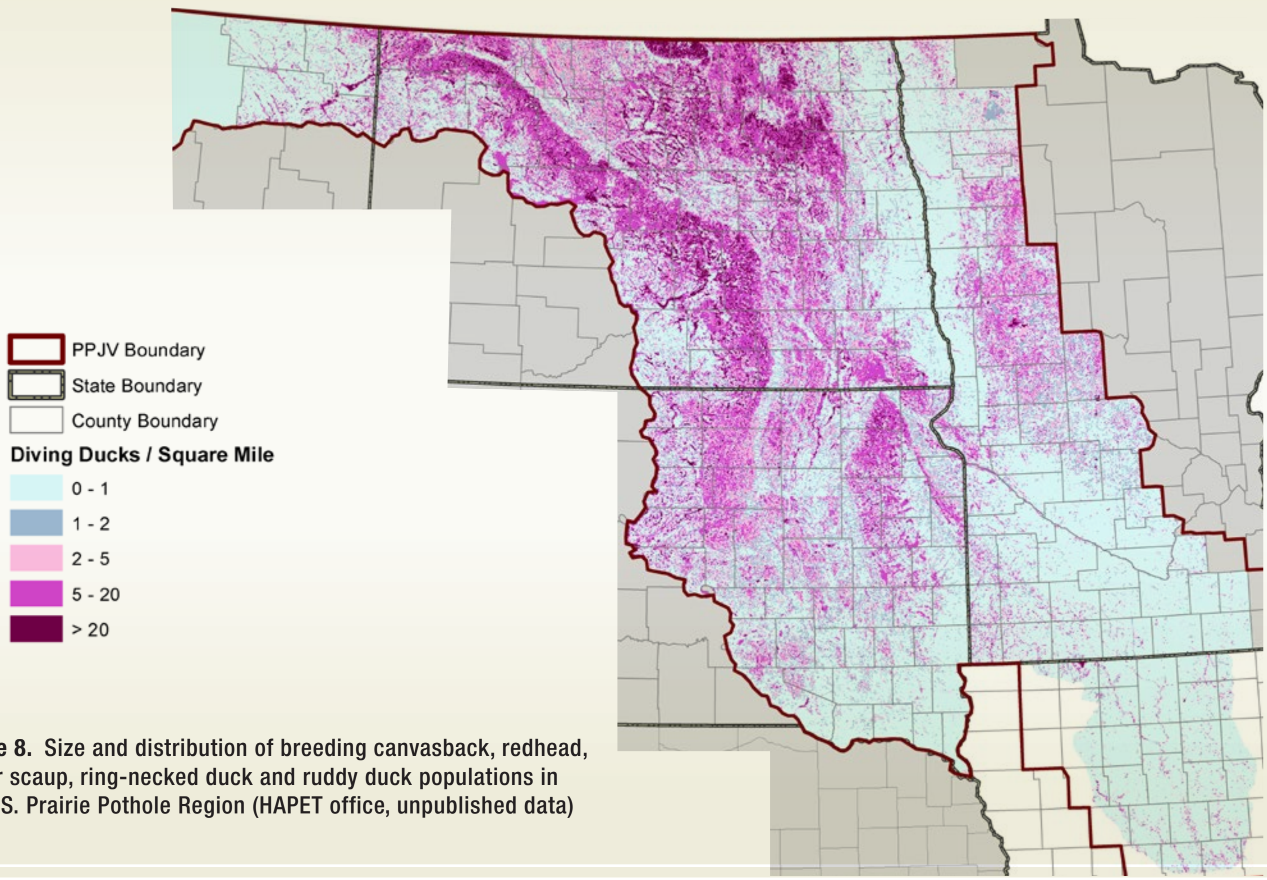


Figure 8. Size and distribution of breeding canvasback, redhead, lesser scaup, ring-necked duck and ruddy duck populations in the U.S. Prairie Pothole Region (HAPET office, unpublished data)

Chuck Loesch

POPULATION AND HABITAT GOALS

The goal of the Waterfowl Plan is to sustain the overall duck production capability that existed in the PPJV during 1994-2015. Habitat restoration and enhancements will be used in areas where wetlands and grasslands have been lost. Additionally, remaining habitat will be protected in areas that are attractive to breeding ducks.

Several approaches will be used to accomplish this goal. “Protection” is defined as those actions that maintain existing habitat features. “Restoration” actions are those that put habitat features back in place that have been destroyed or degraded. More specifically, “programmatic restoration” is defined by term-agreements to deliver habitat programs across the landscape, often as ecological equivalents. “Enhancement” projects are defined as actions designed to improve waterfowl recruitment rates as compared to recruitment that would have occurred in the absence of additional, more intensive management actions. As such, “enhancement” is distinguished from operations and maintenance (O&M), in that O&M are actions that are necessary to keep existing habitat values from degrading. Importantly, we note that both O&M and public policy are actions that can and often do apply to the entire matrix. For example, Waterfowl Production Areas must be maintained by vegetative management, and without regular monitoring and enforcement the habitat values protected by permanent easements would be at risk. Likewise, important public policy initiatives affect annual, term, and perpetual programs.

Habitat Protection

Perpetual protection remains a cornerstone to habitat conservation activities in the PPJV. However, recent analyses by the PPJV (Doherty et al. 2013) suggest rates of securement are inadequate to meet previous habitat protection objectives. Protection efforts, primarily in the form of voluntary perpetual easements, in addition to a much smaller number of fee-title purchases, are securing habitats at a rate that is not keeping up with rates of loss. For example, Doherty et al. (2013) demonstrate scenarios comparing protection and loss rates over time that result in < 50% of 2006 grassland acres and approximately 66% of 2006 wetland acres being protected at the end of the 50-75 year period following the year 2010 (Figures 9 & 10). This example demonstrates the reality of conservation through perpetual protection and the timeline involved with meeting all or parts of objectives. It also clearly demonstrates that, to maintain carrying capacity for waterfowl recruitment, other term-limited programmatic protection (e.g., grassland reserve programs) and programs that restore some ecological function (e.g., conservation reserve programs) need to be in place in the U.S. PPR. Other policy measures (e.g., Sodbuster and Swampbuster) within the Farm Bill are imperative in reducing rates of grassland and wetland habitat loss.

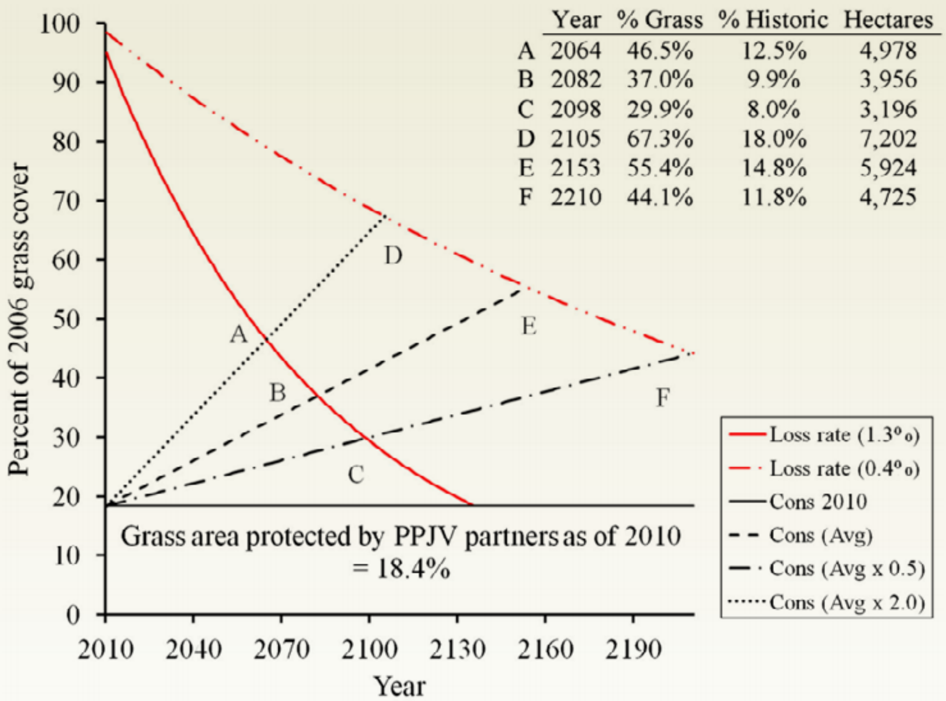


Figure 9. Percent of grass cover protected within the PPJV, and 200-year projections of grassland protection and grassland loss. Projected yearly conservation areas (Cons) are based upon an annualization of actual area protected by PPJV partners during 2001–2010. A constant loss rate was applied to project annual grassland losses. Intersection points are labeled to illustrate potential future conservation outcomes. Areas are in thousands of hectares (see Doherty et al. 2013).

