

Ecology of Wild Turkeys in Wisconsin

A Plan for Their Management:
2015-2025



Wisconsin Department of Natural Resources



**Wisconsin Department of
Natural Resources
Bureau of Wildlife Management**



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in Wisconsin**

A Plan for their Management: 2015-2025

March 2015

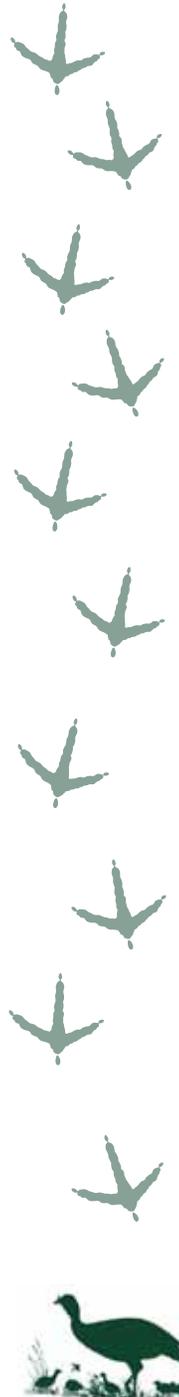
This is a report of the
Wisconsin DNR Turkey Advisory Committee

Committee members represent the following agencies and organizations:

- ✚ Great Lakes Indian Fish & Wildlife Commission
- ✚ National Wild Turkey Federation
- ✚ Wisconsin Bowhunters Association
- ✚ Wisconsin Conservation Congress
- ✚ Wisconsin Wildlife Federation
- ✚ The Nature Conservancy
- ✚ United States Army—Fort McCoy
- ✚ United States Forest Service
- ✚ WDNR Bureau of Law Enforcement
- ✚ WDNR Bureau of Customer & Outreach Services
- ✚ WDNR Bureau of Natural Heritage Conservation
- ✚ WDNR Bureau of Science Services
- ✚ WDNR Bureau of Wildlife Management
- ✚ WDNR Division of Forestry

With approvals by:

- ✚ WDNR Wildlife Policy Team
- ✚ Wisconsin Natural Resources Board





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Dear Wild Turkey Enthusiast:

Thank you for your interest in Wisconsin's wild turkey resource! It is awe-inspiring to consider just how enmeshed turkeys have become both in our wild landscapes and in our sporting traditions since they were reintroduced to the state in 1976. Indeed, it is now difficult to conceive of a spring morning in Wisconsin without the echo of a tom gobbling from a distant ridge. The extent to which wild turkeys have become integrated into our wildlife community and in the hearts and minds of hunters makes their proper management a shared and very important goal.

This document stands as a revision of the 1996 Wisconsin Wild Turkey Management Plan, and as such will help guide our turkey management program through 2025. The latter section includes a number of specific goals that we feel will help us maintain both a healthy turkey flock and a satisfying experience for our state's turkey hunters. A set of realistic implementation strategies is also described that will allow us to make progress toward each goal, and specific products are defined that will serve as our benchmarks of success. As with all such plans, this plan will be adaptive in nature, and we will respond to new issues as they arise concerning wild turkeys and the dedicated hunters who pursue them.

With over 130,000 enthusiastic turkey hunters in Wisconsin, the decisions we make regarding the structure of spring and fall seasons, investment of Wild Turkey Stamp dollars, and general approach to turkey population management are of interest to many. We therefore strove to produce a document that would serve to both inform the reader and make our turkey management program completely transparent. Much of the information contained herein, therefore, has been gleaned from both the scientific literature and previous documents published for Wisconsin's turkey hunters. For those interested in more detail on any topic covered, we encourage you to use the "Further Reading" section to locate other documents that might be of interest.

The hunters who pursue turkeys and the biologists tasked with their management can only work together toward the goal of conservation through frequent communication and the sharing of information, goals, and unique perspectives. We are hopeful that you will find this document both interesting and informative, and hope it further empowers you as a partner in our ongoing mission to preserve wild turkeys for all future generations to enjoy.

Wisconsin DNR Turkey Advisory Committee





Bruce MacQueen



EXECUTIVE SUMMARY

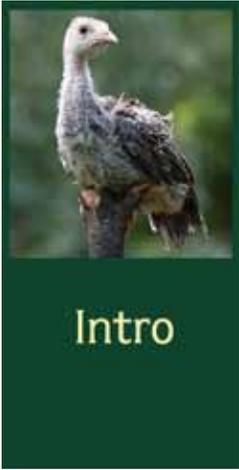


The restoration of wild turkeys to Wisconsin's landscape is widely recognized as one of the greatest success stories in our state's rich wildlife management history, and stands as a testament to the multiple values that stem from properly integrating scientific information with proactive assessments of the myriad social issues inherent in managing a public resource. Absent from the state as recently as the 1970s, wild turkeys are now distributed statewide, provide recreational opportunities for more than 130,000 hunters, and, as a common and visible member of our wildlife community, hold aesthetic appeal for the broader public. The variety of ways in which abundant wildlife populations can impact individual human interests typically engenders a diverse array of public attitudes and opinions regarding their proper management. Certainly attitudes regarding wild turkeys in Wisconsin are varied, even among hunters, with negative interactions (e.g., damage to agricultural crops, nuisance issues in suburban areas) requiring that managers communicate broadly with all segments of the public in order to address issues, maintain a positive public image of our turkey resource, and maximize the recreational potential it provides. The partnership among biologists, landowners, and hunters that supported wild turkey restoration in Wisconsin must remain intact and be expanded to include other groups as needed to address contemporary issues, as we take the wild turkey management program into the next decade. This plan serves as a step toward this broader approach to wild turkey management that will allow us to more effectively embrace the interests and concerns of all Wisconsin citizens.

"Ecology of Wild Turkeys in Wisconsin and a Plan for Their Management, 2015-2025" was developed by members of the Wisconsin DNR Turkey Advisory Committee, which includes representation from a diverse array of public agencies and conservation organizations that collectively bring a wealth of interests and experience to the table. The foundation of the document rests on sound scientific data on turkey ecology and population dynamics, historic turkey demographic and harvest data from Wisconsin, and significant input from the public. Public opinion regarding the structure of hunting seasons has been consistently gleaned from annual hunter surveys, and focused input was gathered in the early phases of plan development via a series of public meetings and an online survey. The information included in this plan is intended to provide interested citizens a completely transparent view of our wild turkey management program, in hopes that it allows constituents to become better informed and more actively engaged partners in the management of Wisconsin's turkey resource. Only via open exchange of information and opinions can strategies be enacted that effectively address the broad spectrum of biological and social issues involved in wild turkey management.

This document serves as both a guidance document for the turkey management program during the period from 2015 through 2025, and as an outreach tool to better inform and engage the public on turkey ecology and management issues. Information is presented in three broad sections: basic wild turkey ecology and population dynamics, a historic overview of wild turkeys in Wisconsin, and a detailed description of objectives and strategies for our turkey management program for the next decade. The first section provides information regarding how wild turkeys function as members of our wildlife community, as well as significant material regarding the factors that influence population size that will allow the reader to better understand how decisions are made regarding harvest management. The second section offers a complete historic account





Ecology of Wild Turkeys in Wisconsin

of wild turkeys in the state and summarizes restoration efforts, the evolution of our spring and fall season frameworks, and historic information regarding harvest and hunter participation. It also provides a discussion of contemporary issues related to turkey management (e.g., crop damage, disease issues). The final section defines our programmatic goal, and describes a comprehensive set of objectives that will help us in achieving this goal. Specific strategies that will allow us to proactively address these objectives are expanded upon, as are desired products related to each strategy. The over-arching goal for the turkey management program is to:

Maintain healthy turkey populations in all suitable range, optimize quality turkey hunting opportunities in spring and fall, and promote a positive public image of our wild turkey resource.

Specific objectives that will guide efforts toward achieving this goal from 2015-2025 are:

- ✚ **Protect turkey populations and optimize hunter opportunity and satisfaction** (12 strategies and 20 products defined; pages 71-79).
Incorporate scientific and social information to maintain spring and fall turkey season structures that allow continued population health, yet meet demands for opportunity and maintain high levels of hunter satisfaction. Develop improved means of monitoring turkey health and addressing nuisance turkey issues, while maintaining an effective turkey damage abatement program. Expand on outreach efforts that will increase public understanding of the various ecological and social data incorporated into management decisions, especially those related to permit allocations and season structures. Continue to support hunter recruitment and retention efforts.
- ✚ **Improve habitat for wild turkeys within the confines of broad land-management goals** (3 strategies and 5 products defined; pages 80-86).
Incorporate knowledge that turkey abundance is a product of habitat quality at varying scales into region-specific habitat goals. Emphasize the enhancement or establishment of openings, trails, fruit-bearing shrubs, and grassland habitat in landscapes with >70% forest cover, and reforestation efforts in areas with <30% forest cover, while recognizing and adapting to potential conflicts with habitat goals for other wildlife species or natural communities. Support efforts to regenerate oak forests in existing forest communities.
- ✚ **Develop educational and outreach tools to communicate effectively with hunters, landowners, and the public regarding turkey population ecology and management issues** (4 strategies and 9 products defined; pages 86-88).
Utilize current, and develop new, methods of increasing public awareness of turkey management issues. Provide clear and detailed explanations for decisions regarding permit levels or changes to season structure using press releases and other media. Provide ready public access to "Ecology of Wild Turkeys in Wisconsin and a Plan for Their Management, 2015-2025" in both hard copy and electronic form. Continue to engage partner organizations (e.g., NWTF, Wisconsin Conservation Congress) on turkey-related issues, and educate members about the ecological and sociological basis for important actions or decisions related to wild turkey management.





 **Minimize negative interactions between wild turkeys and the public** (2 strategies and 3 products defined; pages 88-89).

Support and promote current tools used to abate wild turkey damage to agricultural crops (Wisconsin Wildlife Damage Abatement & Claims Program). Support the development and distribution of documents that educate landowners about wild turkey foraging ecology and summarize research on wild turkeys as an agent of crop damage. Develop tools to better engage municipalities in addressing nuisance turkey issues.

 **Invest Wild Turkey Stamp funds to maximize benefits to turkeys, turkey management, and turkey hunting in Wisconsin** (4 strategies and 8 products defined; pages 89-91).

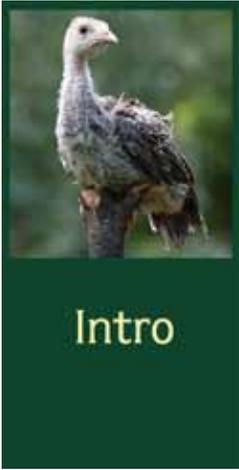
Continue to focus Wild Turkey Stamp funds on practices that address region-specific wild turkey habitat needs. Utilize funds to increase turkey hunter access to private lands, and to support turkey hunter recruitment and retention efforts. Support outreach efforts that will improve communication and support more effective decision-making among and by partners and constituents. Support biological and social research that will increase our ability to achieve the specific goals outlined in this document. Guidelines for Wild Turkey Stamp fund allocations will be reviewed every other year by the WDNR Turkey Advisory Committee, incorporating new information as available to ensure that the goals contained in this plan are appropriately addressed.

 **Conduct research as appropriate to address specific needs related to turkey management in Wisconsin** (4 issues and 6 research projects defined; pages 91-93).

Define wild turkey distribution and habitat associations in the heavily-forested landscapes of northern and central Wisconsin, to foster improved management of hunter densities and turkey harvest. Define wild turkey distribution relative to available forest cover in the open landscape of southeastern Wisconsin, to foster improved management of hunter densities and turkey harvest. Use survival and reproductive data from Wisconsin research projects to develop a demographic model that will clarify the impact of harvest on wild turkey population growth in landscapes with varying levels of forest cover. Conduct social research to clarify hunter expectations and define the factors that determine levels of hunter satisfaction with spring and fall turkey hunting in Wisconsin.

This document provides a comprehensive body of knowledge regarding our turkey management program that will foster effective decision-making related to contemporary and emerging issues regarding our wild turkey resource. The strategies outlined above provide a means to focus energy and resources over the coming decade, but successful implementation will require open communication among all partners and constituents involved in or impacted by those decisions.





◆ TABLE OF CONTENTS ◆

Section 1

Wild Turkey Life History, Ecology and Population Dynamics	1
Taxonomy	2
Physical Description	2
Distribution and Population Status	4
Wild Turkey Life Cycle and Annual Habitat Needs	5
General Habitat Requirements	5
Breeding Season	5
Brood Rearing	7
Fall and Winter	7
Population Dynamics	8
General Summary of Wild Turkey Population Dynamics	9
Nesting and Renesting Rates	9
Clutch Size and Hatchability	10
Nest Survival and Hen Success	10
Poult Survival	11
Juvenile and Adult Survival	11
Box 1: The Issue of Predation	12
Population Modeling	15
Ecology and Dynamics of Wild Turkeys in Wisconsin	16
The Vernon County Study	16
The Gobbler Survival Study	17
The Hen Demographics Study	18
Box 2: Perceptions of Turkey Abundance	20

Section 2

The Wild Turkey in Wisconsin	23
Historical Overview of Wild Turkeys in Wisconsin	24
Box 3: Early Restoration Efforts in Wisconsin	25
Harvest Management	28
Season Structure	28
Box 4: Hunting <i>Mizise</i>	29
Turkey Management Zones	30
Spring and Fall Seasons	31
Harvest	33
Permit Levels	40
Box 5: Permit Allocation Process	44
Registration	46
Hunter Surveys	47
Box 6: A Profile of Wisconsin's Turkey Hunter	50
Health Considerations for Wisconsin Turkeys	52
Bacterial Diseases	52
Viral Diseases	55
Fungal Diseases	56
Parasitic Diseases	56
Toxins	57

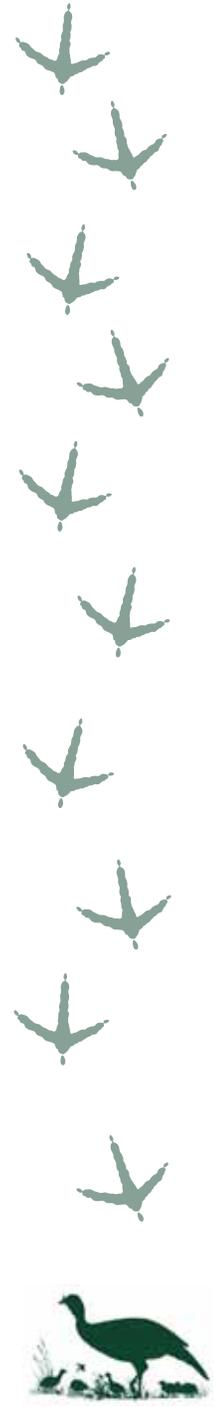




Turkey Damage	59
Nuisance Turkeys	61
Economic Impacts	62
Wild Turkey Stamp Program	64
Section 3	
A Plan for the Future	69
Program Goal	70
Objectives, Strategies, and Desired Products	71
Summary Comments:	
The Next Decade for Wild Turkey Management in Wisconsin	94
Section 4	
Suggested Reading	97



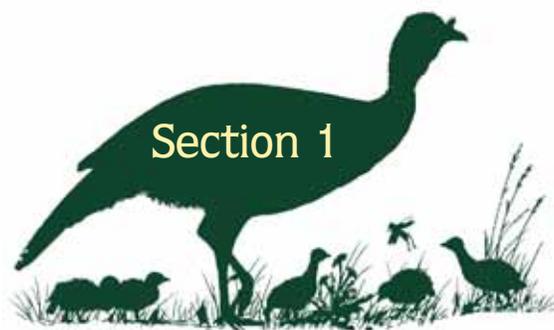
Bryan Eastham







LIFE HISTORY, ECOLOGY, AND POPULATION DYNAMICS





Section
1



Taxonomy

The name “turkey fowl” or “forest turkey” was applied by early European settlers to the large, newly-discovered bird of North America’s forests due to similarities between these birds and the guineafowl common throughout central Europe. Guineafowl had been imported to Europe via Turkey, and were often referred to as “turkey fowl.” The name was later shortened to “turkey.” Turkeys belong to the order Galliformes, family Phasianidae, along with chickens, quail, partridges, pheasants, and grouse. The wild turkey (*Meleagris gallopavo*) is one of two species in the genus *Meleagris*, the other being the ocellated turkey (*Meleagris ocellata*). These are the only two species of turkey currently living, although at least four other North American species are known from the fossil record.

There is significant variation among wild turkeys with respect to plumage coloration and body size, such that five subspecies of wild turkey can be found in North America. Of these, the eastern wild turkey (*Meleagris gallopavo silvestris*) is the only one to occur in Wisconsin. The eastern wild turkey is the largest and most abundant subspecies of wild turkey, and is also the most hunted. The range of *M. g. silvestris* covers the entire eastern half of the United States, from Maine in the northeast to northern Florida in the southeast, continuing west to eastern Kansas, Oklahoma, and Texas.



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Physical Description

The adult male eastern wild turkey, also known as a “gobbler” or “tom,” weighs an average of 17 to 21 pounds, although individuals weighing over 30 pounds have occasionally been recorded in Wisconsin. A

34.5-pound gobbler, harvested in 2002 in St. Croix County, currently ranks as the second-heaviest eastern wild turkey harvested in North America, according to the National Wild Turkey Federation (NWTf) record list. Female (hen) wild turkeys weigh an average of 8 to 11 pounds.

The plumage of the eastern wild turkey is generally dark brown with metallic bronze iridescence, but the trained eye can detect differences used to identify separate age and sex classes (Figure 1). On gobblers, the iridescence is more pronounced, and the breast feathers are tipped with black. The breast feathers of the hen are tipped with buff, lending a rusty appearance. Two characteristics of the juvenal molt can be used to identify juveniles from adults. The molt of the tail feathers in turkeys is sequential, beginning with the outer tail feathers and moving inward until the central tail feathers are replaced. However, in juveniles the molt of the tail feathers is partial, and the central four to six tail feathers will be visibly longer than the outer tail feathers into the second summer. In adults, all tail feathers will be the same length. Juveniles also exhibit an incomplete molt of the primary feathers. During the juvenal molt, only the





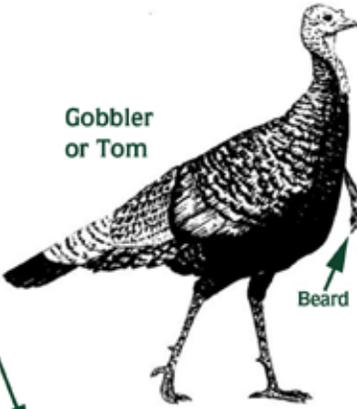
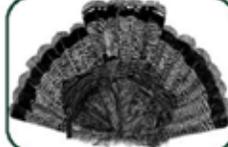
Section
1

inner eight primary feathers are molted. The ninth and tenth primaries (the outer two) thus retain the more pointed tips and worn appearance of the juvenal plumage, with less barring near the tip. The inner eight primary feathers, and all primaries of adult turkeys, will have more rounded tips, sharper and less-worn edges, and barring right to the tip.

The head of the gobbler is unfeathered and brilliantly colored, particularly during the breeding season, and is adorned with a dewlap (a flap of skin on the underside of the neck, also referred to as a wattle), caruncles (fleshy, bulbous bumps growing on the head and neck), and a snood (a fleshy appendage attached above the beak that engorges with blood during display). The head of the hen is generally bluish and lightly feathered, and also features a less pronounced dewlap and caruncles. Gobblers have a bristly beard

Aging and Sexing Eastern Wild Turkeys

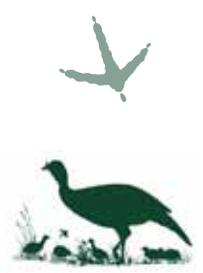
Gobbler or Hen?

 <p>Gobbler or Tom</p>	 <p>Breast Feathers</p>	 <p>Breast Feathers</p>	 <p>Hen</p>
	<p>Gobbler: Black-tipped</p> <p>Gobbler: Spur present</p>  <p>Spur</p>	<p>Hen: Buff-tipped</p> <p>Hen: Spur absent</p>  <p>Lacks Spur</p>	
	<p>Adult or Juvenile?</p>		
<p>Adult: Outer 2 Primaries more rounded with white barring extended to the end. When fanned out, tail forms an even, unbroken outline.</p>		<p>Juvenile: Outer 2 Primaries pointed with no barring near the tips. When fanned out, outline of tail appears broken.</p>	

Adapted from Ohio Division of Wildlife

Figure 1. Guide to aging & sexing of eastern wild turkeys

(actually a modified feather, though it resembles horse hair) hanging from the center of the breast; this feature is absent in the majority of hens, but can be found in about 7% of the female population. Jakes can often be identified at a distance by their relatively shorter beard, as it is normally <6" in length, but older birds may have beards >12" in length. The longest beard recorded for a Wisconsin gobbler was 17" in length. Gobblers also possess spurs on their lower legs; the growth rate for these bony





Section 1



Ecology of Wild Turkeys in Wisconsin

protuberances is ¼” to ½” per year. Generally, jakes will have spurs <½”, whereas the spurs on two-year-old birds will be between ½” and 1”. Gobblers that are three years of age or older will have spurs over an inch in length, often curving slightly back up toward the body. The longest spur recorded for a Wisconsin turkey was 1.875”. Spur development is known to occur in hens, but it is rare.

Distribution & Population Status

Despite its misleading name, the wild turkey is native to North America. Reports from the Cortes expedition of 1519 show that the turkey was widely distributed throughout Mexico and South America as a domesticated bird, and turkeys were the largest ground-nesting bird encountered by the first European immigrants along the eastern seaboard. Reports from early settlers in Ohio toward the end of the 18th century mention flocks numbering in the hundreds if not thousands, and similar reports exist from early settlers in Illinois, Iowa, Missouri, and along the Oklahoma-Texas border.

In Wisconsin, records indicate that turkeys historically ranged as far north as Green Bay to the east and Prairie du Chien to the west, with occasional birds perhaps found as far north as Burnett County. The northern edge of this range undoubtedly fluctuated from year to year in response to the severity of winter weather, and turkeys may have been temporarily absent from the state following particularly harsh winters.

Despite originally inhabiting the continent in large numbers, heavy deforestation and unregulated hunting pushed wild turkey populations to their lowest numbers between the end of the 19th century and the 1930s, with small populations surviving only in the most isolated and inaccessible habitats. An active market for harvested wild game contributed greatly to high harvest levels, and was instrumental in the rapid declines of many native wildlife species, wild turkeys included. In Wisconsin, wild turkeys were completely extirpated by 1900, with the last known record of a native individual occurring in 1881 in Lafayette County.

Following the Great Depression, however, a number of developments related to policy and land use allowed wild turkey numbers to increase across much of North America. First, the forests so important to turkeys began to regenerate on the lands formerly occupied by small farms, recreating potential turkey habitat across broad areas. With the publication of Aldo Leopold’s “Game Management” in 1933, the field of wildlife management began to gain credibility and there was increasing interest in restoring populations of game species. Perhaps most important, the emerging conservation ethic bred a variety of proactive policy and regulatory events



Bruce MacQueen





Section
1

that helped to regulate harvest and provide funding to support wildlife restoration efforts. Critical among these were The Lacey Act of 1905, which prohibited the sale of wildlife and hence ended the era of market hunting, and the Pittman-Robertson Act of 1937, which placed an excise tax on sporting goods and ammunition to provide funding for wildlife recovery programs. These improved conservation practices, along with research and restoration efforts, in the years following World War II eventually led to the establishment of wild turkeys in every state except Alaska. 1991 marked the first year that turkey populations in all 49 states were healthy enough to support a spring hunting season – just 15 years after the start of reintroduction efforts in Wisconsin – and the popularity of the sport has increased greatly since that time. Indeed, wild turkeys occupy more square miles of habitat than any other upland game bird in North America, a testament to modern management efforts as well as to the bird's adaptability to a wide variety of climatic and habitat conditions.

Wild Turkey Life Cycle and Annual Habitat Needs

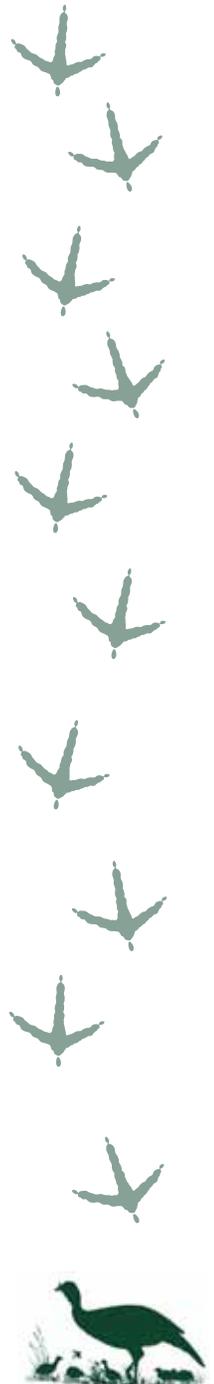
General Habitat Requirements

Although wild turkeys are habitat generalists capable of surviving quite well in a wide variety of habitats, several key components must be present if turkeys are to persist in an area: dependable food sources, quality roosting sites (trees), nesting cover, and suitable places to rear their young. It is also important that these components be close together on the landscape, so that turkeys can meet their needs within the confines of their home range. Areas with diverse and interspersed habitat patches are therefore best able to meet the year-round needs of the wild turkey. Such conditions typify agricultural landscapes, where there exists an interwoven fabric of cropland, fallow fields or pasture, grassland, and forest cover. Large blocks of any single habitat type—be they large contiguous blocks of forest or expansive areas of grassland—usually support relatively low numbers of turkeys.

Successful habitat management for turkeys requires attention at two scales: 1) the presence of site-specific factors such as brood-rearing habitat and roost trees, and 2) the existence of an appropriate landscape structure (the ratio of open:forested cover). As habitat generalists, it is often difficult to determine exactly which factors might be limiting turkey populations in a given area. However, by understanding turkey habitat needs at multiple scales, managers can often determine what elements may be limiting population growth and develop appropriate management strategies.

Breeding Season

In late winter and early spring, winter flocks break up and individuals disperse – males to open areas that will serve as display and breeding grounds and females to locate appropriate nesting habitat. Although increasing day length stimulates the release of sex hormones and therefore determines when turkeys are physiologically capable of initiating breeding behavior, the timing of the mating season is influenced considerably by weather conditions. During springs when the weather is consistently mild, breeding





Section 1

Ecology of Wild Turkeys in Wisconsin

commences relatively early, whereas prolonged winter-like weather may delay the break-up of winter flocks and subsequent breeding activity.

Gobblers select open areas that afford good visibility so that their strutting displays can be seen by hens to good advantage, and are frequently observed in pastures, crop fields, or small forest openings. Often, multiple males will roost, travel, and display together during the breeding season. As the breeding season progresses and females begin to incubate their nests, males may need to spend more time moving and travel further in order to adapt to changes in the distribution of receptive females.

In southern Wisconsin, males may begin to display in early March, but activity picks up with the onset of warm weather and the break-up of winter hen/poult flocks.



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Recent research in southwest Wisconsin documented an increase in gobbling activity in mid-March, a peak in mid-April, and a subsequent decline until few gobblers could be heard gobbling by mid-May.

In females, nest-site selection precedes mate selection, and the selection of suitable nesting habitat often requires extensive movement throughout the landscape. Early research in Vernon County established the chronology of nesting for hens in southwestern Wisconsin. Individual hens initiated (i.e., laid the first egg) first nests between April 9th and May 24th, with the median date of nest initiation varying between the 18th and 24th of April during the four years of the study. Median hatch date varied between the 9th and 16th of June. On average, 55% of hens monitored during this study that lost their first nest initiated a second nest. Incubation lasts roughly 28 days, and hens will frequently abandon the nest if disturbed early in the incubation period. Mean clutch size for first nests in Wisconsin is approximately 11 eggs.

Wild turkey hens nest in a variety of habitat types, from hay fields to woodlands, though preferred nesting sites generally have dense vegetation near the nest to provide concealment from predators. Nests in woodlands are often found near the woodland edge or an opening, and are often constructed near an object such as a tree or log. Recent research in southwestern Wisconsin revealed that hen selection of nest sites varies throughout the spring. The majority of nests initiated prior to May 1st were located in forested habitats, whereas hens increasingly selected open habitat for nesting as the season progressed. This likely reflects the increasing availability of suitable cover in open areas as spring greenup commences.





Section
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Brood Rearing

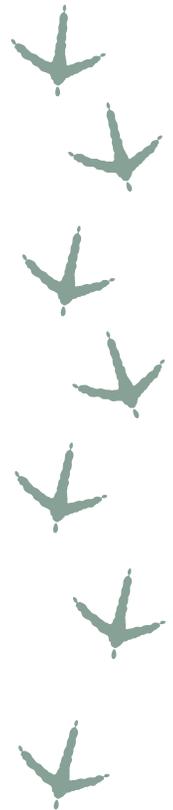
Young wild turkeys, known as poults, are precocial and able to leave the nest 12 to 24 hours after hatching. The poults can walk and feed on insects from this point forward, and the hen will brood the poults if temperatures are either too cold or too hot, or during periods of rainfall. Young turkeys are able to take short flights at only eight days old, and begin to roost in trees with the hen by two weeks of age. Studies frequently report a sharp decline in poult mortality following the first two to three weeks, likely tied to their ability to roost in trees. Most broods stay together for four to five months, at which point males often disperse to form winter flocks with other jakes. Female poults may remain with the hen until the start of the next breeding season.

After hatch, the hen leads her poults to habitats that provide adequate food and cover. Importantly, poults feed primarily on insects during the first three to four weeks of life in order to meet the high protein requirements of their rapidly-growing bodies. Insect abundance is generally higher in open habitats that have extensive herbaceous cover at the ground level, and quality brood-rearing habitat may include prairies, savannas, fallow fields, hayfields, and pastures. The best feeding areas contain a rich mixture of forbs and grasses that provide insects and permit poults to move freely.

Fall and Winter

In early fall, wild turkeys begin to shift away from their summer diet of leaves, grasses, insects, and seeds and move toward habitats such as oak forests or agricultural fields that provide foods such as acorns or waste grain throughout the late fall and winter. Dispersal of juvenile turkeys begins as brood flocks break up in early fall, and these dispersal movements help to ensure the colonization of all suitable habitat on the landscape. Winter flocks also begin to form at this time, and turkeys tend to congregate based on age and sex classes, with individual flocks generally composed of hens with female poults, hens without poults (those that failed to nest or lost their eggs or poults), jakes, or adult gobblers.

Since Wisconsin is on the northern edge of the wild turkey's range, winter habitat quality can be important in determining local turkey abundance. In areas or years with little snow cover, wild turkeys can move freely across the landscape and readily locate food and roosting habitat. When snow cover is deep and/or persistent, however, these two main habitat components need to be located within close proximity because deep snow impairs turkey mobility. Though turkeys can scratch through a few inches of powdery snow to reach food on the ground, a layer of ice or snow >6" in depth limits access to this food, and turkeys will need to locate alternate food sources. Standing corn or other grain, shrubs with nuts, berries or catkins, or grasses or forbs with intact seed heads can all provide important food during periods of persistent snow cover. In severe winters, turkeys also consume accessible buds from trees and shrubs. Where available, groundwater seeps may also provide foraging on invertebrates and green vegetation throughout winter. Movements by



Bruce MacQueen





Section 1

Ecology of Wild Turkeys in Wisconsin

large animals (e.g., deer) through deep snow can open up travel lanes for turkeys, and their foraging activities may expose food sources that are then available for turkeys to exploit.

Winter roosts tend to be in areas protected from prevailing winds, such as in ravines or small river valleys, and often take advantage of the warmer conditions and reduced snow cover present on south-facing slopes. Turkeys will also readily utilize conifers as winter roost sites when available, as they provide effective thermal cover. Protected roosting areas in close proximity to accessible food resources combine to form the basis of quality winter cover, and give wild turkeys their best opportunity to withstand severe winter weather.

Population Dynamics

Most people with an interest in wildlife ponder basic questions related to the abundance and distribution of individual species. For example, turkey hunters may observe varying numbers of turkeys from one year to the next, and speculate on the reasons behind these perceived changes. The field of population dynamics seeks to address such questions objectively, in order to understand how abundance changes through time and, more importantly, to identify the factors responsible. Population dynamics research and modeling can provide us with information regarding how habitat, weather, predation, and harvest impact turkey numbers over the long-term, information that can lead to better stewardship of our turkey resource.

Once reintroduced to Wisconsin, wild turkeys quickly increased in number and expanded their range across the state, to the extent that many areas were opened to hunting within a decade of initial releases. Over time, however, hunters in many parts of the state began to notice that turkey numbers were leveling out or declining slightly in their area. This is a classic example of what biologists refer to as logistic population growth. Given suitable habitat, newly-established wildlife populations can increase in number at a rapid rate. Eventually, however, factors such as food availability, predation, disease, and others act to suppress survival and/or reproduction, and the population will begin to fluctuate around what is often termed "carrying capacity." The initial growth phase may be so rapid that the population shoots well past carrying capacity before leveling out. Certainly, many hunters have commented that there seem to be fewer turkeys in the southwestern part of the state than there had been in the late

1990s, and it is likely that these high numbers reflected a population that shot past carrying capacity and has since begun to fluctuate around the long-term carrying capacity for that environment. This phenomenon may be reflected in our harvest data, as hunter success rate within zones have generally increased and then leveled off or declined slightly (Figure 7). Now that turkeys are well-established across the state, populations will likely continue to fluctuate around



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the level supportable by the local habitat, with annual variation due largely to weather conditions during winter and the critical spring breeding period.

At a very basic level, the dynamics of a wildlife population are determined by rates of birth, death, and movement into or out of an area. A significant amount of wildlife research has thus involved attaching radio transmitters to individuals so that these measures can be estimated directly. By following a sample of radio-marked turkeys throughout the year, for example, biologists are able to measure nesting rate (the proportion on females that initiate a nest), clutch size, nest survival, and poult and adult survival; document causes of nest, poult, and adult mortality; and examine patterns of movement and habitat use. Radio telemetry studies have therefore allowed biologists to attain significant understanding of the factors that drive turkey population dynamics through time. Below, we draw from an extensive literature on wild turkey ecology to summarize our general understanding of the vital rates that drive turkey population dynamics, and provide a more detailed overview of research conducted here in Wisconsin.

General Summary of Wild Turkey Population Dynamics

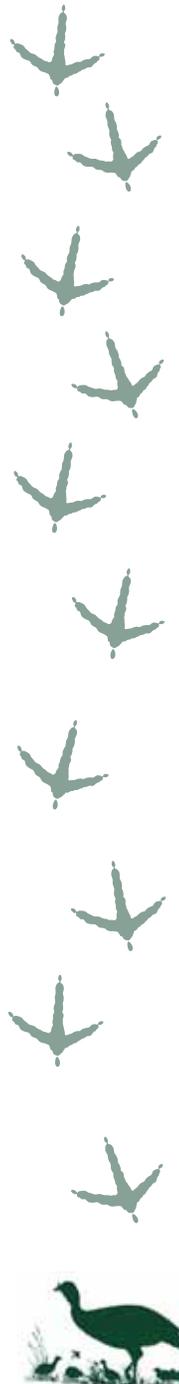
Ignoring movements, how a population changes through time is simply the result of the addition (reproduction) and subtraction (mortality) of individuals from one year to the next. Reproduction is itself the product of numerous components (e.g., nesting rate, clutch size, hatching success), and mortality can be measured during numerous stages (i.e., nest, poult, juvenile, adult). Additionally, variation in each of these measures can arise from multiple sources. For example, predators, disease, hunter harvest, and starvation can all have different impacts on hen survival from one year to the next, but collectively these and other factors determine how many hens survive. Attaining a clear understanding of the factors responsible for changes in turkey population size is therefore extremely challenging. As well, the environments inhabited by turkeys vary significantly (in terms of the plant and predator communities present, harvest levels, climate, etc.) across their range, so the factors driving population dynamics also vary from one place to another, and prudent management requires data pertaining to the dynamics of the local flock. Regardless, research has provided us a general picture of the various fitness components and an emerging understanding of turkey population dynamics. The information provided below is intended to paint this general picture of the factors underlying eastern wild turkey population dynamics.