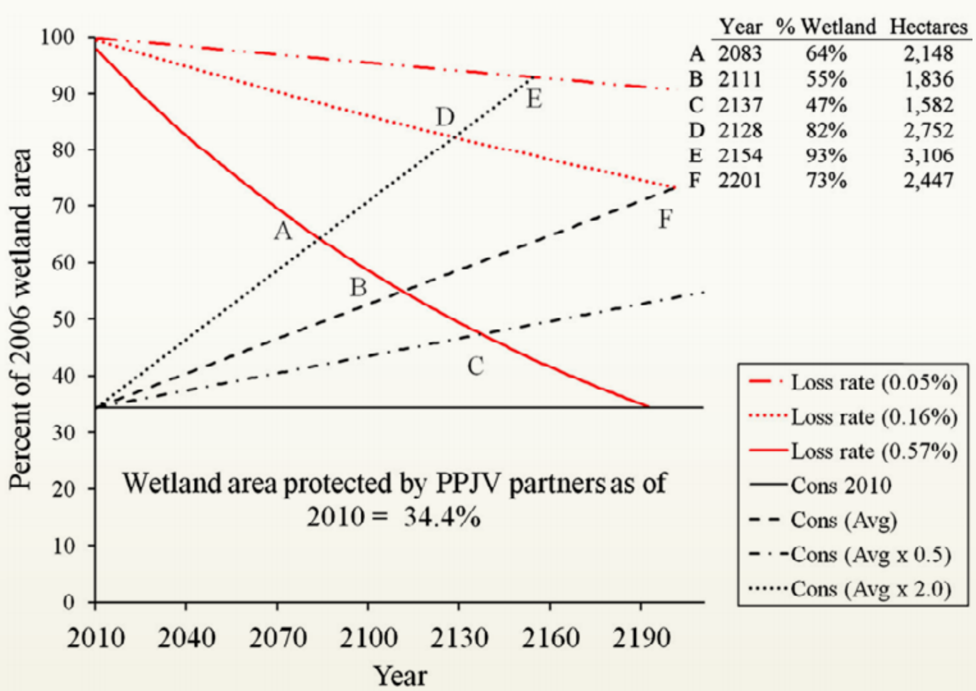


Figure 10. Percent of wetland area protected within the Prairie Pothole Joint Venture (PPJV) of the United States, and 200-year projections of wetland protection and wetland loss. Projected yearly conservation areas (Cons) are based upon an annualization of actual area protected by PPJV partners during 2001–2010. A constant loss rate was applied to project annual wetland losses. Intersection points are labeled to illustrate potential future conservation outcomes. Areas are in thousands of hectares (see Doherty et al. 2013).

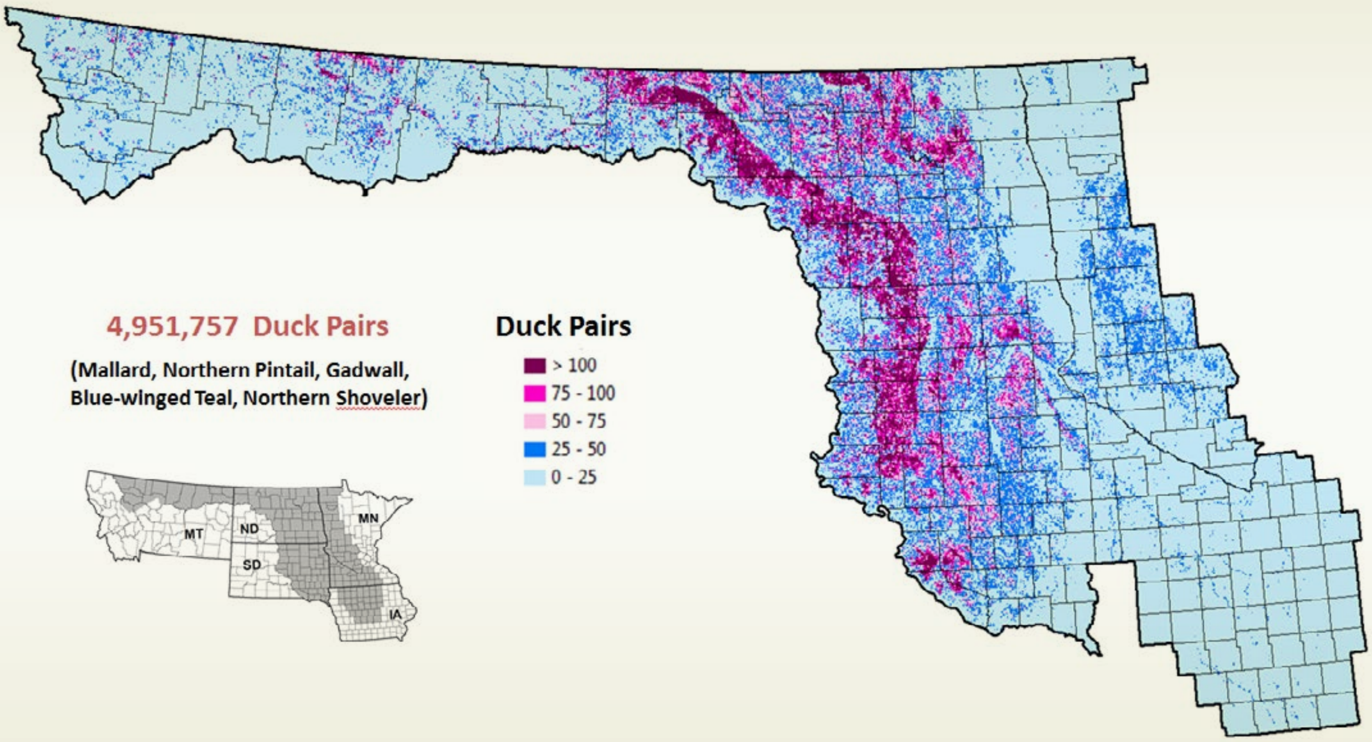


Figure 11. The present size and distribution of the PPJV breeding duck population

Wetland Protection – Maintaining the duck production capacity within the PPJV administrative area is the highest priority of the PPJV. This requires that wetland basins remain intact and functional, as they are the foundation for duck habitat. Ecological dynamics of prairie wetlands are difficult to restore or replace. Protecting wetland resources will provide a foundation of habitat to allow for other breeding habitat components (i.e., upland nesting cover) to be protected, added, or enhanced to the benefit of breeding ducks. Overall, the FSMS indicates that the PPJV administrative area supports an average of 5 million breeding duck pairs on 8.74 million wetland acres (Figure 11). Maintaining these pairs requires that wetland basins remain intact and functional.

The NAWMP set population objectives for 10 of the most common duck species in North America. The sum of the NAWMP duck population objectives was about 34 million breeding ducks in the “traditional survey area” of the May WBPHS (Figure 1). Roughly one-third of that total—10 million breeding ducks—was envisioned to occupy the PPJV.