Nesting and Renesting Rates

Wild turkeys are physiologically capable of breeding in their first spring, at about 10 months of age. While jakes may be relatively unsuccessful in competing with adult gobblers and hence experience reduced breeding success, nearly all females attempt to nest. Reported nesting rates (the percentage of hens that attempt to nest) for eastern wild turkeys vary from 72-100%, though in many populations juvenile hens are less likely to nest than adults. The nesting rate can also be reduced following severe winters, when hens enter spring in poor physical condition.



Section 1





Section
1



Marcia Griffin

Hens that lose their nest may attempt to renest a second or even a third time, and these renesting attempts can contribute significantly to overall production within a given year. Generally, around half of the hens that lose their initial nest might be expected to renest, with adult hens more likely to do so. Hens that lose their first nest during the laying period or early in incubation are more likely to renest than hens whose nests fail later on. Renesting rates may also be lower in years with a delayed onset of spring-like conditions, as hens losing their first nest later in the year are less likely to initiate a second nest.

Clutch Size and Hatchability

Reported average clutch sizes for various populations of eastern wild turkeys vary from 9.0-12.7 eggs, and there appears to be little difference between adult and juvenile females. Clutch size of first nests tends to be from one to three eggs greater than for subsequent nesting attempts. Hatchability of eggs within clutches can be reduced due to infertility or death of the developing embryo, but published reports suggest that hatchability tends to be high in wild turkeys, normally >80%.

Nest Survival and Hen Success

Nest survival rate refers to the proportion of nests that hatch at least one egg, and is of obvious importance in determining overall levels of production. Published nest survival rates vary significantly among study areas and years, generally ranging between 20% and 60%. Predation accounts for the vast majority (>80%) of nest mortality in most studies, though both nest abandonment and hay mowing activities are occasionally implicated as important agents of nest loss. Some studies have revealed lower survival for nests initiated by juvenile hens and for second nests, but these differences are not universal.

Significant annual variation in nest survival is typical, and has been linked to specific weather conditions. The relationship between weather and nest survival, however, varies across the species' geographic range. Research on an arid south Texas study area revealed that a lack of fall precipitation results in poorly-developed nesting cover the following spring, making nests more visible and easier for predators to locate. Nest survival rates were significantly higher in years when there was sufficient precipitation to allow dense nesting cover to develop. Research in New York, on the other hand, where climate and habitat are more similar to that in Wisconsin, suggests that warm, moist conditions allow mammalian predators to better utilize olfactory cues to locate nests. Nest survival rates in this study were highest in years when cool, dry conditions during the incubation period made nests more difficult to locate.

Since wild turkey hens renest, one must consider all nesting attempts when measuring overall production of poults. Hen success (the proportion of hens hatching ≥ 1 egg, all nesting attempts included) is therefore a more accurate measure of poult production than nest survival alone. Though hen success will be higher than nest survival due to the inclusion of poults produced from second or third nesting attempts, it still exhibits significant variation among areas and years, with published values varying from 25-83%.





Section
1

Poult Survival

The survival of poults from hatch through the summer brood-rearing period also varies from year to year, and seems to again be linked to weather conditions during the first few weeks of life. Most poult mortality occurs within the first two weeks post-hatch, when ground roosting by flightless poults increases their vulnerability to predators and poorly-developed thermoregulatory abilities make them sensitive to chilling. Colder-than-normal temperatures and/or higher-than-normal precipitation during the two- to three-week period following the peak of hatch can significantly reduce poult survival. Conversely, relatively warm, dry conditions during this critical period foster high poult survival. Cool temperatures and precipitation during this period



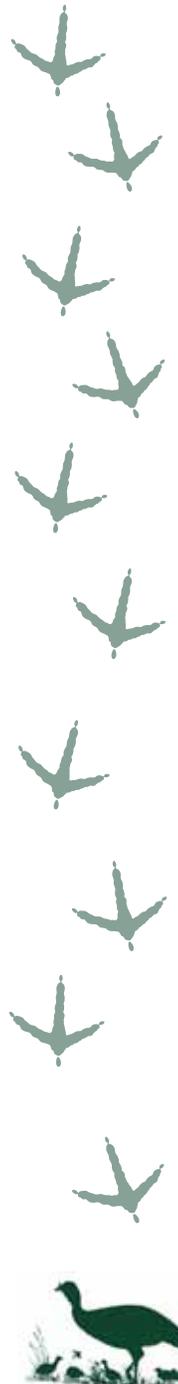
may also have indirect impacts on poult survival by reducing the availability of invertebrates, which are critically important for proper early development of young turkeys. Poult survival through the first month of life has varied from 11-76% in published studies of eastern wild turkeys and, though annual variation is tied to weather conditions, predation is often the direct source of mortality.

Survival rates increase after the first month of life, and are often similar to that of adult birds through the fall and winter. Collectively, annual variation in the production and survival of poults has significant implications for turkey population dynamics and harvest management, as will be discussed below.

Juvenile and Adult Survival

Harvest imposes an additional mortality factor on juvenile and adult wild turkeys, and influences seasonal patterns of survival. Annual survival rates for both hens and gobblers tend to range from 40-65%, though estimates as low as 28% and as high as 78% have been reported. For gobblers, harvest mortality typically leads to lower survival during spring than during other times of year. Since wild turkeys are promiscuous, male-biased harvest does not impact population trends, although removal of more than approximately 35% of males can alter age ratios such that hunters encounter relatively fewer adult gobblers in subsequent seasons (measured gobbler harvest rates in Wisconsin have varied from 18-31%).

Hen survival also tends to be lower during spring than during other time periods, but the primary mortality factor is predation of nesting hens rather than harvest. As mentioned, warm, wet weather may increase the ability of predators to use olfactory cues to locate nests. Hens may also experience a secondary increase in mortality during the fall in states with an either-sex fall hunting season. Hen harvest during the fall season must be closely monitored, as excessive harvest will reduce poult production the following spring and, hence, population size. Generally, hen harvest rates of <10% are believed to have little impact on turkey populations, though this impact depends itself on poult production the previous spring; i.e., populations with high production of poults can sustain higher hen harvests. Survival of juvenile hens and gobblers can be lower than that of adults, but this pattern is not consistent in the literature.





Section 1

Box 1

THE ISSUE OF PREDATION

Members of the public with an interest in the health of wildlife populations are frequently concerned by apparent population declines, and inherently seek to identify and address the factors responsible. Intuitively, perhaps due to the dramatic and direct nature of predation, constituents often believe that predators are responsible and hence sometimes advocate for predator control. Certainly, predation accounts for the majority of nest, poul, juvenile, and adult hen mortality among turkeys (legal harvest is normally the leading cause of mortality for adult gobblers). However, there is little scientific support for predator control as an effective means of increasing numbers of wild turkeys or other upland game birds.

The simple fact that Wisconsin's wild turkey population, once reintroduced, rapidly expanded and increased in size and has since stabilized across the state suggests that predation does not limit population growth. Indeed, the vast majority of research suggests that turkey population dynamics are most sensitive to variation in fall hen harvest rate and spring production levels; there is little support for the idea that predation controls the size of turkey populations. Various studies do show that focused predator control efforts can increase nest survival and poul production, but these studies rarely document increased population size resulting from removal efforts.

Staff from the National Wild Turkey Federation conducted a thorough review of the literature pertaining to the effects of predators on turkey populations, and identified the following major points:

- ✦ Though predation is the leading source of mortality for all wild turkey age classes except adult gobblers, predation does not regulate most turkey populations.
- ✦ Productivity in some turkey populations may be limited by low rates of nest initiation. In such situations, the combination of low nest initiation rate and predation on nests and poults may combine to limit population growth.
- ✦ Predator removal efforts are generally not acceptable to the public. A nationwide survey suggested that focused efforts to control specific mammalian predators in order to reverse declines of desirable avian species may be supported, but landscape-scale predator control programs are not acceptable. Control of avian predators was not acceptable under any circumstances.
- ✦ Predator control can increase nest survival and poul production locally, but there is little evidence to suggest that this leads to increased population size.





Section
1

- ⚠️ Predator control is expensive and time-consuming.
- ⚠️ Predator control leads to only short-term benefits, as predators quickly re-colonize areas after control efforts have ended.
- ⚠️ Predator control programs may lead to incidental mortality among non-target species.
- ⚠️ Release of mid-size predators via the removal of “top” predators may offset any gains made by predator removal programs. For example, removal of coyotes in Texas led to increases in bobcat, badger, and gray fox populations.

In conclusion, these authors suggested that:

“Turkeys have evolved with a host of predators. The literature indicates that predation has not been a regulating factor for most turkey populations, nor has predator control been shown to have long-term benefits. Predator control may be justified in site-specific instances. Widespread use of predator control to benefit turkey abundance is probably not a prudent expenditure of management dollars.”



Hugh Vandervoort





Section 1

Ecology of Wild Turkeys in Wisconsin

Severe winter weather in northern areas can also elevate mortality rates for both hens and gobblers, as persistent deep snow and cold temperatures interact to impose severe energetic constraints on turkeys. Temperatures below 11°C (52°F) force wild turkeys to increase their metabolic heat production to maintain a constant body temperature, and these demands increase as temperature drops further. Meeting these demands requires either additional time spent foraging for food or the use of body fat reserves. For example, Minnesota researchers estimated that a hen turkey would need to consume an additional ¾-ounce of food per day (about 85 kernels of corn) for every drop of 10°C below the critical threshold. Over four inches of powdery snow make it more difficult for turkeys to scratch for food, and depths >8 inches can increasingly limit turkey movements and their ability to locate food sources that may be distant from

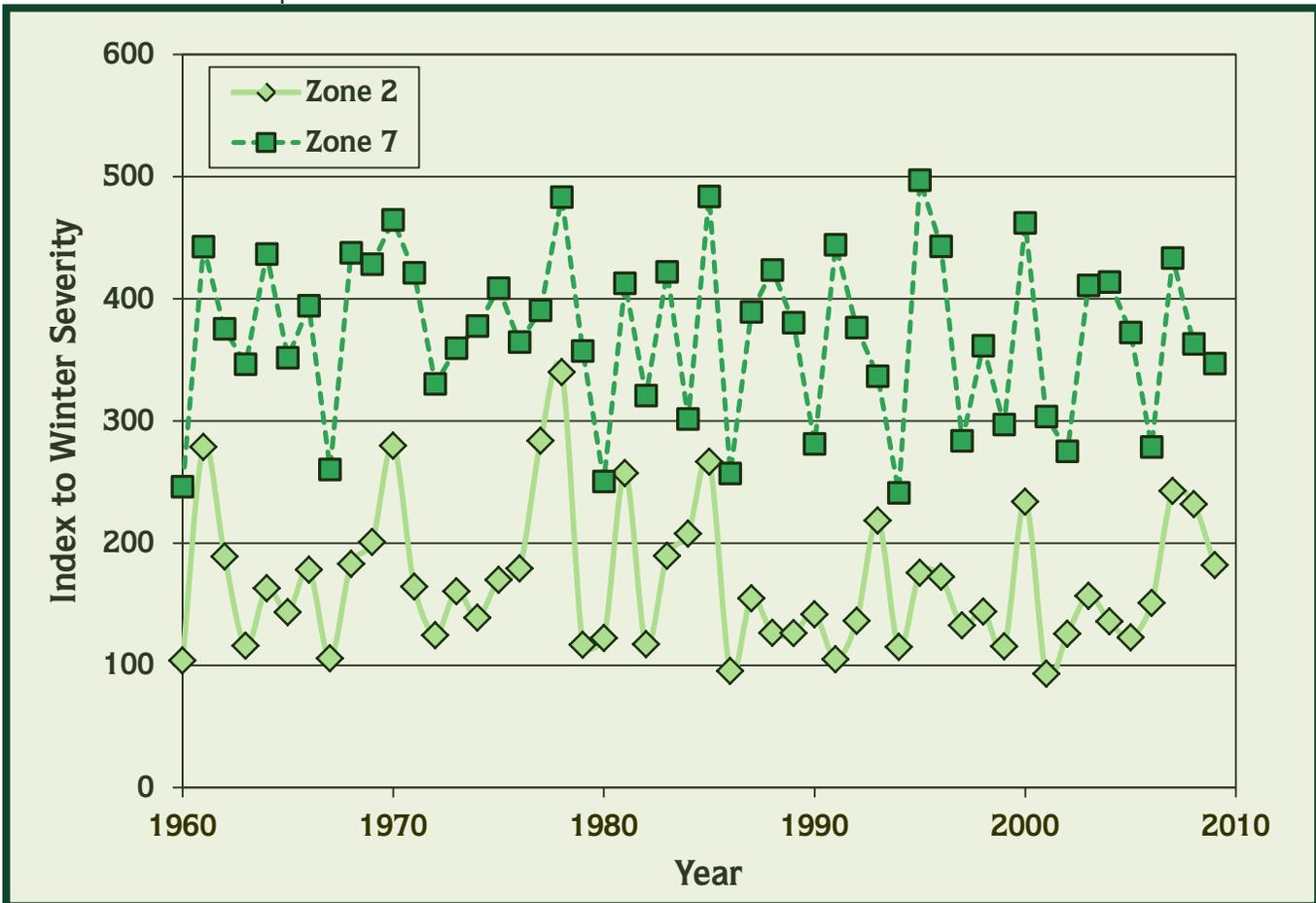


Figure 2. The winter severity index for turkeys in Turkey Management Zones 2 (southern WI) and 7 (northern WI), 1960-2010. The index incorporates documented effects of temperature and snow depth on turkey energy demands and mobility.

roosting areas. Crusted snow or ice may make travel easier for turkeys, but such snow conditions make it even more difficult to access food on the ground. Snow therefore makes it more difficult to locate food at a time when that food is most critical, and ensuring that there is adequate food (e.g., standing corn) near roost sites during winter can mitigate the impact of severe winters on turkey populations. Though severe winter weather reduced overall hen survival during a study in central Minnesota, the survival of hens that had access to standing corn was over 40% higher than that of hens in the same area for which such food sources were lacking.





Section
1

In Wisconsin, biologists have developed a winter severity index (WSI) for turkeys that incorporates the effects of both temperature and snow depth, as summarized above, using data from weather stations within each turkey management zone (TMZ). Figure 2 plots this index for TMZs 2 and 7, from 1960-2010, and makes it clear that winter weather likely has quite different effects on turkey populations in northern and southern parts of the state. A “hard” winter for turkeys in TMZ 2, for example, would be equivalent in severity to a relatively “mild” winter for turkeys in TMZ 7. Such data may facilitate greater understanding of winter impacts on Wisconsin’s wild turkey population in future years.

Disease is also recognized as a mortality factor, and various diseases are known to occur among wild turkeys. Generally, disease is not known to be a significant driver of wild turkey population dynamics at broad scales, but outbreaks of specific diseases may impact local flocks. Many diseases to which wild turkeys are susceptible may also be found in domestic poultry flocks; given the many poultry operations in existence in Wisconsin, transmission of disease from domestic poultry to wild turkeys is a possibility that requires vigilance.

Population Modeling

Estimates of reproductive output and survival for a particular turkey population can be combined into a population model that allows biologists to determine which vital rates are most important in driving population dynamics, and to predict how population growth rates would be impacted if specific vital rates were altered. For example, hen and gobbler harvest rates can be varied within the model to make predictions regarding how various harvest levels impact population growth. Such information is of obvious utility for managers responsible for establishing hunting season frameworks while maintaining abundant turkey populations.

Population models developed for turkeys in various regions have suggested that turkey populations are most sensitive to variation in poult production and hen survival. Biologists can therefore focus management activities, to the extent possible, to improve these measures. For example, ensuring adequate dispersion of secure nesting cover may help reduce nest and hen mortality in spring. Since predation and weather are largely responsible for annual variation in poult production and hen survival during spring, however, significant annual variation in these measures is likely even given adequate nesting cover. Biologists closely monitor fall hen harvests explicitly because population modeling has suggested that excessive harvests can result in population declines.

Impact of Harvest on Survival. In order to develop accurate models of turkey population dynamics, biologists need to understand how harvest impacts survival. In many wildlife populations, survival does not decline as harvest increases—at least, not to the degree expected—because the impact of other mortality sources (e.g., predation, starvation) declines as harvest-related mortality increases. Thus, harvest and natural mortality essentially balance each other out such that survival remains unchanged. This “compensatory mortality” allows sustainable, and often significant, annual harvests to occur with no impact on long-term population trends. Much of the evidence accumulated thus far, however, suggests that the harvest of both gobblers (during the spring and fall seasons) and hens (during the fall season) is additive to natural mortality, such that increasing harvest does in fact lead to reduced survival rates. Based on this, population models developed for wild turkeys have generally assumed that harvest





Section 1



Ecology of Wild Turkeys in Wisconsin

is additive to other sources of mortality, and leads to reduced survival. This again suggests that fall hen harvest must be controlled to ensure that sufficient females survive to reproduce the following spring.

Density-dependence. Although research has revealed clear links between annual variation in numerous vital rates and specific weather conditions, population growth rate also increasingly appears to be influenced by the size (or density) of a wild turkey population itself. This phenomenon, known as “density-dependence,” has been described for many wildlife populations. Density-dependence is an interesting process that acts to reduce survival and/or reproduction as population size increases, generally because resources (e.g., food) become more limited as the number of individuals in the population (density) increases. Indeed, it is this process that causes wildlife populations to remain fairly stable (near carrying capacity) through time. When populations are above carrying capacity, low survival and/or reproduction push numbers downward; when populations are below carrying capacity, on the other hand, survival and/or reproduction tend to be high enough to allow numbers to increase. This process may be responsible for the apparent overshoot and stabilization of permit success rates within individual TMZs referred to earlier, and apparent in Figure 7 (page 35).

Turkey populations ebb and flow through time, in response to both external (e.g., weather, predation) and internal (density-dependence) forces. Research that further clarifies how these forces interact to nudge turkey numbers upward or downward from one year to the next will greatly increase our ability to predict how populations would respond to variable levels of harvest.

Ecology and Dynamics of Wild Turkeys in Wisconsin

Three large-scale research projects have taken place in Wisconsin since the reintroduction of turkeys began in the 1970s. Each of these projects had a specific focus, and provided valuable information regarding wild turkey ecology in Wisconsin that has translated into improved management. All research to date has been conducted in the southwestern and west-central portions of the state (primarily TMZ 1).

The Vernon County Study (1987–1994)

This large-scale endeavor utilized radio-telemetry to examine hen productivity and survival, gobbler survival, and turkey population dynamics in Vernon County.

Hen and Gobbler Survival. Annual survival for both adult and juvenile hens averaged 53%, but varied from 43% to 63% for 224 hens monitored during the study. Survival varied seasonally, with higher mortality occurring during the reproductive period (March-July). Predators accounted for 70% of mortalities for which the mortality agent could be identified, with fox and coyotes responsible for at least 78 of 94 mortalities. Two hens were killed on roosts by great horned owls. Starvation of hens only occurred in the relatively harsh winter of 1990-91, and was responsible for the deaths of eight adult and two juvenile hens. These birds roosted in areas where the local food supply was exhausted or covered by snow, and powdery snow cover limited their ability to move in search of alternative food. Legal harvest of bearded hens and illegal hen harvest during spring seasons together accounted for 4%, and legal harvest during the fall season 8%, of overall hen mortality.



Section
1

About one-half of adult and juvenile gobblers also survived from one year to the next. Of 66 radio-marked gobblers monitored, 59% were harvested during the spring hunting season. Predators, primarily coyotes, accounted for a further 27%, and three gobblers died from infections or disease during the severe winter of 1990-91.

Production. For hens alive in early April, 98% of adults and 79% of juveniles attempted to nest. However, nest survival was low, with only 14% of nests successfully hatching ≥ 1 egg. Over half (55%) of hens that lost their first nest attempted to renest, and in total 22% of hens were successful in hatching eggs in a given year. Of all nests destroyed, 92% were destroyed by mammalian predators. Nests contained an average of 11.2 eggs, with slightly fewer eggs in renests and nests of juvenile hens. Most first nests were initiated from mid- to late April and hatched in late May through June. Survival of poults averaged 47% during the first month of life.

Population Dynamics. Information on survival and production were used to develop population models that allowed biologists to 1) predict turkey population trends in Vernon County and 2) examine the impact of fall hen harvest on population trends. Primarily due to relatively poor nest and poult survival, the model predicted a local population decline between 1988 and 1994, and this prediction was supported by a reduced turkey observation rate among deer hunters during this period. Relatively poor reproduction during these years also influenced model predictions regarding the impact of fall hen harvest. Research elsewhere has suggested that fall harvests that remove $< 10\%$ of the hens will not impact turkey population trends, but models based on data collected during the Vernon County study suggested that this threshold should be lowered to 7% for Wisconsin.

The Gobbler Survival Study (2005–2007)

Increasing interest in turkey hunting as turkey populations expanded in Wisconsin throughout the 1990s and 2000s suggested to managers that better information regarding gobbler survival and abundance was needed. This project used information from 251 radio-marked male turkeys to directly estimate the gobbler survival rate, and to examine the influence of landscape composition on gobbler survival and abundance. The average annual survival rate for adult gobblers (45%) was similar to that in the Vernon County study, and mortality was again highest during the spring hunting season (60% of all mortalities). Overall survival of males from the end of one spring season to the beginning of the next was 85%. The percentage of marked males harvested during the 2005-07 spring seasons was 31.5%, 27.6%, and 18.3%, respectively, and constitutes our best estimates to date of the male harvest rate in Wisconsin.



Chris Pollentier

Though this study reported male survival rates similar to earlier work, it greatly extended our understanding of how habitat composition influences both gobbler survival and turkey abundance. Regardless of the surrounding landscape structure, gobblers tended to select areas with similar amounts of open and forested habitat. However, gobblers living in more heavily-forested landscapes had larger home ranges than did





Section 1



Ecology of Wild Turkeys in Wisconsin

gobblers in areas composed of a more even distribution of open and forested habitats, and also experienced lower survival. This interesting relationship may arise because greater movements by gobblers in heavily forested landscapes lead to greater exposure to hunters, predators, or both. The fact that turkey population dynamics are influenced by landscape-level habitat composition can both inform management decisions and increase hunter understanding of how local turkey abundance may reflect surrounding habitat conditions.

By conducting gobbler surveys in areas with variable levels of forest cover, the researchers also uncovered an important link between turkey abundance itself and the percentage of forest cover on the landscape scale. Turkeys were more numerous in landscapes with >30% but <70% forest cover, with far fewer gobblers heard during surveys in more open and in more heavily-forested landscapes. This relationship was further supported via more extensive information provided in the subsequent study on hen demographics.

The Hen Demographics Study (2008–2011)

This project again allowed the estimation of various reproductive measures for wild turkey hens in Wisconsin, solidified our perception of how turkey abundance reflects habitat composition on the landscape scale, and also provided novel insight into how habitat may lead to spatial variation in hen survival and productivity.

The nesting rate for the 129 radio-marked hens monitored during this study was lower (52%) than in other published studies, including the earlier Vernon County study, and juvenile females were less likely to nest (16%) than were adult hens (63%). Adult hens were also more successful at hatching nests (36%) than juveniles (22%), with 34%

of nests overall hatching at least one chick. Including hens that did not attempt to nest, 26% of hens successfully hatched eggs during the study. Nests initiated early in the spring were more likely to be located in forest habitat and were less likely to hatch than those initiated later in the season.

To examine the influence of landscape composition on turkey abundance, the researchers conducted 128 roadside gobbling surveys in four southwestern Wisconsin townships with varying ratios of open to forested habitat. The results, in conjunction with roadside surveys conducted during the previous gobbler study, clearly reveal a link between landscape composition and turkey abundance, with turkeys more numerous in landscapes composed of 30-70% forest cover (Figure 3). Abundance declined rapidly in both more open and more heavily forested landscapes.

Monitoring the 129 radio-marked hens also revealed interesting links between landscape composition and hen survival and productivity. Although the annual hen survival rate (51.6%) was similar to that documented during the Vernon County study, hen survival was significantly higher for hens in relatively open landscapes (67.4%) than for hens in more forested areas



Chris Pollentier





Section
1



(35.6%). Predation during the reproductive period again accounted for most (78%) hen mortality. Legal fall harvest accounted for only three of 72 (4%) documented mortalities. Although nest survival was similar between open and forested landscapes, poult survival to four weeks of age was higher in relatively open landscapes (35%) than in those with more forest cover (24%).

In summary, the Wisconsin research has provided estimates of critical wild turkey vital rates, allowed modeling of population dynamics and the impact of fall hen harvest, and illuminated interactions between habitat composition and population dynamics. Given the varied landscapes occupied by turkeys in Wisconsin, this information allows more informed discussions regarding both regional habitat management goals and hunting season frameworks. Further research and modeling efforts will be important in better understanding how the abundance and distribution of forest cover impacts turkey dynamics in both heavily (TMZs 6 and 7) and lightly (TMZ 2) forested regions of the state.

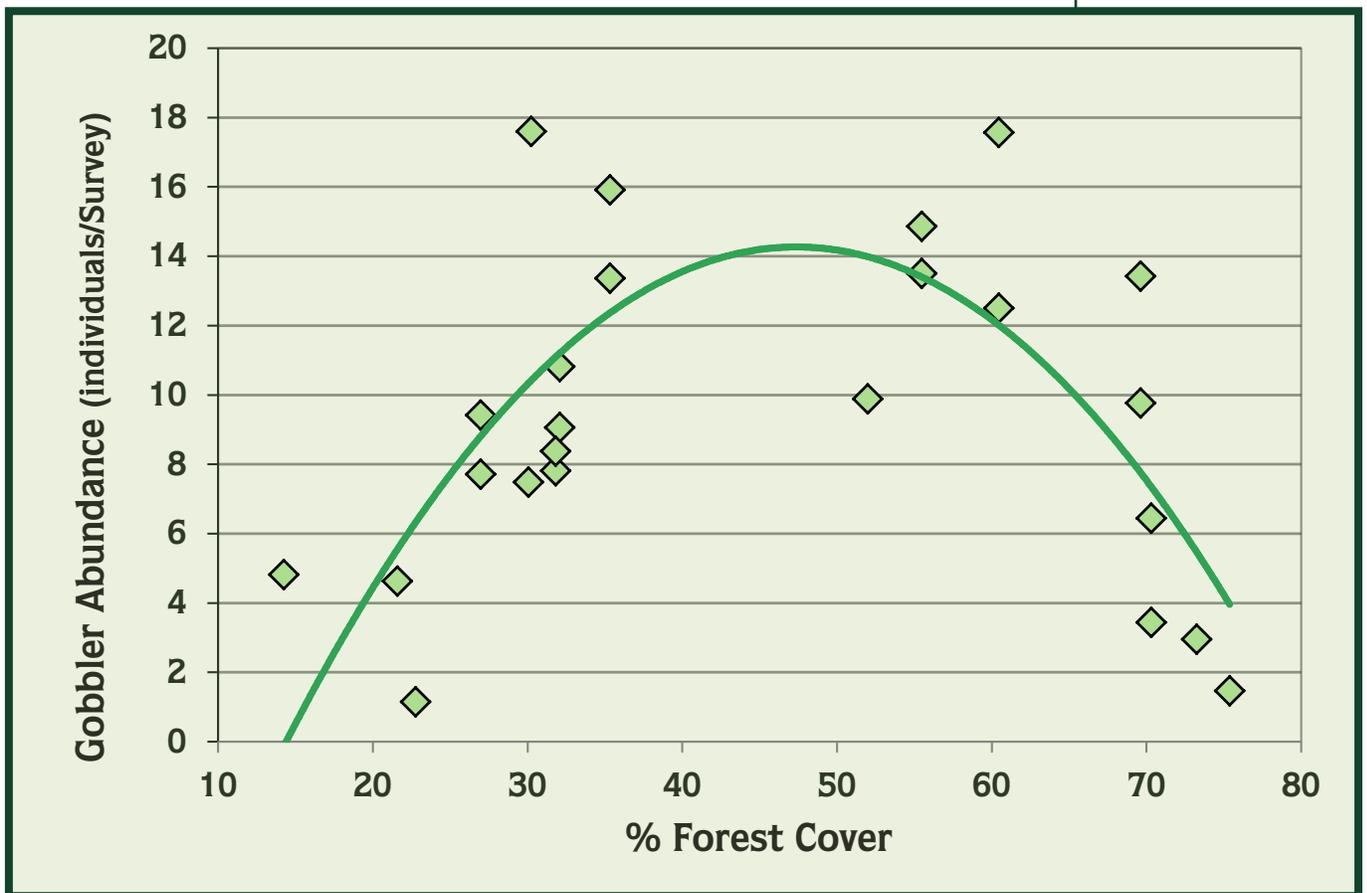
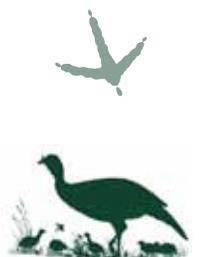


Figure 3. The influence of landscape composition on turkey abundance, using data from gobbling surveys conducted from 2004-2008 and 2010-2011. Note that abundance is highest when forests cover 30-70% of the landscape, and lower in more open and heavily-forested landscapes.





Section 1

Box 2

PERCEPTIONS OF TURKEY ABUNDANCE

Turkey hunters all enter the spring or fall woods with expectations that they will see or hear turkeys and perhaps harvest a bird, and the number of turkeys that hunters encounter during their time afield frames their perception of turkey abundance on the landscape. Certainly, their success at locating birds is influenced by annual changes in turkey abundance itself. However, many other factors influence turkey behavior, the distribution of birds on the landscape, and hence the number of birds encountered. Understanding these factors can help explain why hunters may have very different perceptions of turkey abundance—even within the same local area.

! **The distribution of turkeys varies throughout the year.** Flock formation results in a very uneven distribution of turkeys on the landscape during the fall and winter months, when nearly all turkeys within an area may belong to one of a few large flocks. A hunter who locates such a flock in December may find few turkeys in that immediate vicinity following flock break-up the next spring, however, as the turkeys have dispersed to surrounding breeding areas.

! **Turkeys prefer some habitats or landscapes over others.** Turkeys, and other wildlife, are very adept at selecting areas that provide needed resources and afford the greatest chance of survival; this selection for specific habitats or landscapes over others can lead to a very uneven distribution of turkeys. Generally, research suggests that turkey abundance is greatest in areas that contain both forest cover and open areas, and lower in areas that are either too lightly (<30%) or too heavily (>70%) forested. This effect can be manifest even at fairly local scales, such that hunters on properties near one another may encounter very different numbers of turkeys.

Figure 2A shows that hens within a west-central Wisconsin township were primarily found in areas where both forest cover and open areas were available. Very few hens were located in heavily-forested areas of the township that lacked openings. Although turkeys were common in this area, individual hunters would have very different views of turkey abundance depending upon where they hunted.

! **Turkeys take advantage of shifting food resources.** Turkeys will move to and concentrate their activity in areas with relatively plentiful food resources, and abundance in any particular area will therefore change as food resources appear and disappear on the landscape. For example, oak trees tend to produce bumper crops of acorns only in some years; when they do, turkeys will spend more time feeding in the forest than in other, more open habitats where they are more visible to hunters. This can not only alter a hunter's perception of turkey abundance, but research also suggests that variable acorn production can affect the vulnerability of turkeys to harvest. In years with poor acorn crops, turkeys spend more time in open areas—often, agricultural fields—and are thus more visible and vulnerable to hunters. Harvest rates tend to be lower when good acorn crops restrict turkey activity more to woodland habitats.





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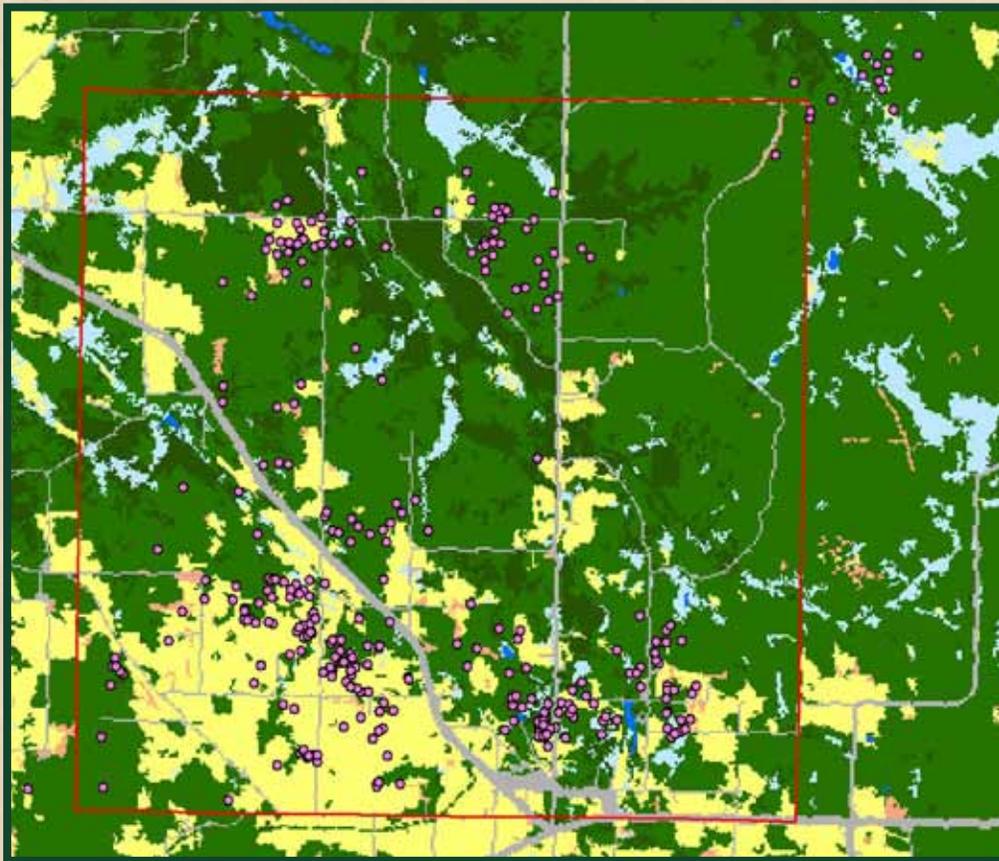


Figure 2A. Locations of all radio-marked hen turkeys on a west-central Wisconsin study area during spring and summer of 2010. Forest cover is in green, and open areas light yellow.

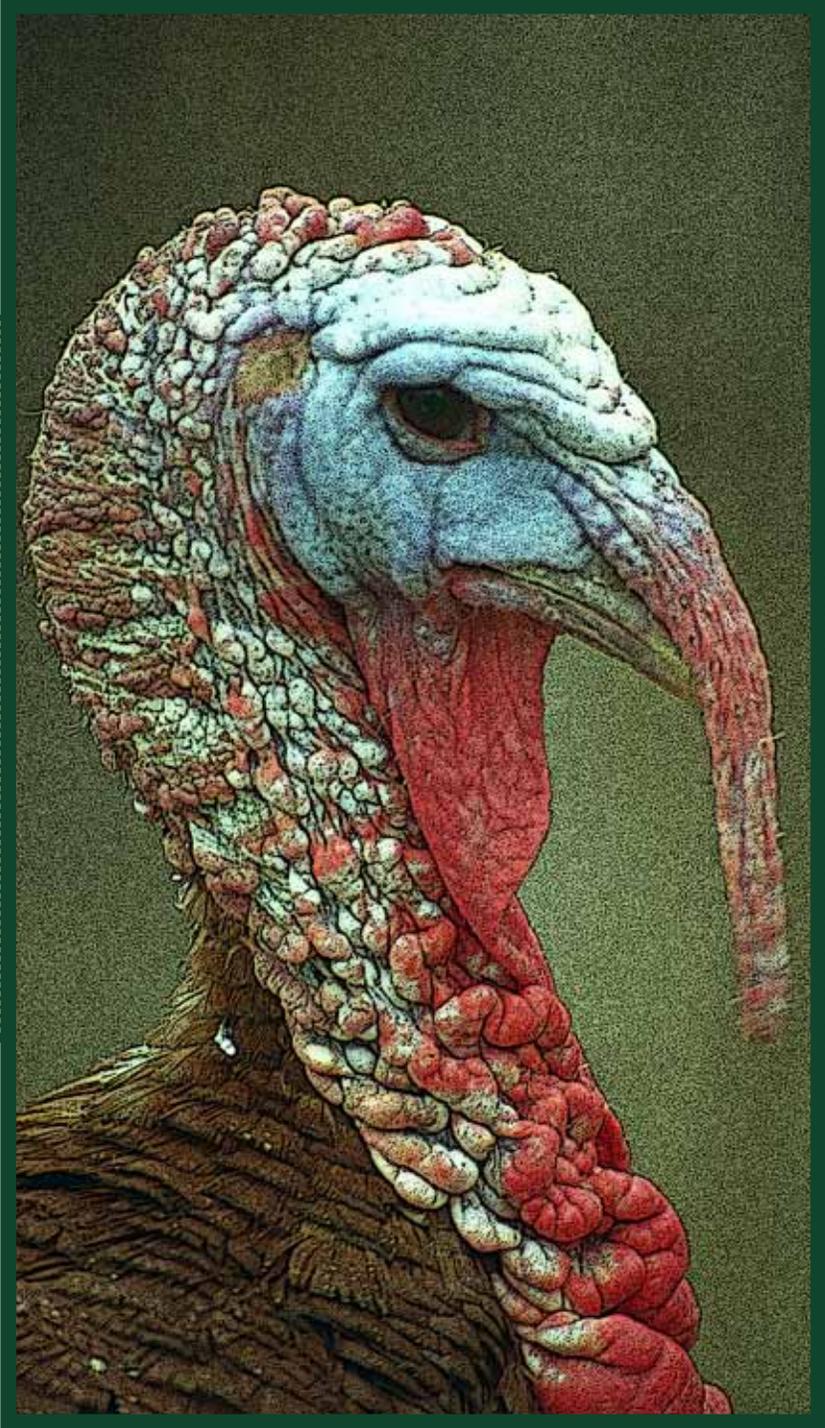


Weather conditions can alter the behavior of turkeys. Weather can alter the behavior of individual turkeys and the timing of annual life cycle events, both of which may alter hunter perceptions of turkey abundance. Wind, clouds, and precipitation may reduce gobbling activity during the spring breeding season, and hunters who encounter these conditions while afield may hear fewer gobblers and perceive there to be fewer turkeys present. Delays in the onset of spring weather may also keep turkeys concentrated in winter flocks later than normal, and during these years hunters may see or hear fewer turkeys in their hunting area because the turkeys have not dispersed from winter concentration areas and assumed normal reproductive behavior.