During the 1970s, the period from which NAWMP objectives are set, the portion of the PPJV encompassed by the WBPHS averaged only 4.4 million ducks (Appendix 1). Conditions were deteriorating as the U.S. prairies dried, grasslands were being lost, and nest predators were extremely abundant. Intensive management practices (e.g., predator exclusion fences, predator removal, deployment of nesting structures, and building nesting islands) proved insufficient to meet regional recruitment and population goals despite excellent localized results. However, successful implementation of the CRP and a wet cycle that began in summer 1993 set new standards for status of breeding ducks in the U.S. Prairies. Since 1994, the WBPHS portion of the PPJV administrative area has averaged 8.7 million breeding ducks of the 10 species with NAWMP objectives. The WBPHS estimates of breeding ducks in PPJV strata have eclipsed 10 million 6 times, all in recent years (2000, 2009-2013). During this time there has been wet conditions across most of the U.S. PPR and abundant programmatic grassland restoration (the product of which is called “program grass”), mostly implemented by the CRP. While the WBPHS does not encompass areas of the eastern PPJV administrative area, the response of ducks in the surveyed area to abundant program grass and excellent wetland conditions assumedly should hold true in eastern areas. The FSMS has coverage throughout the entire PPJV administrative area, and resulting models can be used to deliver conservation programs, both through term-limited contracts, or perpetually, throughout the PPJV administrative area. The FSMS is also critical to assign interactions of both risk and management to breeding duck resources throughout the PPJV.

In 2015, the FSMS indicated there were 5 million pairs of breeding ducks (mallard, northern pintail, blue-winged teal, northern shoveler, and gadwall) in the PPJV administrative area. These pairs are supported on 8.74 million acres of wetlands, of which 3.61 million acres are protected through fee title acquisitions, perpetual wetland easements, or are enrolled in the CRP. Throughout the PPJV, 1.83 million pairs reside on wetlands considered to be protected by agency ownership, easement, or CRP, leaving the majority of the breeding pairs (3.17 million; 63.4%) dependent on wetlands that are unprotected.

Currently, there are 5.13 million acres of unprotected wetlands in the PPJV administrative area; however, not all wetlands experience the same level of risk of loss nor are they all equal in biological value. Wetlands with the greatest risk of loss are those embedded in cropland. Additionally, wetlands embedded in grasslands with the greatest risk of conversion to cropland (i.e., high suitability for farming as defined by NRCS SSURGO land capability class 1-4) are considered high-risk. Temporary or seasonal wetlands and semi-permanent wetlands that are <25 acres are faced with the greatest threat of impairment by altered hydrology. **Priority wetlands for protection are those small, shallow wetlands embedded in cropland or embedded in grasslands with the highest risk of conversion to cropland that support >25 duck pairs per square mile.** The 25 duck pair threshold represents the mean number of dabbling duck breeding pairs with access to uplands for nesting across the PPJV administrative area. There are approximately 1.78 million acres of priority wetlands that are in greatest need of protection. These high priority unprotected wetlands support 1.96 million duck pairs (39% of the estimated PPJV administrative area breeding population).

We quantified recent accomplishments by PPJV partners to develop 5-year wetland protection objectives and estimated additional accomplishments assuming a 25% increase in funding over the 5-year duration of the plan. PPJV partners continue to find innovative funding mechanisms and additional funds may come through new initiatives (e.g., new USDA conservation programs) or existing programs such as the Land and Water Conservation Fund and North American Wetlands Conservation Act. This analysis forms the basis for the following wetland protection objective:

PROTECT 468,000 ACRES OF HIGH PRIORITY WETLANDS (AS DEFINED ABOVE).

SUB-OBJECTIVE 1: Protect 132,000 wetland acres through perpetual easements.

SUB-OBJECTIVE 2: Protect 16,000 wetland acres through fee title acquisitions.

SUB-OBJECTIVE 3: Protect 320,000 wetland acres through term-limited conservation programs.

Wetlands identified for protection have been mapped at the legal section level for the PPJV administrative area and are available from the HAPET offices.

Grassland Protection – Many duck species use uplands for nesting, and an increasing body of evidence suggests that nesting success increases with the amount of grassland in the landscape. Land-cover mapping indicates that 37.89 million acres of grasslands exist in the PPJV administrative area, of which 3.8 million acres are CRP. In 2008, CRP in the PPJV administrative area peaked at 8.35 million acres. Currently there are 10.8 million acres that are considered to be high priority grasslands for protection in the PPJV administrative area. The minimum block of grassland required for several species of area-dependent birds (i.e., Type 3 Grassland Bird Conservation Area, see Johnson et al. 2010) is 55 acres. Protecting areas of this size integrates conservation actions for grassland nesting species with those for ducks. Thus, **Priority grasslands are defined as unprotected grasslands >55 acres in size, and are accessible to >25 duck pairs per square mile.**

Additionally, 2.8 million acres have a high risk of conversion based on their suitability for farming as defined by land capability classifications (classes

1-4). Given that grassland loss occurs at rates higher than protection (Doherty et al. 2013), it is unreasonable to assume that all priority acres can be perpetually protected. However, it is critical that the remainder of these high-priority, unprotected grasslands (10.8 million acres) be perpetually available for breeding waterfowl. Even the loss of a portion of these grasslands could have significant implications for ground nesting birds and expose more wetlands to higher drainage risk.

We quantified recent accomplishments by PPJV partners to develop 5-year grassland protection objectives and estimated additional accomplishments assuming a 25% increase in funding over the 5-year duration of the plan. Additional funds may come through programs such as the Land and Water Conservation Fund and North American Wetlands Conservation Act. This analysis forms the basis for the following grassland protection objective:

PROTECT AN ADDITIONAL 1,732,000 ACRES OF PRIORITY GRASSLAND (AS DEFINED ABOVE).

SUB-OBJECTIVE 1: Protect 399,000 grassland acres through perpetual easements.

SUB-OBJECTIVE 2: Protect 45,000 grassland acres though fee title acquisitions.

SUB-OBJECTIVE 3: Protect 1,288,000 grassland acres though term-limited conservation programs.

Legal sections identified as priority areas have been mapped for the PPJV administrative area and are available from the HAPET offices.

The long-term objectives for both additional wetland protection (1.78 million acres) and grassland protection (10.8 million acres) are substantially more than the 1,891,315-acre objective set forth in the NAWMP (North American Waterfowl Management Plan, Plan Committee 2004). Nevertheless, the goals in this Waterfowl Plan are based on updated scientific analysis, and deemed necessary to achieve the long-term waterfowl productivity in the PPJV administrative area.

Restoration Objective

Restoration can take many forms, from limited-term benefits derived from restoring grasslands and wetland function with the CRP, to permanent benefits of restorations associated with perpetual projects under NAWMP or the WRP and its successor, Wetland Reserve Easements (WRE). Numbers of breeding ducks in the PPJV administrative area's WBPHS strata exceeded 10 million ducks only in recent years of abundant water and program grass, demonstrating the dramatic impact of Farm Bill programs. As with protection projects, the PPJV desires to gain the most cost-effective return on restoration projects, which usually means investing in projects with the most enduring benefits in priority landscapes. Those benefits go beyond the biological benefits to breeding waterfowl and should address ecological functions and the resulting benefits to society.

Wetland Restoration/term-limited agreements – Substantial wetland and grassland losses have occurred throughout the PPJV administrative area. It is desirable and necessary to address these losses through restoration even while we strive to maintain the wetlands and grasslands that still remain. Some of the highest abundances of breeding ducks in the PPJV administrative area have occurred during years of high precipitation and abundant program grass. Given that objectives for protection in perpetuity will not be met in the near-term, stopgap objectives need to be in place. Therefore, the following objectives for term-limited conservation are:

ENROLL 36,000 ACRES OF HIGH PRIORITY WETLANDS AT RISK (AS DEFINED ABOVE) IN TERM-LIMITED RESTORATION PROGRAMS.

Some areas have wetland and grassland resources that are at risk, but are not accessible to >25 duck pairs per square mile. These areas are of conservation value, but often do not compete well for conservation program funding. Restorations in proximity to these areas will not only add habitat to the landscape, but also bring these areas back into the competitive pool for conservation.

Grassland Restoration/term-limited agreements – Within the U.S. PPR, grasslands have suffered even greater percentage losses than wetlands, and though several million acres of grasslands have been restored through farm programs like CRP, these restored acres are not secured in perpetuity and are considered to be stop-gap measures.

To ensure adequate grassland cover, the PPJV will continue to seek opportunities to restore grasslands within and around existing high density wetland communities or, where both grasslands and wetlands can be restored together, to develop landscapes that support breeding waterfowl.