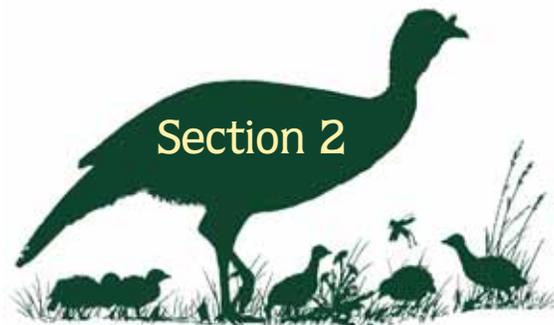
Steve Oehlenschlaeger







THE WILD TURKEY IN WISCONSIN



Section 2



Section 2

Historical Overview of Wild Turkeys in Wisconsin

Turkeys were found throughout the prairie and oak savanna habitat that typified much of southern Wisconsin prior to settlement, but some early reports suggest that, locally, turkeys were tied to areas with standing timber, which likely provided winter food and roost sites. The removal of vast areas of timber from southern Wisconsin that took place concurrent with the conversion to intensive agriculture, high harvests supported by active markets for wildlife, and the disappearance of source populations in Illinois led to turkeys becoming rare in Wisconsin by 1860. Wild turkeys were considered entirely extirpated from the state by the late 19th century, with the last known turkey being harvested near Darlington in 1881. Given the dramatic landscape changes that led to the loss of turkeys from Wisconsin and adjacent states, noted Wisconsin conservationist A.W. Schorger predicted in 1942 that “it is doubtful if a planting will ever become successful in Wisconsin.”



The British Library Collection

Indeed, the wild turkey remained largely absent from Wisconsin’s landscape for much of the next century, although numerous early restocking efforts were attempted (Box 3). It seemed that Schorger’s cynical view of the future for wild turkeys in Wisconsin was warranted, and that successful restoration of turkeys was unlikely. Biologists learned from these early efforts, however, that a successful restoration effort would require the use of truly wild birds, not the game farm or semi-domestic turkeys typical of early releases. Research into wild turkey ecology had also provided an increased understanding of turkey habitat needs. With this new information in hand in the early 1970s, Wisconsin was set to join other states on the path toward turkey restoration.

An agreement between the Wisconsin DNR and the Missouri Department of Conservation paved the way for the successful restoration of wild turkeys to Wisconsin. Missouri, with a healthy wild turkey population, was interested in bolstering their flagging ruffed grouse population via translocation. Both agencies realized that a cooperative venture, whereby Wisconsin provided ruffed grouse in exchange for wild-captured Missouri turkeys, would be mutually beneficial and help to address the conservation goals for both species. In January 1976, 29 turkeys were released in the Bad Axe River watershed in Vernon County, and over the following nine years a total of 334 Missouri wild turkeys were released at various sites in southwestern Wisconsin. Birds released were eastern wild turkeys (*Meleagris gallopavo silvestris*), the largest of the five subspecies found in North America and likely the subspecies best adapted to the climatic conditions found in Wisconsin. These wild birds also proved to possess the survival skills lacking in the pen-reared or semi-domestic birds used in previous restocking efforts and benefited from mild winter weather and good production during the early years of translocation. As a result, turkeys began to increase in number in areas near the initial release sites.

To hasten expansion, the WDNR initiated intrastate translocation efforts in 1979, moving birds from established populations in southwestern Wisconsin and releasing them at suitable sites throughout the southern two-thirds of the state. These “trap-



Box 3

EARLY RESTORATION EFFORTS IN WISCONSIN



1887: Two pairs of wild turkeys were released near Lake Koshkonong in Rock County by a private landowner. This flock increased to >200 by 1890, but was composed primarily of hybrids produced by crosses with domestic turkeys. The population disappeared by the early 1900s.

1929-1938: The State of Wisconsin released 2,942 pen-reared turkeys in Sauk and Grant Counties. This flock declined and disappeared due to many factors, including unregulated harvest, selection against adaptive traits in game farm birds, and domestication.

1954-1957: Over 700 turkeys, reared at a Pennsylvania game farm, were released on the Meadow Valley Wildlife Area and adjacent Necedah National Wildlife Refuge. Initial population growth was hindered by the severe winter of 1957-58 and an outbreak of blackhead disease, but the flock subsequently increased to a level such that a limited season for hunters on these properties was held each year from 1966-1968. A series of harsh winters reduced numbers on the area in succeeding years, however, and the season was again closed. Turkeys from Meadow Valley were transplanted to seven other counties and the Nicolet National Forest in the 1960s, but all of these releases were unsuccessful. Turkeys persisted at low numbers in the Meadow Valley/Necedah area into the 1980s.

Though the Meadow Valley/Necedah flock was the most ambitious of the early reintroduction efforts, its failure was attributed to its game farm roots and the lack of "wildness" and survival skills in these birds.



Section
2





Section 2

Ecology of Wild Turkeys in Wisconsin

and-transfer” efforts to expand the range and increase numbers of turkeys in Wisconsin were initially hindered by staff inexperience with capture techniques, relatively little staff time allocated to the project, and a reliance on internal funding mechanisms (small game and deer license revenue and federal dollars allocated through the Pittman-Robertson Federal Aid in Wildlife Restoration Act). Given these constraints, only 300 turkeys were translocated within Wisconsin during the first six years of the project.

The National Wild Turkey Federation (NWTf) provided the solution for more rapid turkey restoration efforts in Wisconsin, and across the country, through its “Target 2000” program. Via this creative approach, NWTf staff developed partnerships with many state natural resource agencies to facilitate the interstate shipment of turkeys for restoration purposes. States providing turkeys to others were reimbursed at a standard rate of \$500 per turkey. Wisconsin, with an already established and healthy turkey flock in the southwestern part of the state, was able to provide turkeys to other states that were initiating their own turkey restoration efforts. Nearly 1,400 turkeys were shipped to Michigan, Minnesota, North Carolina, Kentucky, Texas, and Louisiana over the next decade. Moreover, staff had acquired significant experience with turkey capture techniques during the initial years of our intrastate translocation program, such that the cost to capture and transport turkeys was often less than \$500/bird. Net funding received through the Target 2000 program was reinvested in Wisconsin’s turkey program by updating trapping equipment and supporting greater staff investment in the trap-and-transfer efforts.



Paul M. Walsh

The Driftless Area of southwest Wisconsin was selected as the general area for initial stocking because it possesses key habitat elements believed at the time to be critical for the establishment of a turkey population. To ensure the highest probability of successful restoration, specific release sites within this area were selected based on stringent criteria. To receive Missouri turkeys, areas were to have significant oak-hickory forest cover, south-facing slopes, and spring seeps embedded in an agricultural matrix that provided open areas for spring breeding activities and brood-rearing habitat, and waste grains as a winter food source. This strategy proved very successful, as turkey numbers continued to climb throughout the region even as turkeys were being trapped for out-of-state shipment and to support intrastate restoration efforts.

While site-specific habitat factors are important in determining the success of release efforts, on a broad scale it was believed that climate would ultimately determine the northern range limit of turkeys in Wisconsin. Wild turkeys face increased metabolic demands when temperatures drop below 11°C (52°F), and persistent deep snow inhibits their movements. As such, early release sites were confined to the southern two-thirds of the state, where 10” of snow persisted for no more than 30 days in an average winter. To the surprise of many, however, wild turkeys proved much better able to tolerate the habitat and climatic conditions typical of more northerly portions of the state. The successful establishment of turkeys at sites along this snow band eventually led to releases in more northerly counties. In total, at least 3,843 turkeys were captured, translocated, and released at 183 sites across Wisconsin (Figure 4).





Section
2

Currently, wild turkeys are found in all Wisconsin counties, and both spring and fall seasons are open statewide. The restoration of wild turkeys therefore stands as one of the greatest success stories in the history of wildlife management in Wisconsin. From complete absence to a healthy statewide population in 30 years, wild turkey restoration efforts in the state provide a classic example of how effectively wildlife research and management efforts can mesh, but also reveal how partnerships among dedicated conservation organizations can lead to landscape-level benefits to our wildlife community and the human users that enjoy it.



Figure 4. Wild turkey release sites in Wisconsin, 1976-2006. Counties that received shipments of Missouri turkeys are shaded, and the initial 1976 release site in Vernon County is denoted with a star.





Section 2

Harvest Management

Season Structure

Managing wildlife populations that are subject to harvest entails applying knowledge with two goals in mind:

- ↳ To reduce the risk of overharvest and maintain healthy game populations, and
- ↳ To maximize quality recreational opportunities for hunters.

Thus, there are both ecological and social issues at work in population management. Managers must incorporate both knowledge of population dynamics relevant to the species being harvested, and also the values, opinions, and preferences of the hunting community with respect to the design of hunting seasons. The wild turkey management program in Wisconsin has relied heavily on both sources of information throughout the evolution of our current spring and fall turkey season frameworks. Information derived from turkey harvest data and dedicated research projects has shed valuable light on turkey ecology and population dynamics. As well, managers have been able to effectively gauge hunter sentiment regarding season structure through open communication with partner groups, such as the Wisconsin Chapter of NWTf, Wisconsin Conservation Congress, Wisconsin Wildlife Federation, and others. Seasons have changed appreciably over the years, often in response to hunter input, and managers have implemented such changes only after carefully reviewing potential impacts on turkey populations and future hunting opportunity. This management strategy has proven successful, as turkey harvests remain high and >80% of both spring and fall turkey hunters surveyed suggest they are satisfied or highly satisfied with current season frameworks.



Bruce MacQueen





Section
2



Box 4

HUNTING *MIZISE*

In northern Wisconsin, turkeys are also harvested by members of various Ojibwe tribes which reserved certain use rights (including harvest) when they ceded the lands they were occupying to the United States. All of Turkey Management Zones 6 and 7, and portions of TMZs 3, 4, and 5 consist of lands originally ceded in the treaties of 1837 and 1842 (Figure 4A).

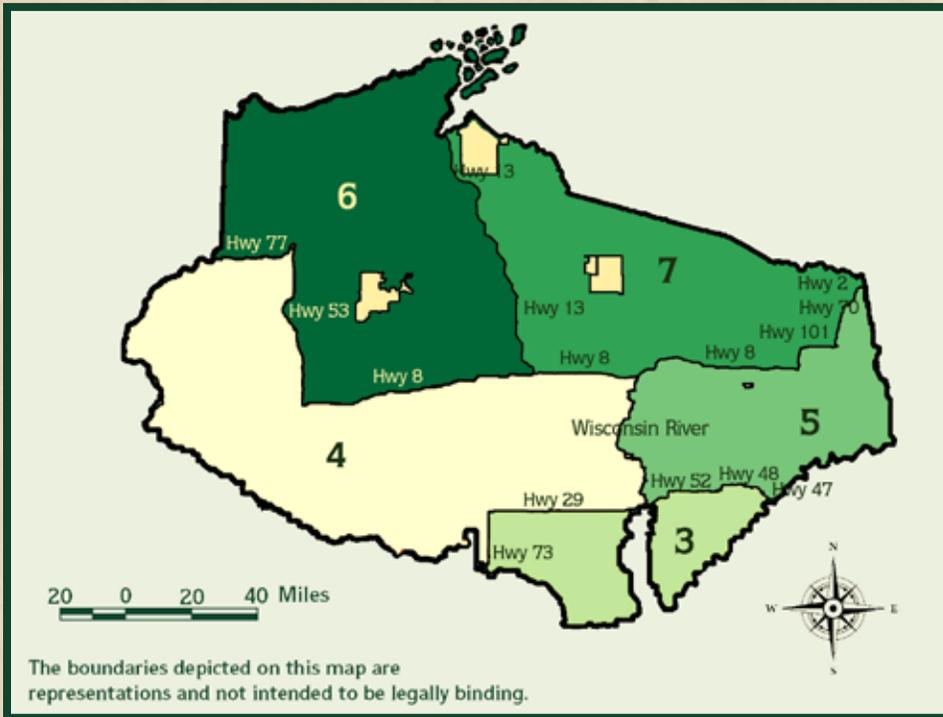


Figure 4A. Tribal off-reservation, ceded territory Turkey Management Zones.

Each tribe with off-reservation harvesting rights regulates the take of *mizise* (turkey) by its members. As with other harvested species, take is coordinated between the tribes for on-reservation harvesting, and between the tribes and the state within the ceded territory, to ensure that total harvest is limited to biologically appropriate levels. To date, harvest of *mizise* by tribal members has been minimal, remaining under 60 turkeys per year, and the state has not needed to adjust its own permit levels to accommodate tribal harvest.

The Department recognizes sovereignty rights and authority in turkey management and acknowledges that this plan in no way intends or should be construed to modify, alter, abridge, or in any way affect treaty-reserved rights as they have been established by the law, court decisions, and stipulations. The Department will implement its authority and jurisdiction claims consistent with this plan in a way that does not infringe upon the established rights and responsibilities of tribal entities.





Section 2

Ecology of Wild Turkeys in Wisconsin

Turkey Management Zones

As turkeys expanded their range across Wisconsin, Turkey Management Zones (TMZs) were established so that harvest could be regulated in accordance with turkey population status and habitat suitability in specific areas (Figure 5). The first modern spring wild turkey season was held in 1983 in four southwestern Wisconsin zones, and by 2006 turkey hunting was available statewide. Forty-six individual TMZs were eventually created, along with 17 state park units and a federally-managed season at Fort McCoy. The numerous zones allowed managers a fine-grained approach to harvest management and also early initiation of turkey hunting in areas that could support

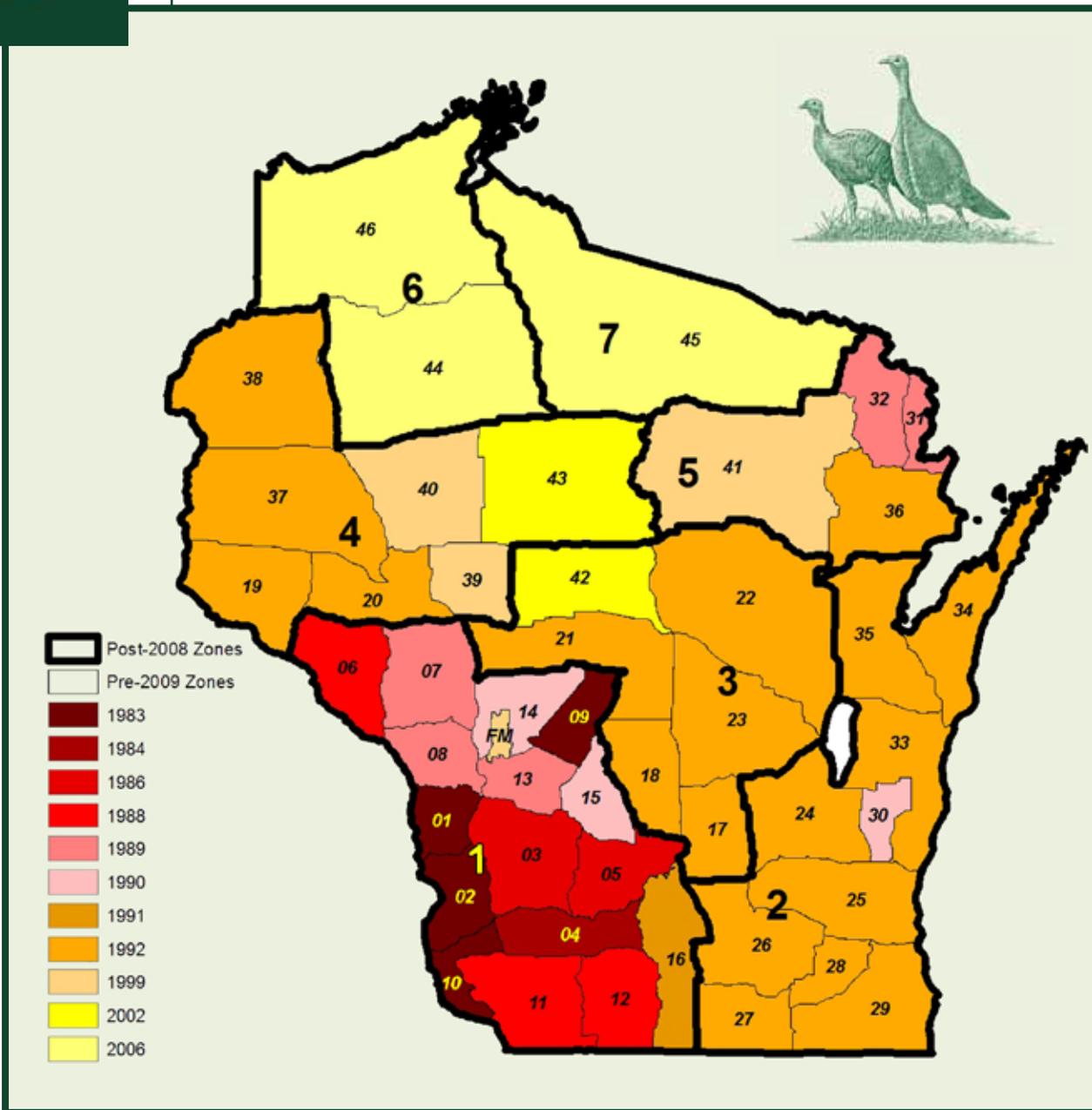


Figure 5. Current (post-2008) and past (pre-2009) turkey management zones in Wisconsin. Colors reflect the year in which the spring turkey season was initiated in each former zone.



harvest. As permits were issued by zone, however, the smaller zones limited hunter ability to explore and hunt new locations.