ENROLL 296,000 ACRES OF HIGH PRIORITY GRASSLANDS (AS DEFINED ABOVE) IN TERM-LIMITED RESTORATION PROGRAMS (E.G., PRIVATE LAND WILDLIFE ENHANCEMENT AGREEMENTS).

MAINTAIN ENROLLMENT OF 1.9 MILLION ACRES OF RESTORED GRASSLANDS AS PART OF TERM-LIMITED CONSERVATION PROGRAMS (E.G., CRP) THAT REPLACES PERENNIAL NESTING COVER AND ARE ACCESSIBLE TO >25 BREEDING PAIRS PER SQUARE MILE.

Enhancement Objectives

To generate wetland and grassland habitat enhancement objectives for the 5-year implementation plan, we reviewed USFWS Partner for Fish and Wildlife (PFW) strategic plans, State Wildlife Agency plans, NGO plans, and previous USDA conservation program accomplishments. These projects include several PPJV partners that work with the PFW program (e.g., state wildlife agencies, Ducks Unlimited, Pheasants Forever). Assuming current funding and partnerships continue for the next 5 years, PPJV partners can expect to:

ENHANCE 434,000 ACRES OF GRASSLANDS ASSOCIATED WITH PRIORITY LANDSCAPES (>25 BREEDING PAIRS).

ENHANCE 58,000 ACRES OF WETLANDS ASSOCIATED WITH PRIORITY LANDSCAPES (>25 BREEDING PAIRS).

INSTALL 600-800 NEW HEN HOUSES AND MAINTAIN 1,460 EXISTING HEN HOUSES TO ENHANCE WETLANDS.

MAINTAIN 15 RECURRING PREDATOR MANAGEMENT SITES TO ENHANCE GRASSLANDS.

Hunter Retention and Access Objectives

In the most recent NAWMP revision in 2012, it was acknowledged that hunters are a critical component to the overall conservation of waterfowl. Migratory Bird Conservation and Hunting Stamps (i.e., federal Duck Stamps) are required for all waterfowl hunters in the U.S. who are 16 years of age or older. Revenues from Duck Stamp sales go directly towards conservation of wetland, grassland, and other related habitats critical to the conservation of waterfowl and other birds. Other wildlife, including fish and insects directly benefit from the protection of these habitats, too. In addition to the millions of privately owned wetland and grassland acres perpetually protected with conservation easements, 35 national wildlife refuges and hundreds of waterfowl production areas in the U.S. Prairie Pothole Region were created or expanded using Duck Stamp dollars. Many of these National Wildlife Refuge System lands are open for public recreation, including hunting, fishing, wildlife photography, and bird watching. Expanding Duck Stamp sales to bird watchers and conservation supporters will continue to be a priority for PPJV partners. Given the few funding options available for habitat conservation in the prairies, the PPJV needs to find better mechanisms to expand the financial contribution from all those who benefit from duck stamp revenue.

Chuck Loesch

Ensuring public access to waterfowl hunting opportunities is critical to sustain conservation of the migratory bird public trust. There are limitations as to which public hunting access should be sought, and in no way is it implied that lands brought into conservation using Duck Stamp dollars should be guaranteed to be open for public access. However, there are hunter access programs that can overlap conservation of waterfowl habitats, but not necessarily be fee title or funded using Duck Stamp dollars. Providing public hunting access to habitats important for waterfowl conservation can instill a sense of ownership and appreciation for those lands and what they can provide to a region.

Determining goals to provide habitat to sustain waterfowl hunting can be difficult. Not every location will be a heavily used destination and not every heavily used destination can have public access. The amount of quality hunting land with hunter access varies across the PPJV due to different trespass laws, sentiment among private land owners, and the availability of public land. However, over the past 20 years, anecdotal evidence suggests that free/open accessibility to private lands has decreased. Areas that once were accessible through private lands permissions have now become difficult to obtain in some places. Waterfowl hunting can also vary considerably in the type of hunting undertaken (e.g., diving duck hunting on a large open wetland, a teal hunt in shallow water, or hunting in an agricultural field for geese and mallards). Additionally, an important factor to consider is that not all areas should be available for public access. High hunting pressure can be detrimental to the overall hunting experience in a given area. Hunting some large wetlands may be unpopular locally because those wetlands provide roosting areas for waterfowl, and if disturbed, birds may leave the area. Therefore, a certain mix of public access and less disturbed areas are important for maintaining quality hunting opportunities.

Given that landscapes and population densities vary considerably across the PPR, there is no "one-size fits-all" model for determining public access goals for waterfowl hunting. However, as part of step-down plans, wetlands should be the habitat modeled to deliver public access for waterfowl hunting opportunities. Although agricultural fields are important for waterfowl hunters, they are not part of the conservation strategy of this Plan. Thus, determination of agricultural fields that are viable for waterfowl hunters is best left to local entities. Specific objectives and strategies for delivering public hunting access for waterfowl hunting in the PPJV will be developed at the state level in individual tactical plans.

The objective for hunter retention and providing public hunting access for waterfowl hunters is to **maintain the 1995–2015 average number of waterfowl hunters in Iowa, Minnesota, Montana, North Dakota, and South Dakota.** The USFWS Division of Migratory Bird Management maintains records for total hunters by state, and total duck and goose hunter days by county. These data provide a mechanism for partners to track hunter activities in PPJV states. The average number of hunters in all PPJV states between 1995 and 2015 is 197,000.

SUB-OBJECTIVE 1: Recruit 9,300 new hunters through 155 hunter curriculum events

SUB-OBJECTIVE 2: Support state-based youth-only hunting seasons and expand to include adults new to hunting

SUB-OBJECTIVE 3: Maintain 2,500,000 acres of private land open to hunting through state perpetual easements and state term-limited leases.

SUB-OBJECTIVE 4: Provide an additional 110,000 acres of private land open to hunting through state perpetual easements and state term-limited leases.

Private Landowner Engagement

Private landowners who engage in conservation programs (e.g., sell perpetual easements, participate in Farm Bill programs) are primary constituents that support PPJV goals and objectives. However, recent analysis by Doherty et al. (2013) suggests conservation partners cannot reach conservation goals given current habitat loss rates unless landowner interest and acceptance of conservation programs remains high, conservation funding is increased, and wetland and grassland loss rates are decreased via public policy or other mechanisms. The PPJV Communications Plan (Plan Foundation Section, Appendix B) provides a framework to engage diverse supporters, including private landowners. A range of tactics are outlined in the plan, including educational (e.g., workshops, tours, demonstrations) and informational (e.g., newsletters, factsheets, popular magazine articles) product delivery. To maintain high private landowner interest and acceptance of conservation programs, PPJV partners must continue to engage this group using all of these tactics.

Kurt Forman

ACTIONS AND TREATMENTS

Efforts to protect, restore, and manage habitat to support breeding duck populations remain a central focus of PPJV partners across the breadth of the administrative area. At the very core of these efforts are three primary objectives:

1. **Maintain wetland resources sufficient to allow recently observed high breeding populations to occur when precipitation fills wetland basins;**
2. **Conserve landscapes with functioning wetland and grassland complexes that are currently meeting duck production goals; and,**
3. **Address limiting factors that are currently suppressing duck carrying capacity and recruitment through a diversity of restoration, creation, or intensive management actions.**

These common objectives provide a framework for actions targeted at breeding ducks over the diverse landscapes of the PPJV administrative area. We recognize that across the U.S. PPR, land use and emerging pressures that threaten waterfowl habitat and duck production vary by region. These differences lead to different strategies and tactics employed at the state or even more limited scale to meet the habitat and duck production outcomes desired by the PPJV partners.

Conservation planning and delivery should take into account these differences. While partners in the Missouri Coteau of South Dakota may focus their resources on grassland easements to preserve landscapes with intact functioning wetland and grassland complexes, partners in Iowa may address limiting factors by focusing on wetland and grassland restoration to augment a reduced carrying capacity. Both of these actions would be consistent with the goals of this plan. Additionally, conservation actions that span timescales from perpetual to annual have a role within the PPJV's suite of conservation options. Perpetual protection of existing habitats has long been the focus of the partnership and those efforts have resulted in a vast inventory of resources conserved in perpetuity.