As turkey populations became well-established across the state, hunters expressed interest in greater flexibility with respect to hunting location, and managers realized that turkey habitat quality was similar on a scale greater than that captured by the current 46-zone system. As a result, the 46 zones were consolidated into seven larger TMZs in 2009. These larger zones allow hunters much greater mobility with respect to hunting location, yet still allow managers to monitor turkey populations and regulate harvest in accordance with regional assessments of turkey numbers and habitat quality.

Spring & Fall Seasons

The quality of a spring turkey hunt is, in part, determined by a hunter's ability to "work" a gobbler or gobblers free of disturbance from other hunters. Maintaining the quality of the spring turkey hunt therefore requires that managers limit the density of hunters on the landscape at any one time. Biologists responsible for developing the first spring wild turkey season framework in Wisconsin therefore used a limited allocation of permits and separate zones to spread hunters out on the landscape, and separate time periods to spread them out temporally within seasons. Though hunting opportunities and seasons have changed over the years, these strategies still form the basis of our spring season framework and have been well-supported by hunters, who understand the link between hunter density and hunt quality.

The first modern spring turkey season in Wisconsin took place in 1983, and included three separate five-day time periods, with the first time period commencing on the Wednesday nearest April 13th. Over the ensuing quarter century, turkeys and turkey hunting expanded across the state, three additional time periods were added, and the time periods were lengthened to seven days (Table 1, next page). The first statewide spring season took place in 2006.

Either-sex fall hunting seasons have the potential to impact turkey population size, if hen harvest is excessive. Hence, the initial fall seasons were also designed to result in a conservative harvest. The first fall turkey season was held in 1989, with three five-day time periods (Wednesday-Sunday) in several southwestern zones. As turkeys continued to increase in number and expand their range in Wisconsin, fall seasons were opened in new zones—generally a few years after the establishment of a spring hunt—and numerous changes have since been made to the fall season (Table 1, next page). Considering the six spring time periods and the extended fall season in TMZs 1-5, Wisconsin now offers turkey hunting opportunities for over 135 days each year!

Although the current spring season framework, with six seven-day time periods, is well-supported by hunters, modifications that expand opportunity or simplify and standardize regulations should continue to be explored. Such changes should be made, however, only with sufficient input from the hunters who would be impacted.



Section 2

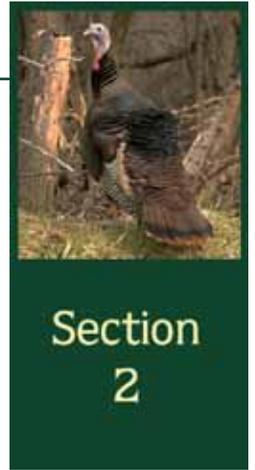


Dan Small Outdoors LLC



Table 1. Timeline for important changes to the spring and fall wild turkey hunting seasons in Wisconsin.

Year	Spring Season	Fall Season
1983	<ul style="list-style-type: none"> ↓ First spring season ↓ Three five-day (Wed.-Sun.) time periods ↓ Hunting hours end at noon daily ↓ Landowner preference established ↓ No dedicated turkey license; hunters apply for a permit with other hunting license 	
1986	<ul style="list-style-type: none"> ↓ Wild Turkey Stamp (\$11.75) first required 	
1988	<ul style="list-style-type: none"> ↓ Four five-day time periods 	
1989		<ul style="list-style-type: none"> ↓ First fall season ↓ Three five-day time periods
1990	<ul style="list-style-type: none"> ↓ Six five-day time periods ↓ Preference point system established 	
1991	<ul style="list-style-type: none"> ↓ Wild Turkey Stamp price reduced (\$5.25) 	
1992	<ul style="list-style-type: none"> ↓ Unused permits randomly issued via 2nd drawing 	
	<ul style="list-style-type: none"> ↓ First dedicated turkey hunting license issued 	
1993	<ul style="list-style-type: none"> ↓ First Fort McCoy turkey season 	
1994		<ul style="list-style-type: none"> ↓ 28-day continuous season
1999	<ul style="list-style-type: none"> ↓ Turkey hunting hours extended to 5:00 p.m. 	
2005		<ul style="list-style-type: none"> ↓ 40-day continuous season, opening the Saturday nearest Oct. 10th
2006	<ul style="list-style-type: none"> ↓ First statewide spring season (46 zones) 	
	<ul style="list-style-type: none"> ↓ Remaining permits sold over-the-counter 	
2007	<ul style="list-style-type: none"> ↓ First two-day Youth Hunt ↓ Turkey hunting hours extended to sunset 	<ul style="list-style-type: none"> ↓ 61-day continuous season, opens Saturday nearest Sept. 15th ↓ Fall turkey hunting with dogs pilot program launched in nine southwest counties
	2008	<ul style="list-style-type: none"> ↓ 46 zones consolidated into current seven-zone format ↓ First statewide fall season
2009	<ul style="list-style-type: none"> ↓ 46 zones consolidated into current seven-zone format 	<ul style="list-style-type: none"> ↓ Extended fall season trial in TMZs 1-5
2010	<ul style="list-style-type: none"> ↓ Mentored hunting program begins 	<ul style="list-style-type: none"> ↓ Fall turkey hunting with dogs legal statewide
2011		<ul style="list-style-type: none"> ↓ Extended season in TMZs 1-5 made permanent ↓ Phone-in and internet registration replaces registration station system
	2012	<ul style="list-style-type: none"> ↓ Six seven-day time periods (Mondays and Tuesdays added) ↓ Phone-in and internet registration replaces registration station system



Harvest

Mandatory registration has allowed estimation of statewide turkey harvest for each spring and fall season, as well as within each TMZ and during each spring time period. Since the number of permits issued is also known, permit success (harvest/total permits issued) can also be calculated for each zone and time period. Although both total harvest and permit success in any one year, TMZ, or time period are likely influenced by other factors (e.g., weather), managers have used both of these metrics as a means of tracking population size. Since harvest will be strongly influenced by the number of permits available, permit success rates may provide a better index to population size.

During the inaugural spring season in 1983, 182 turkeys were harvested by 1,200 hunters in four southwestern zones, for a permit success rate of 15%. Statewide harvest increased rapidly over the following quarter century as turkeys expanded their

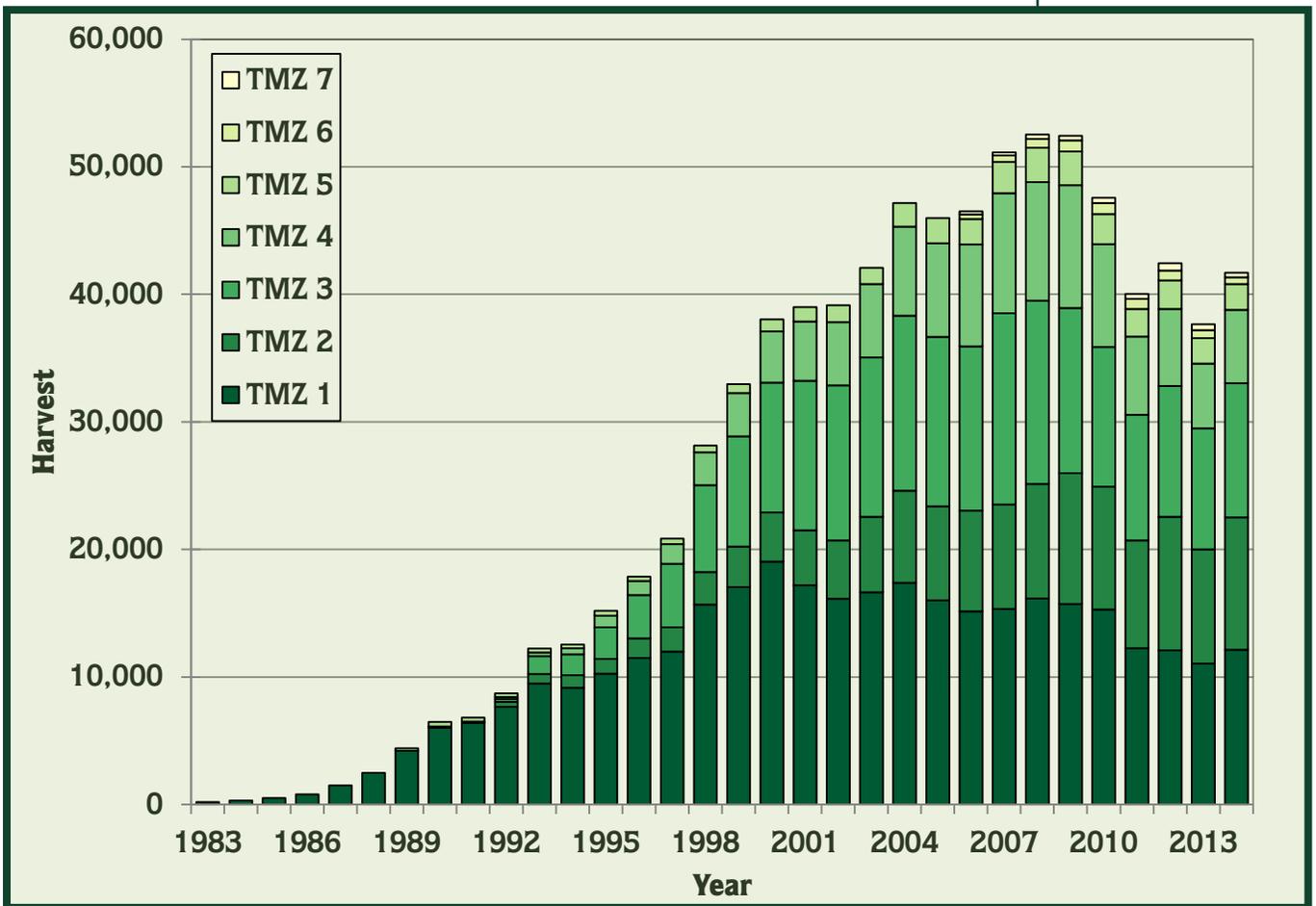


Figure 6. Wisconsin spring wild turkey harvest by TMZ, 1983-2014.

range and new zones were opened to turkey hunting (Figure 6). Spring harvest peaked at 52,880 turkeys in 2008, and has since declined slightly, with between 37,643 and 42,441 birds registered between 2011 and 2013. Such trends reflect patterns in both hunter effort and turkey abundance; the recent decline may reflect stabilization of turkey populations around carrying capacity, as discussed on page 8.





Section 2



Ecology of Wild Turkeys in Wisconsin

Permit success (the percentage of permits issued that result in a harvested turkey) has shown significant annual variation, with statewide success varying from 15%-29%. In general, success increased throughout the 1990s, coincident with an increasing and expanding turkey population, leveled out from 2000-2008, declined through 2011 as severe winters and wet springs may have impacted turkey numbers, and increased somewhat in 2012. Variation in success among zones is also evident, and has been fairly consistent in recent years, with hunters in TMZ 2 having relatively higher success, and hunters in the northern zones (TMZs 6 and 7) relatively lower success (Figure 7). Estimates of permit success rate are not corrected for participation, but hunter surveys suggest that participation rates are fairly consistent from year to year.

Trends in harvest and permit success within spring seasons are fairly consistent among years, with harvest declining throughout the spring season. Permit success also declines from time period A through time period C, and stabilizes at a relatively low level for the latter three time periods (Figure 8). These trends probably reflect changes in turkey numbers and behavior throughout the hunting season, as well as changes in hunter effort. Weather conditions during the spring season can also influence both turkey and hunter behavior, and hence influence the distribution of harvest. For example, relatively more turkeys were harvested during early time periods in 2012, when mild conditions prevailed, than in 2011 when the early time periods were characterized by cold, wind, rain, and snow. Relatively more turkeys were harvested during later time periods in 2011, likely due to hunters utilizing over-the-counter permits to take advantage of better hunting conditions late in the season.



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Statewide harvest during the fall season increased from the 1,570 turkeys registered during the first season in 1989 to a peak of 12,554 in 2003. Harvest remained high (>10,000) and fairly stable from 1999 through 2008, but has since tapered off significantly, dropping to only 5,433 turkeys in 2011 and 7,054 in 2012 (Figure 9). The 2011 harvest was the lowest fall harvest since 1994, when fall turkey hunting was still confined largely to the southern half of the state. The dramatic reduction in fall harvest may partially reflect a declining turkey population from 2008-2011 in some parts of the state, but declining hunter participation in the fall hunt is certainly a driving

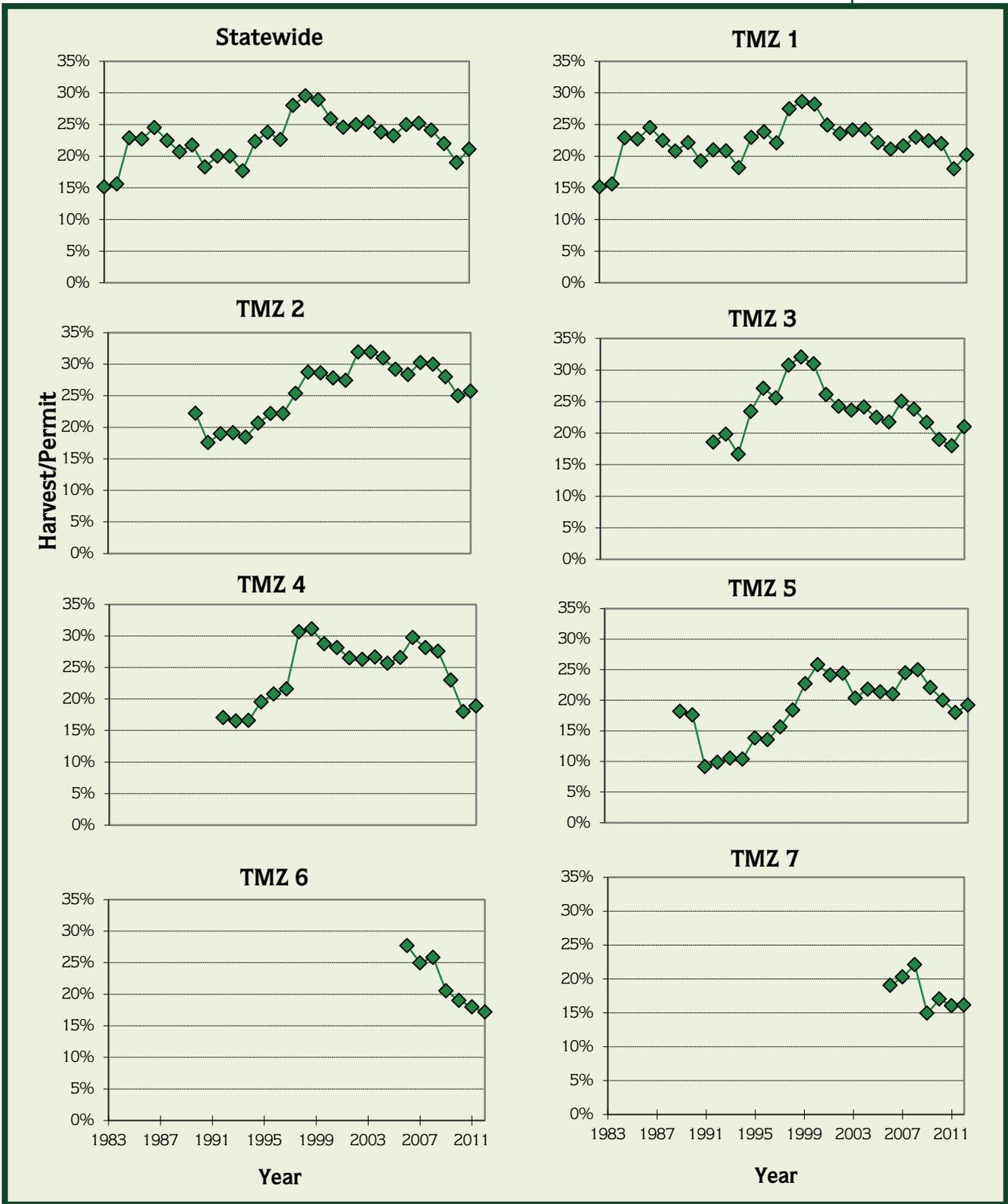


Figure 7. Permit success (turkeys harvested/permit issued) by TMZ for the spring wild turkey season, 1983-2012.





Section 2

Ecology of Wild Turkeys in Wisconsin

factor. The total number of permits issued for the fall season declined steeply over this timeframe (Figure 13); the number of permits issued in 2011 was 36% lower than the number issued as recently as 2005. As well, hunters who purchase a fall permit may be less dedicated to pursuing turkeys than during previous years. Fall Turkey Hunter Questionnaire data from 2006-2011 reveal that nearly one-third of individuals who purchase fall turkey permits do not hunt turkeys. As well, an increasing percentage of respondents suggest that they hunt turkeys only “opportunistically while pursuing other game” during the fall; this percentage increased from 10% in 2006 to 30% from 2009-2011.