Yet, the PPJV acknowledges that the potential scale of effect may well be reduced by a singular focus on perpetual easements and fee title acquisition. Vast acreages can be impacted by policy programming (e.g., CRP) that will positively impact duck production or mechanisms like Swampbuster that provide baseline protections for wetlands. Term lease agreements can conserve wetlands and grasslands or provide for beneficial management when other longer-term tools are not feasible. Additionally, site-specific annual treatments like the planting of winter wheat or predator management can increase duck production in a targeted manner. The dynamic nature of threats and differing limiting factors necessitates that partners are able to pick from the entire range of treatments to meet the goals of preserving carrying capacity, ensuring functioning landscapes, and high duck production.

PROGRAMMATIC ELEMENTS

The PPJV has long relied on a range of conservation treatments to achieve habitat conservation and duck production goals. These have been as varied as the Multi-Agency Approach to Planning and Evaluation (MAAPE) process that listed both landscape treatments of restored grassland as well as prescriptive management actions aimed at USFWS incremental increases in recruitment at the Wetland Management District scale, to more universal goals of long-term habitat securement outlined in the 2005 PPJV Implementation plan. These differences are likely driven by differing perspectives over time as to the most appropriate remedies against observed trends in production and pressures on key habitats.

As has been the case since the inception of the PPJV, perpetual protection will be prioritized in this Plan's 5-year term. Wetland and grassland easements continue to provide long-term protection to the most valuable habitat resources, and must remain the centerpiece of the JV's activities. What is different from the 2005 Plan is the emerging recognition that goals for perpetual tools (as established in the 2005 Plan) are unlikely to be achieved. This recognition has driven the partners to broaden their scope of activities.

Against the backdrop of diverse landscapes, limiting factors, and goals amongst individual partners this broadened scope of activity is an asset to the PPJV enterprise, so long as the actions are congruent with the specified objectives of this Plan. The tools and tactics required to remedy breeding duck carrying capacity and overall recruitment deficiencies must be tailored to the individual focal area (e.g., state, ecoregion). In all areas, the PPJV embraces the use of enhancement, restoration, and protection across time scales from annual to perpetual (Table 3).

It is important to note that before tools are considered and implemented, an assessment of limiting factors facing breeding ducks within the target landscape should be completed. Because the limiting factor for duck reproduction in the Missouri Coteau is nesting success, which is positively correlated with amount of grassland habitat, the use of grassland easements augmented by grazing treatments provides a sound strategy for this area. In cropland dominated landscapes in the Drift Prairie, where there are several limiting factors on nest success, hatching success, and recruitment, wetland protection tools (e.g., easements, mid-term contracts) and intensive annual treatments (e.g., removing predators, planting winter wheat) may be the prescribed treatments to secure carrying capacity and increase recruitment. Additionally, wetland restoration and other means of augmenting recruitment may be the most appropriate strategies for large portions of Minnesota and Iowa where wetlands are limited.

Table 3. Waterfowl conservation tactics typically used in the PPJV. Individual tactics are displayed in relation to the three primary programmatic elements (enhancement, restoration, and protection) and the duration of benefits received.

Programmatic Element \ Duration	Annual	Term	Perpetuity
Enhancement	Winter wheat Predator removal Tax Incentives	Predator fences Nest structures Grazing Agreements	Wetland creation (with perpetual protection)
Restoration	-	Wetland restoration CRP, EQIP, etc.	Wetland restoration Upland cover establishment
Protection	Easement enforcement O&M of fee lands	Wetland leases Nest cover establishment and leases	Easement acquisition Fee title acquisition

As described in the 2005 PPJV Implementation Plan, utilizing spatial tools can strengthen the ability to match landscapes with suitable treatments. Pair density data combined with mapping of percent perennial cover can serve as a sound basis for prescribing the most appropriate treatments (Figure 12). Finally, as the fundamental driver of duck carrying capacity, tools to protect small, at-risk wetlands should be prioritized across the PPJV administrative area. While wetland easements have been the focus of wetland protection efforts to date, the PPJV suggests that greater attention be provided to leases and other term-limited approaches to protect wetlands in instances where perpetual instruments face legislative impediments (e.g. easement caps in ND) or are otherwise challenging.

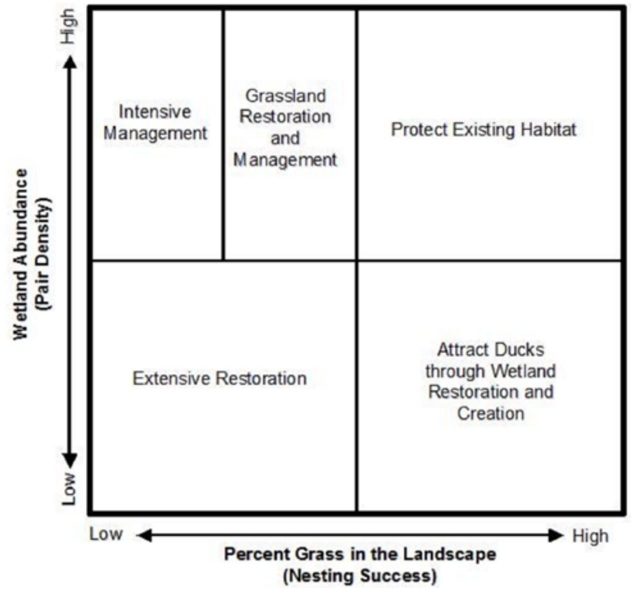
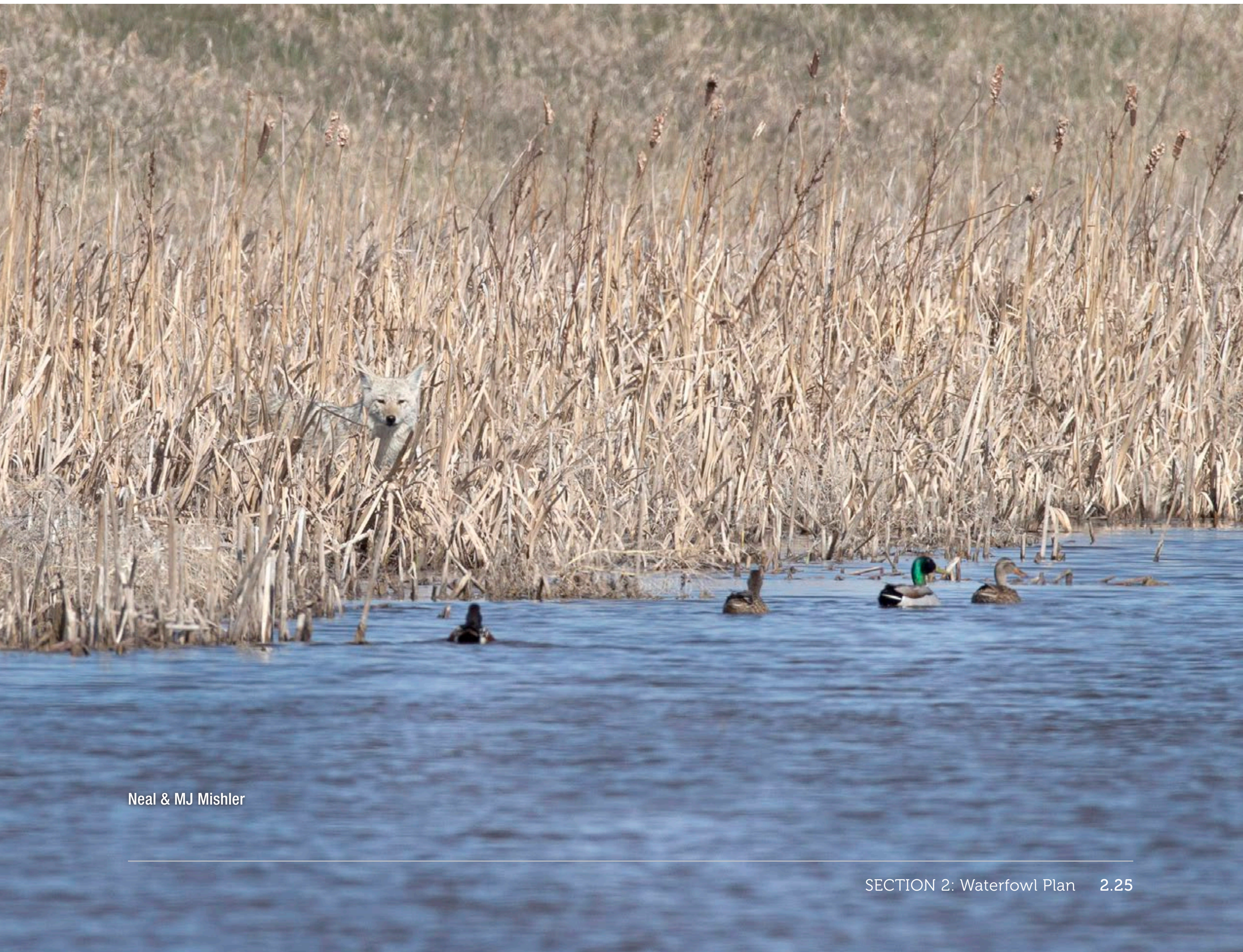