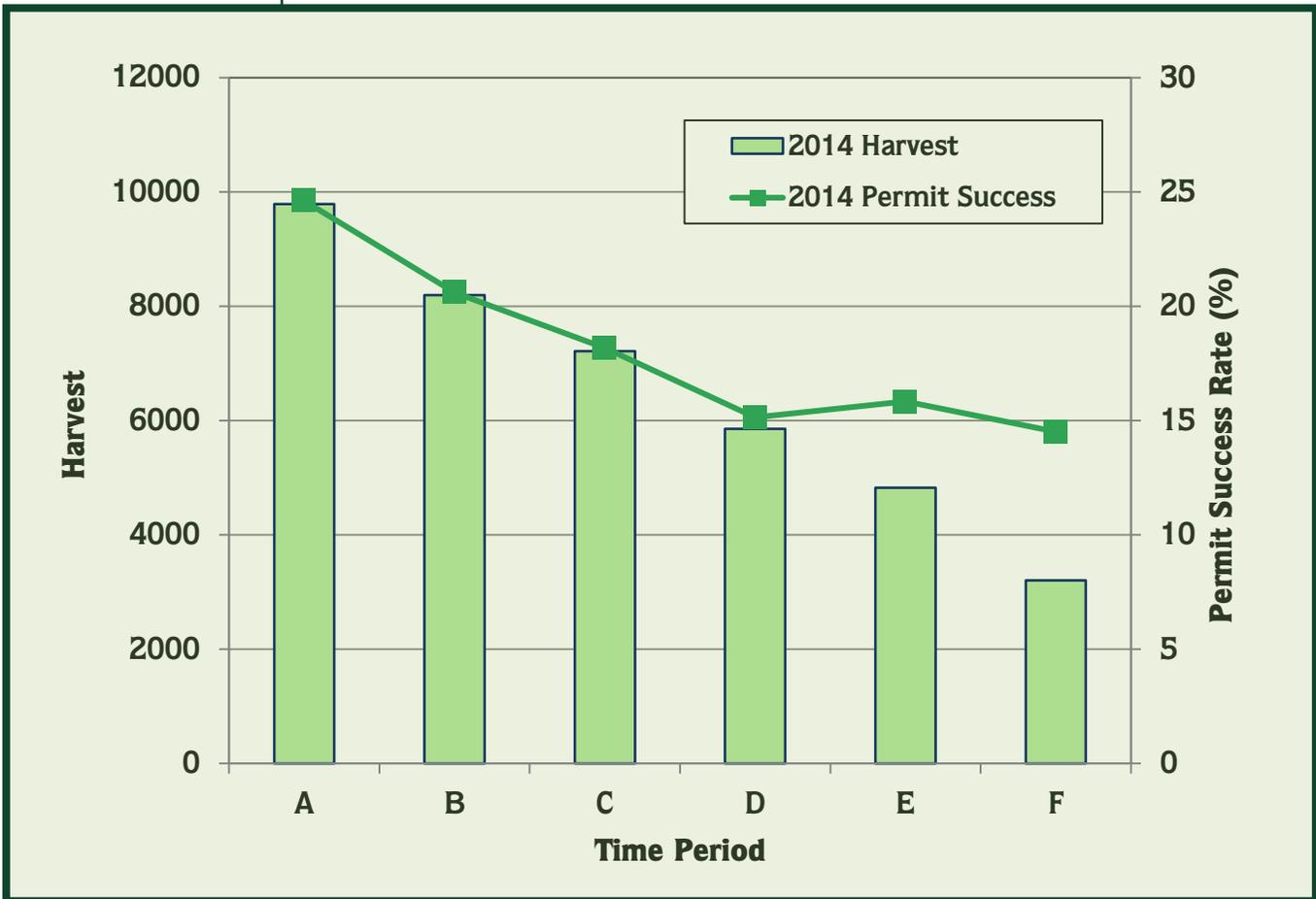
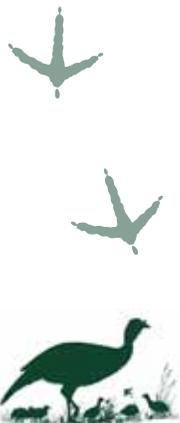


Figure 8. Statewide harvest and permit success by time period during the 2014 spring wild turkey season.



From a population perspective, the either-sex nature of Wisconsin’s fall turkey season suggests that managers must monitor hen harvest rates, and consider reducing permit levels when >10% of hens are being harvested. This number was reduced to 7% for Wisconsin, though these researchers emphasized that the threshold for allowable hen harvest varies according to levels of reproduction, and that reproduction was low during their study. Higher levels of reproduction allow higher sustainable levels of fall hen harvest. Hen harvest rates of 7% (1988-1994) and 4% (2010-2011) have been documented using radio telemetry in southwestern Wisconsin.



Section
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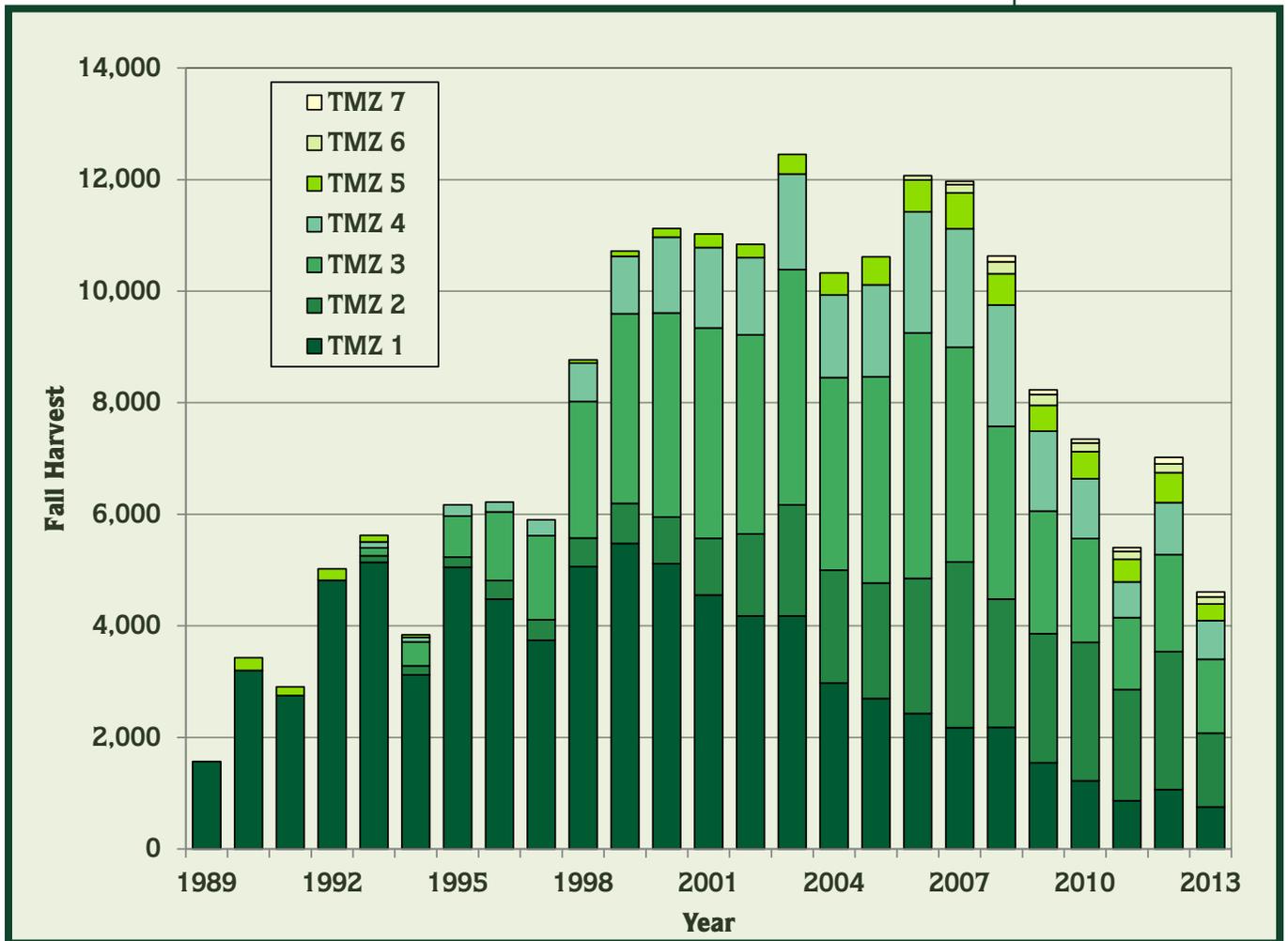
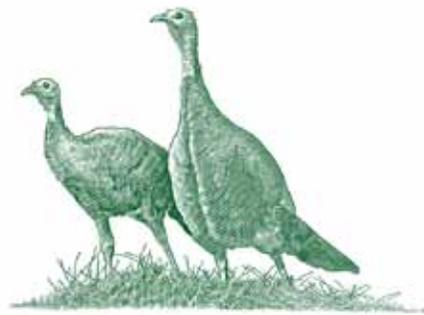


Figure 9. Wisconsin fall wild turkey harvest by TMZ, 1989-2012.





Section 2



Ecology of Wild Turkeys in Wisconsin

In Wisconsin, we are unable to directly measure hen harvest rate (the percentage of hens alive at the beginning of the fall hunting season that are harvested) because we do not estimate population size, and so do not know how many hens are present on the landscape. However, mandatory registration provides us an accurate estimate of hen harvest, and this can be depicted as hens harvested per square mile of turkey habitat (forest cover). This technique provides a means of interpreting fall hen harvest on the landscape within each TMZ. Recent fall hen harvests have been low. For example, 4,162 and 2,908 hens were harvested statewide during the fall season in 2010 and 2011, respectively (Table 2). Assuming the last turkey population estimate of 350,000 turkeys and an equal sex ratio, these would translate into hen harvest rates of 2.4% and 1.7%, both far below levels where impacts on turkey numbers might be predicted. Harvests within individual zones also appear to be low when expressed as hens harvested/mi² of timber. In the northern TMZs (5, 6, and 7), a single hen was harvested for every 16-100 square miles of timber during these years.

	Year	TMZ 1	TMZ 2	TMZ 3	TMZ 4	TMZ 5	TMZ 6	TMZ 7
Hen Harvest	2010	742	1313	1123	610	251	88	35
	2011	495	989	719	378	210	71	33
Harvest/mi ²	2010	0.17	0.97	0.38	0.14	0.07	0.02	0.01
	2011	0.11	0.73	0.24	0.09	0.06	0.02	0.01

Table 2. Total fall hen harvest and hen harvest per square mile of forest cover, by TMZ, 2010 and 2011.



In TMZs 1, 3, and 4, harvest varied between one hen per three mi² of timber to one hen per 10 mi² of timber. In TMZ 2, a single hen was harvested per 1.0 to 1.4 mi², suggesting a higher hen harvest rate than elsewhere in the state. However, the forests in TMZ 2 are very fragmented, so one hen per square mile of timber would translate into one hen per many square miles on the landscape. Given reasonable estimates of population size, recent hen harvests appear very low, and are likely well below documented thresholds where hen harvest is known to reduce population growth.

Fall permit success has exhibited significant annual variation, but no trend is apparent from 1989-1999. Since 2000, however, success during the fall season has declined steadily in all zones (Figure 10).



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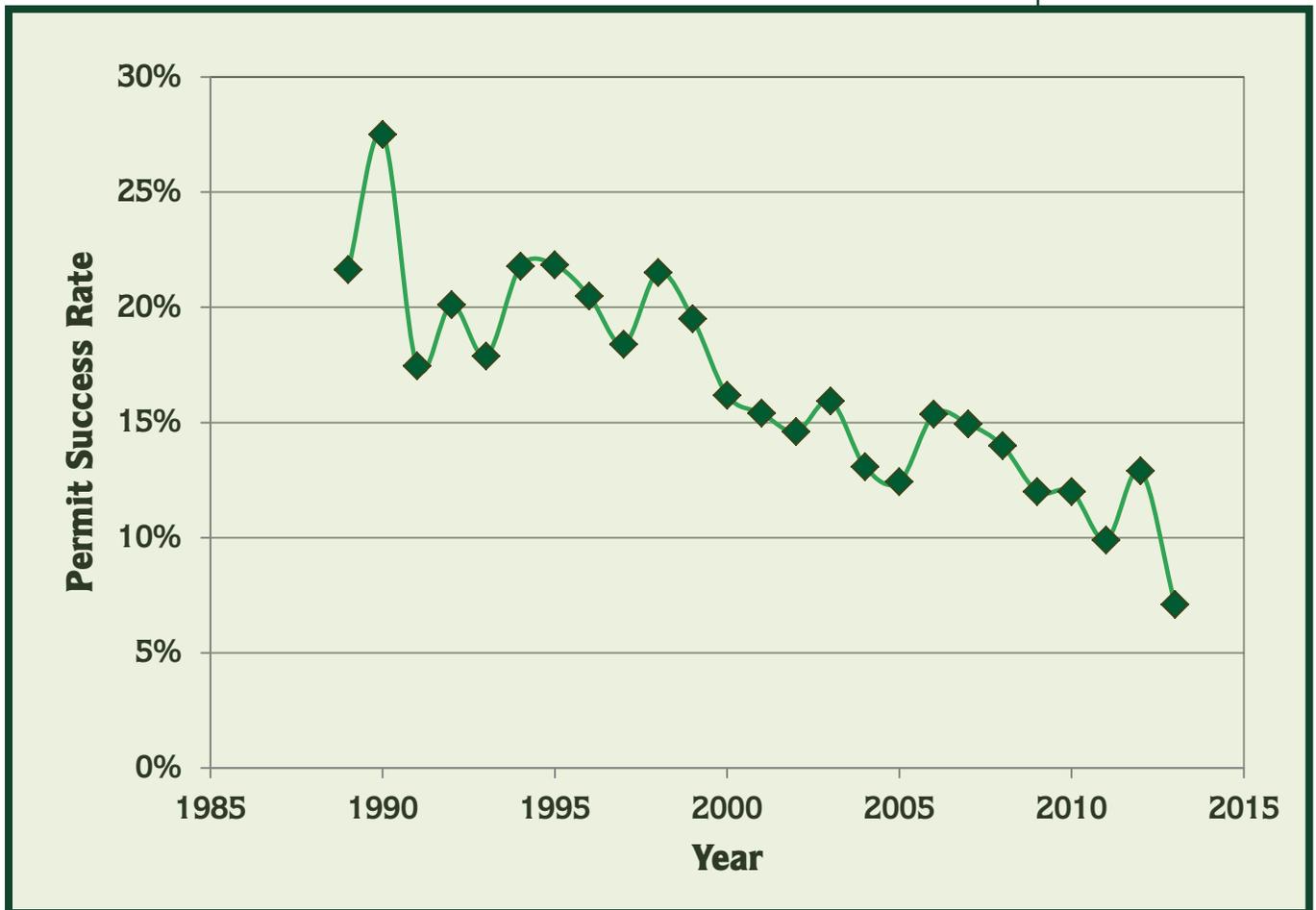
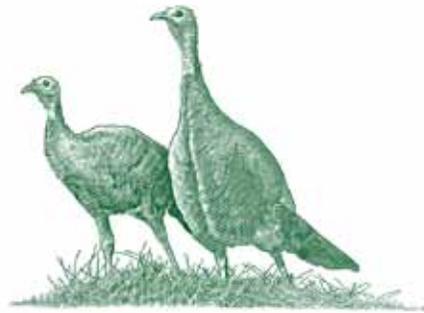


Figure 10. Permit success (the percentage of permits issued resulting in a harvested turkey) for the fall wild turkey season, 1989-2013.





Section 2

Ecology of Wild Turkeys in Wisconsin

Permit Levels

The rapid increase in wild turkeys throughout Wisconsin has likely only been outpaced by the concurrent rise in enthusiasm for turkey hunting. Starting from a limited permit drawing in a few select southwest Wisconsin zones in 1983, Wisconsin now offers statewide spring turkey hunting opportunities to >130,000 hunters, and fall hunting to >40,000, each year. Statewide, the number of permits issued increased rapidly through 2009, and has declined slightly since (Figure 11).