Figure 12. A conceptual decision matrix for waterfowl conservation displaying recommended actions based on wetland abundance and percent grass in the landscape.



SPATIAL PRIORITIZATION

Spatial databases generated using GIS have enabled PPJV planners to understand the distribution, abundance, and trends in important landscape features in ways that were never imagined when the PPJV was formed. Two GIS products—the predicted distribution of breeding duck pairs (Figure 13) and the distribution and abundance of perennial vegetation (Figure 14)—have been particularly important for waterfowl conservation purposes.

…PPJV planners can identify the best tactics to employ in particular geographic areas.

Conservation Strategies and Targeting

Although the PPJV has a strategic umbrella to conceptualize conservation actions together with the longevity of their benefits (Table 3), there remains a need for a biologically-based decision process that directs where certain treatments or tactics should be targeted on the landscape. Since about 1995, PPJV partners have used a simple, conceptual decision matrix for this purpose (Figure 12). This matrix uses a combination of wetland abundance (because wetlands affect pair densities) and grassland abundance (because of the generalized relationship between the amount of grassland in the landscape and duck nesting success) to suggest an appropriate management tactic. Different partners employ different wetland and grassland thresholds for the categories. In the Dakotas and Montana, a typical threshold for the wetland (pair density) dimension is 50 pairs per square mile, and for the grassland dimension is 40% grass within a 4 square-mile-area (20% between "intensive management" and "grassland restoration" boxes). Lower pair and grassland densities are usually applied to the PPJV portions of Minnesota and Iowa.Using GIS, this conceptual matrix can be made spatially explicit by combining two separate GIS products, in this case the maps depicted in Figures 13 and 14. Using approaches like this, PPJV planners can identify the best tactics to employ in particular geographic areas. These decision support tools have been used since 1988 for targeting PPJV program delivery, and similar products will continue to evolve as a key part of conservation planning and delivery for waterfowl.

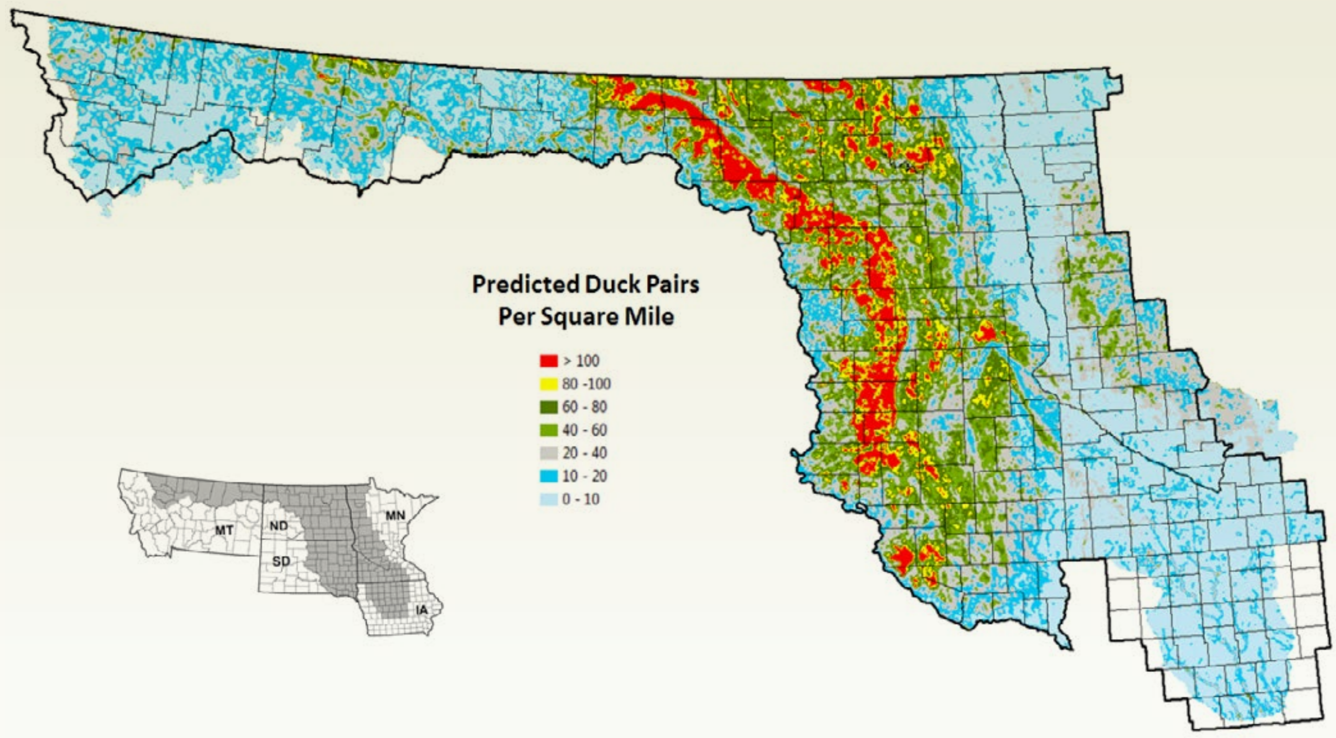


Figure 13. Upland accessibility by predicted breeding duck pairs (mallard, northern pintail, gadwall, blue-winged teal, northern shoveler) in the PPJV administrative area. PPJV partners often refer to this GIS model as the "thunderstorm map" because of its resemblance to a weather radar image.

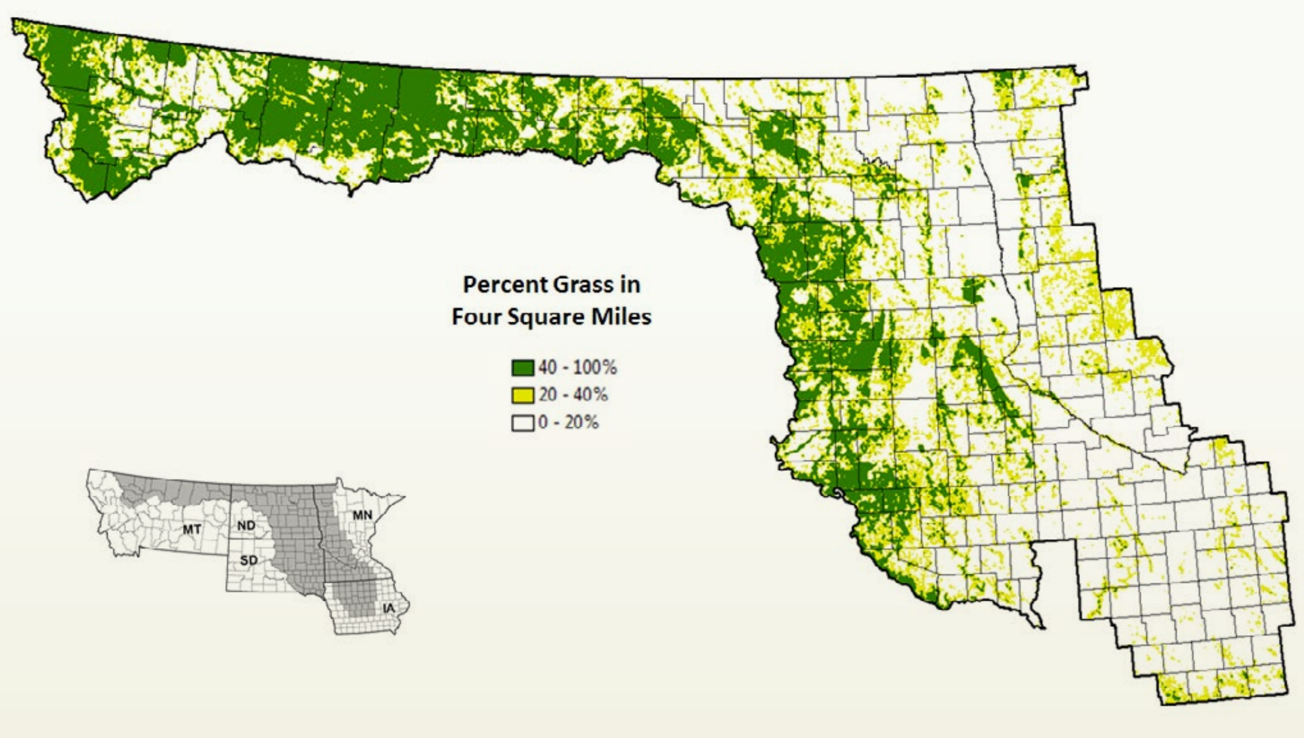


Figure 14. Percent perennial cover within a four-square-mile area throughout in the PPJV landscape (derived from 2011 LANDSAT TM data).

MONITORING LANDSCAPE CHANGE AND EVALUATING DEMOGRAPHIC RESPONSE

Waterfowl conservation programs in the PPJV administrative area will follow the strategic habitat conservation described in Section I of the 2017 PPJV Implementation Plan. Specifically, PPJV partners intend to document the critical landscape features (particularly wetlands and grasslands) that existed during 1994-2014, when duck populations increased to record and near-record levels, to establish a habitat baseline. On a large spatial scale, LANDSAT satellite imagery and the digital National Wetlands Inventory database can serve this purpose. Those databases have already been obtained for the entire U.S. PPR, although remapping may be warranted in areas of wetland change resulting from drainage and other anthropogenic alteration.

Traditional LANDSAT imagery analysis has limited utility in tracking important U.S. PPR habitat features over time. These limitations include identifying subtle changes in the quality and structure of upland and wetland habitats, and the loss or partial drainage of small wetlands. However, new methods of analysis have been identified that may prove useful to overcoming these limitations (see Halabisky et al. 2016). Using remote sensing information with higher resolution capabilities for vegetation composition and structure (i.e., LIDAR) may also provide a solution once it is available for the entire U.S. PPR. Until then, the solution is to utilize a statistically valid design that identifies sample plots that are representative of the PPJV as a whole. That sampling frame exists already, in the form of the FSMS plots developed and monitored by FWS personnel. These plots have already formed the basis for much of the information used by waterfowl planners in the PPJV administrative area. Dahl (2014) used a similar sample-based approach to estimate the wetland area extent and change rates of U.S. PPR wetlands from 1997-2009. A random subset of FSMS plots was included in that analysis.

PPJV partners intend to continue and expand the utility of the FSMS to detect changes in the PPJV landscape at periodic (i.e., 5-year) intervals. Aerial photography, coupled with field surveys, will be used to detect changes in important habitat features on FSMS plots. Enhanced monitoring of waterfowl pairs, nest fates, and brood abundances will be considered in order that changes in landscape features can be related to vital rates of waterfowl. With these data, the mallard productivity model can be updated and expanded to all areas of the PPJV administrative area, including Montana and Iowa. It may also be possible to "scale up" some results and use LANDSAT and similar products to view changes in the PPR landscape in totality. The intention is to develop and employ GIS and simulation models through scenario planning to estimate the net change in the duck production capacity of the U.S. PPR, and to use that information to realign conservation priorities in recognition of habitat that has been lost and in anticipation of future changes and threats.

DEVELOPMENT OF TACTICAL PLANS

State Tactical Plans, as described in Section I of this Implementation Plan, have been developed by PPJV partners in coordination with the PPJV Technical Committee. These plans flow from the foundation and priorities presented in this Plan, and describe specifics of approaches to be used, budgets, timetables, partner involvement, and monitoring/evaluation. State Tactical Plans can be found as supplements to the Implementation Plan.

As long as the tactical plans have an objective and defendable scientific foundation and contribute positively to the conservation goals in the PPJV, they should be encouraged and supported by the Joint Venture. At the same time, partners should carefully consider how their individual interests can be harmonized with those overarching needs and goals of the PPJV. Progress will be greatest when partners' individual causes coalesce around the common objectives of the PPJV.

Chuck Loesch

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Table 4. Estimated breeding populations ducks with NAWMP objectives and breed in the PPJV (WBPHS strata 41, 45–49), 1970–2015.

Year	American wigeon	Blue-winged teal	Canvas-back	Gadwall	Scaup	Green-winged teal	Mallard	Northern pintail	Northern shoveler	Redhead	Total
1970	78,307	1,386,530	33,439	572,622	114,577	241,078	1,122,043	1,160,942	682,118	208,004	**5,599,660**
1971	61,444	1,803,702	21,970	531,637	49,622	43,155	1,115,947	942,592	313,147	182,652	**5,065,868**
1972	105,308	1,721,123	40,086	545,266	71,150	98,441	1,074,226	1,109,500	596,005	175,475	**5,536,580**
1973	66,720	1,251,344	39,868	348,532	57,213	62,526	906,448	519,197	229,882	130,096	**3,611,826**
1974	88,152	1,482,217	69,743	327,008	75,675	103,211	698,213	613,462	272,202	131,914	**3,861,797**
1975	123,512	1,346,967	46,997	447,153	89,954	96,512	827,301	740,253	298,532	240,085	**4,257,266**
1976	123,868	599,507	23,444	130,957	84,958	38,607	638,587	428,232	193,833	60,284	**2,322,277**
1977	61,523	476,610	12,569	138,489	46,108	7,458	395,335	200,308	117,395	43,627	**1,499,422**
1978	167,832	1,866,988	33,915	524,749	192,147	52,092	966,272	1,330,555	716,486	339,169	**6,190,205**
1979	97,828	1,649,814	44,387	482,299	176,128	48,275	1,081,336	918,875	850,842	256,307	**5,606,091**
1980	172,885	1,294,059	38,738	317,347	80,242	159,014	781,668	470,969	265,092	154,851	**3,734,865**
1981	194,104	504,631	42,405	350,783	151,098	47,677	451,954	250,832	347,205	107,117	**2,447,806**
1982	108,834	1,272,737	47,172	537,788	163,413	56,492	664,657	684,876	575,105	309,801	**4,420,875**
1983	116,161	1,137,382	16,098	614,449	152,501	60,365	581,024	507,359	355,576	308,494	**3,849,409**
1984	105,391	1,657,813	66,543	740,274	162,772	30,331	780,604	571,775	468,027	283,621	**4,867,151**
1985	96,768	1,018,852	25,804	399,340	128,261	85,777	593,166	353,921	250,641	154,596	**3,107,126**
1986	77,467	2,151,736	50,156	499,484	238,536	67,299	855,170	613,720	622,667	166,873	**5,343,108**
1987	83,716	1,228,187	34,889	450,766	151,453	53,717	973,873	371,230	470,697	134,366	**3,952,894**
1988	84,878	1,012,043	24,138	467,692	178,741	54,753	666,771	224,094	176,678	75,815	**2,965,603**
1989	57,159	1,123,056	44,997	482,172	147,632	27,887	764,425	251,991	356,883	189,689	**3,445,891**
1990	76,615	491,998	21,127	391,058	96,407	10,313	290,068	163,810	184,687	40,538	**1,766,621**
1991	51,483	1,156,787	13,351	389,952	117,297	14,705	575,214	130,461	206,377	27,212	**2,682,839**
1992	79,944	942,397	21,068	614,898	71,773	26,832	695,551	173,304	215,735	124,373	**2,965,875**
1993	54,149	889,260	34,976	568,937	57,246	17,335	824,008	309,849	391,471	159,355	**3,306,587**
1994	166,960	2,022,962	74,505	766,549	263,713	82,722	1,454,979	625,363	796,548	248,256	**6,502,558**
1995	157,933	2,691,006	51,658	1,119,324	232,238	103,232	1,670,171	773,089	936,112	283,231	**8,017,995**
1996	150,807	2,861,855	66,728	1,176,218	179,949	150,576	1,761,243	546,767	941,078	307,489	**8,142,710**
1997	156,468	2,842,486	76,260	1,329,609	174,457	144,713	2,353,200	711,654	846,109	264,833	**8,899,788**
1998	149,484	2,948,917	57,492	1,396,082	232,777	64,730	2,091,214	474,060	557,826	394,427	**8,367,009**
1999	125,053	3,404,267	47,080	1,361,239	173,396	70,212	2,326,887	687,246	891,279	313,172	**9,399,831**

Year	American wigeon	Blue-winged teal	Canvas-back	Gadwall	Scaup	Green-winged teal	Mallard	Northern pintail	Northern shoveler	Redhead	Total
2000	135,066	4,251,268	26,642	1,775,772	247,987	61,180	2,424,241	391,309	815,646	332,901	**10,462,012**
2001	113,196	3,256,194	71,478	1,189,664	183,258	78,727	2,432,815	733,502	1,132,138	274,135	**9,465,107**
2002	117,137	2,238,900	36,095	1,082,114	184,598	77,666	1,788,249	294,984	555,901	218,964	**6,594,608**
2003	100,240	2,059,693	30,226	904,058	179,114	58,474	1,582,940	202,599	470,602	131,259	**5,719,204**
2004	77,896	1,585,598	48,024	1,099,111	261,691	106,714	1,607,542	311,299	480,076	169,907	**5,747,859**
2005	103,463	1,422,446	34,179	759,934	140,587	64,638	1,455,992	293,895	520,059	112,955	**4,908,147**
2006	108,666	1,677,124	39,199	735,514	144,428	88,724	1,799,373	391,675	479,717	145,750	**5,610,170**
2007	155,858	2,673,116	60,143	1,309,021	188,743	59,626	2,237,460	591,896	745,322	248,627	**8,269,812**
2008	56,919	2,576,360	28,685	939,775	138,605	24,554	1,648,000	306,129	691,214	176,205	**6,586,446**
2009	225,082	4,249,358	85,080	1,192,852	284,813	160,204	2,632,948	1,111,663	1,836,038	500,653	**12,278,691**
2010	273,464	3,901,085	140,481	1,333,978	276,598	348,481	2,552,740	1,281,934	1,596,677	453,452	**12,158,890**
2011	159,035	4,663,922	142,018	1,412,494	263,591	113,237	2,802,733	1,591,502	1,404,160	625,517	**13,178,209**
2012	136,353	4,949,469	88,469	1,678,568	290,295	121,192	2,799,198	1,053,791	1,208,219	553,193	**12,878,747**
2013	139,217	3,285,290	125,972	1,411,896	291,596	162,492	2,883,740	825,248	1,349,698	455,706	**10,930,855**
2014	176,462	2,660,819	111,484	1,180,356	431,521	213,919	2,171,460	787,273	1,284,843	304,502	**9,322,639**
2015	201,849	2,362,083	137,358	1,198,520	396,439	120,992	1,917,344	548,244	629,154	249,439	**7,761,422**

Directed Research Needed in Support of PPJV Waterfowl Programs

The PPJV has a rich research history that has provided the knowledge upon which most of our waterfowl programs are founded. Cox et al. (2000) summarized waterfowl research needs for the Northern Great Plains, and the 2005 PPJV Implementation Plan identified important information needs within the PPJV, which are listed below.

Research needs identified by Cox et al. (2000)

- Determine effects of landscape factors on demographics and recruitment of ducks in the Prairie Pothole Region
- Develop, improve, or update estimates of important parameters used in existing models for management and planning
- Evaluate waterfowl management activities at broad, regional scales
- Direct studies at waterfowl species of concern
- Evaluate applicability of the bird-conservation-area concept to waterfowl

Ongoing waterfowl research and needs identified in the 2005 Implementation Plan

- Effectiveness of landscape-level grassland restoration/CRP evaluation
- Effectiveness of wetland restorations
- Survival rates for breeding duck populations in the PPJV
- Duck nesting success in relation to landscape configuration in the Missouri Coteau
- Determinants of mallard and gadwall nesting on constructed islands in North Dakota

Many of the research needs identified in the two documents have been addressed in the past decade or are currently being addressed by ongoing research. However, the continued need to test the underlying assumptions of PPJV decision support tools and conservation actions remains an important part of directing conservation priorities not only for waterfowl, but for priority species of shorebirds, waterbirds, landbirds and resident game birds as well. Identifying what limits priority species population growth will continue to be a priority. Additionally, identifying what limits the PPJV societally and logistically from achieving acreage goals will guide partner research priorities. Thus, the PPJV Technical Committee has identified additional research needs that fall within 5 key themes that will guide the PPJV for the duration of this Plan. These are listed below.

Theme 1: Evaluate Population/ Habitat Biological Relationships

Investigating the factors that limit waterfowl populations from reaching desired levels has historically been the primary focus of research in the PPR. This genre of research generally centers on investigating environmental and ecological relationships that affect vital rates and identifying conservation actions used to address those population limiting factors. Supporting research that builds a fundamental understanding of priority species ecology and assesses impacts of system change to those species will continue to be a priority for the PPJV.

Theme 2: Evaluate Landscape Stressors

Wetland and grassland habitat loss continues to be the primary challenge confronting the fulfillment of PPJV goals and objectives. Those losses stem from several landscape stressors: agricultural intensification resulting in wetland drainage and consolidation; grassland conversion, and increased pesticide use; energy development including oil and gas extraction, wind, and biofuels; and the direct and indirect effects of climate change on waterfowl populations and habitats. Supporting research that investigates the impacts of these landscape stressors on species ecology will be a priority for the PPJV.

Theme 3: Build PPJV Partners' Adaptive Capacity

The 2012 NAWMP identified the need for the waterfowl conservation community to keep pace with environmental and social change. Accordingly, a primary recommendation of the plan is to increase adaptive capacity such that structured learning


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becomes part of the culture of waterfowl management thus increasing program effectiveness. The PPJV waterfowl conservation model must be able to explicitly reflect the PPJV partners' understanding of the U.S. PPR system change through time. Supporting research dedicated to building PPJV partners' adaptive capacity to landscape and social change will be a priority for the PPJV.

Theme 4: Bridge Knowledge/ Implementation Gaps

Contemporary landscapes of the PPJV administrative area are shaped by agriculture, making the U.S. PPR one of the most anthropogenically-influenced landscapes in the world. Individual producers make land use decisions based on tradition, expertise, life style choice, and economic profitability. A principle obstacle confronting the PPJV is targeting conservation actions on priority habitats with the highest risk of agricultural conversion. The current PPJV habitat risk assessment is limited to current land use and soil productivity. However, biological risk assessment techniques have progressed well beyond the basic approaches currently used in the PPJV. Partners must be able bridge the gap between conceptual and operational conservation planning and delivery. Supporting research that investigates the ecological and financial efficiency of conservation actions at local, state, and regional scales will be a priority for the PPJV.

Theme 5: Evaluate Socio-economic Implications to Conservation Planning and Implementation

Conservation social sciences have focused considerable attention on understanding the relationship between humans and nature and on improving conservation outcomes. In light of the current habitat losses in the U.S. PPR, Doherty et al. (2013) emphasized the need to adapt the PPJV conservation delivery strategies to maintain high landowner interest and acceptance of conservation programs. Building and maintaining relationships with private landowners will be critical to conservation planning and delivery because the vast majority of lands within the PPJV are privately owned. Supporting research dedicated to investigating the socio-economic impact of continued grassland loss, wetland drainage and consolidation, as well as protected and restored habitats, will be a priority for the PPJV.

LITERATURE CITED

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