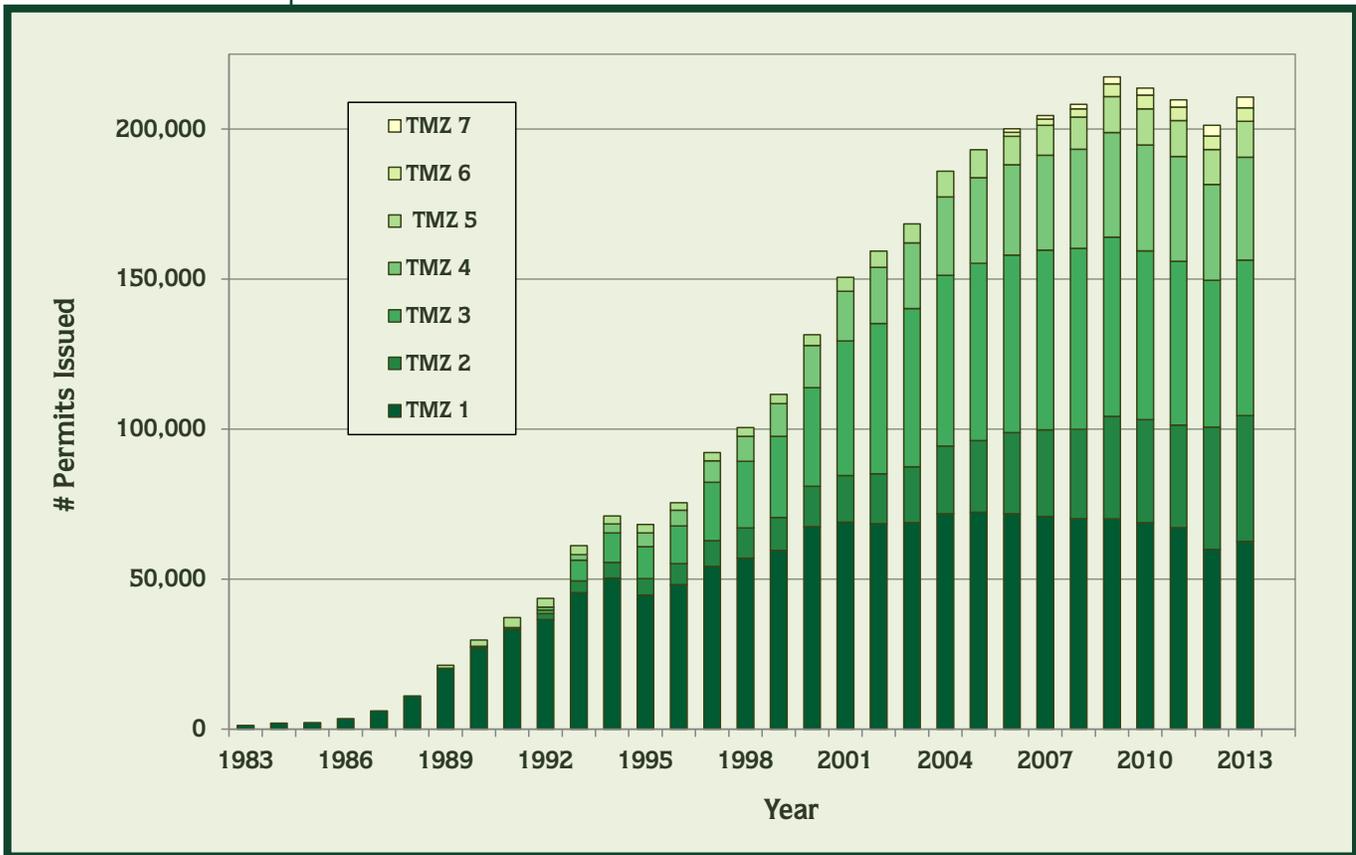
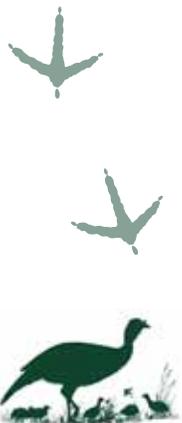
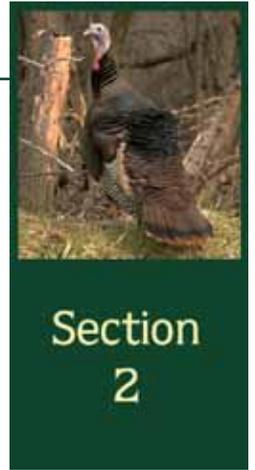


Figure 11. The number of permits issued, by zone, during Wisconsin's spring turkey season, 1983-2013.





Within zones, participation during the spring season was initially limited by permit availability, with some hunters not drawing permits in the early years following zone establishment. As turkeys increased within each zone, permit levels and resulting hunter participation increased, to the point that permit levels exceeded the number of applicants and surplus permits were available. Over-the-counter (OTC) permits were available for all zones in 2013, although only for latter time periods (due to strong hunter preference for early time periods; Figure 12). All hunters thus have the opportunity to hunt turkeys in their desired zone, although some hunters may not receive a permit for a desired early time period—especially in zones (such as 2, 6, and 7) with relatively high demand for permits. Following the spring 2013 season, TMZs 1, 3, and 4 had unused permits remaining, suggesting that participation may be satiated in these zones. Remaining zones were fully subscribed through a combination of permits allocated via the drawing and sold OTC.

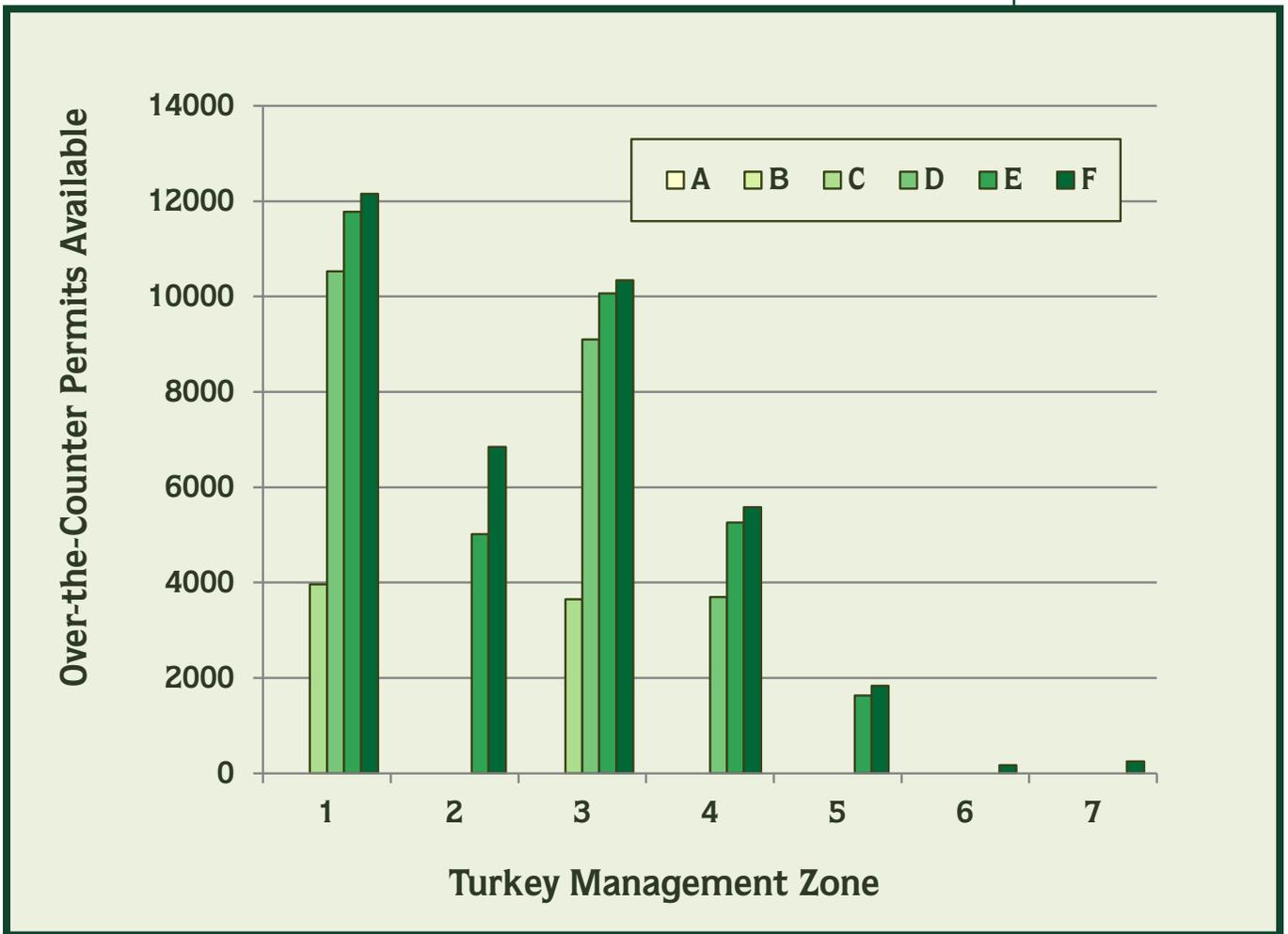
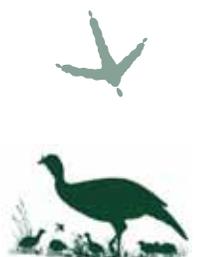


Figure 12. The number of OTC permits remaining after the drawing, spring 2014 season, for time periods A through F.





Section 2

Ecology of Wild Turkeys in Wisconsin

Participation in the fall turkey season also increased rapidly as turkeys expanded and more zones were opened to fall hunting. Following the issuance of 7,260 permits during the initial fall season in 1989, participation increased to the point that 85,678 permits were issued in 2005. Since that point, however, participation has fallen sharply, even though two new zones (6 and 7) were opened to fall hunting in 2006 (Figure 13). Permit issuance fell 36% from 2005 levels by 2011, when hunters purchased only 54,949 permits. The decline in participation in the fall hunt has been most marked in

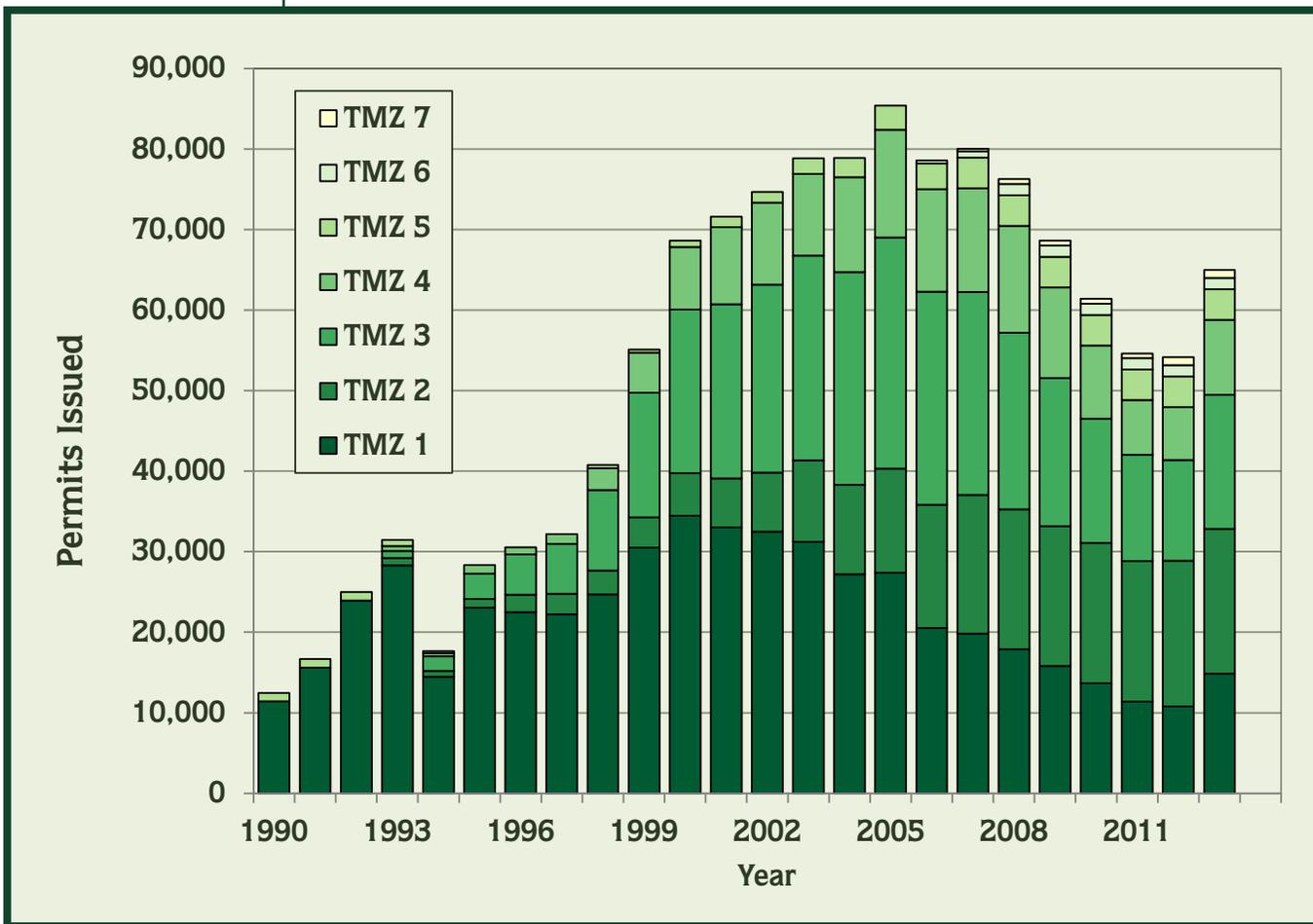
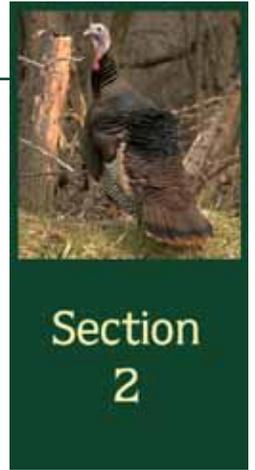


Figure 13. The number of permits issued, by zone, during Wisconsin's fall turkey season, 1989-2013.





TMZs 1,3, and 4, where less than half as many fall permits have been sold in recent years relative to historic numbers. The number of permits issued in TMZs 2, 5, 6, and 7 is stable and these zones were fully subscribed for the fall 2012 season. Over-the-counter permits were available in TMZs 1-5 for the 2012 fall hunt, whereas all permits available in TMZs 6 and 7 were issued via the drawing (Figure 14).

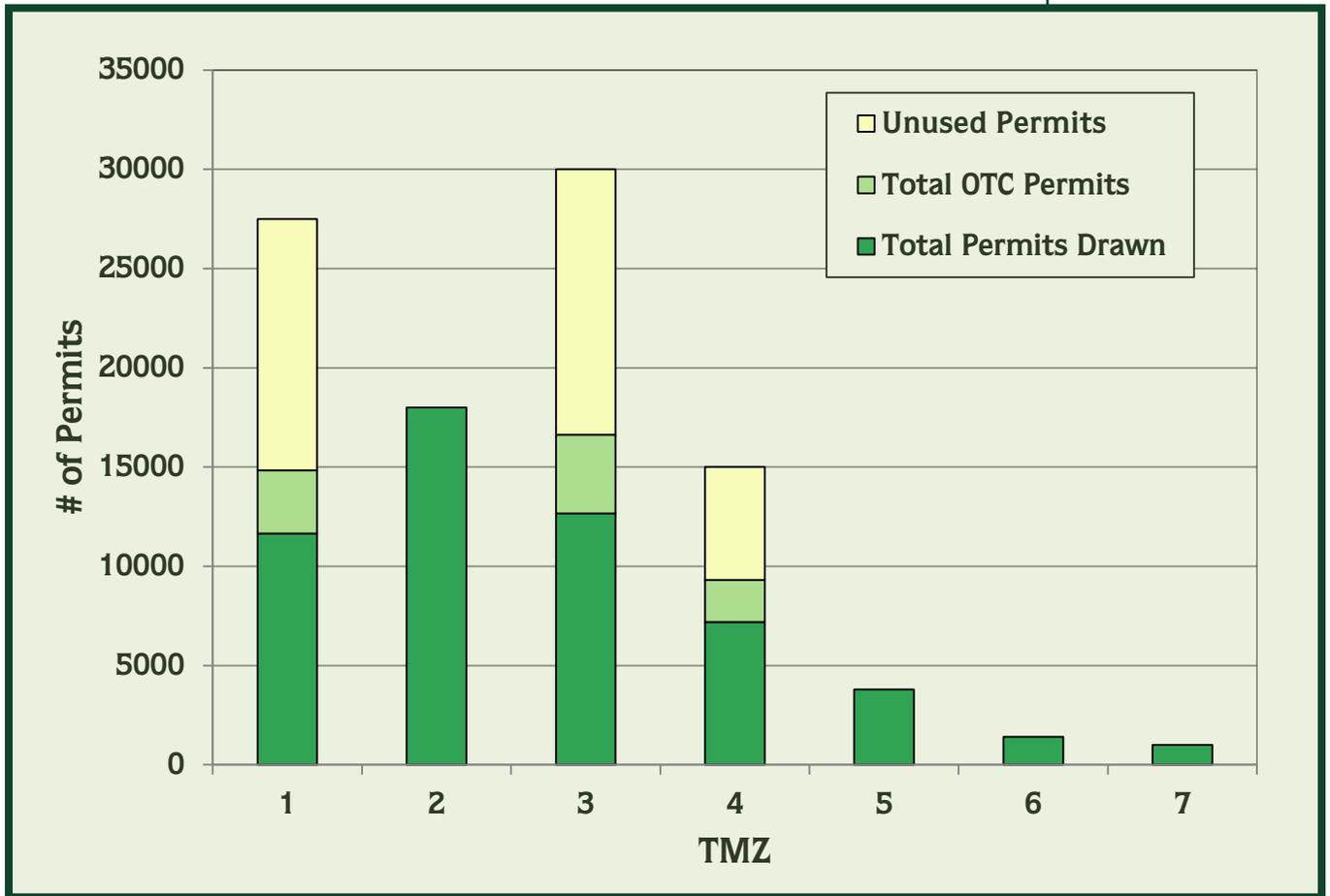


Figure 14. The number of permits issued through the drawing and over-the-counter, and the number of unused permits, for the fall 2013 turkey season.





Section 2

Box 5

PERMIT ALLOCATION PROCESS

Controlling the number of permits available within each TMZ and spring time period helps to mitigate the potential impact of harvest on turkey populations and maintain hunt quality by limiting the density of hunters afield at any given time. The random nature of the permit allocation process ensures that each hunter has a fair chance of receiving a permit for his or her preferred TMZ and time period, given established preference categories.

Establishing Permit Levels

The number of permits available for each TMZ and spring time period is set by the WDNR Turkey Advisory Committee and the Wildlife Policy Team. This group meets twice per year in order to decide upon prudent permit levels for the subsequent spring or fall hunting season. The committee reviews trends in harvest and permit success rates for each TMZ, in conjunction with indices to brood production, hunter densities, and information from local field staff, partners, and hunters when setting permit levels. For the spring season, the total number of permits available for each zone is equally distributed among the six time periods.

Spring Season

Hunters must apply for their permit by the December 10th deadline to be considered in the permit drawing. As part of the application, hunters select and rank a series of preferred zones and time periods for which they would like to receive a permit. Once all valid applications have been collected, each hunter is assigned a unique, random number (their "rank"). Hunters enter the drawing based on three distinct criteria: the preference category to which they belong, the number of preference points they have accumulated, and their rank.

The four preference categories give preference to Wisconsin residents and to landowners (those individuals owning 50 or more contiguous acres within a TMZ), and hunters enter the drawing in the following order: 1) resident landowners, 2) resident non-landowners, 3) non-resident landowners, and 4) non-resident non-landowners. Current rules stipulate that no more than 30% of the permits allocated to any TMZ and time period combination can be issued to hunters claiming landowner preference. Preference points are awarded to hunters who applied for, but did not receive, a spring turkey permit during previous spring turkey seasons. Preference points accumulate, are season-specific, and are lost if a hunter does not apply for a spring turkey permit at least once in three consecutive years.



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Section
2

Once hunters are sorted by descending preference points and ascending rank, the drawing begins first for resident landowners, and consists of three parts:

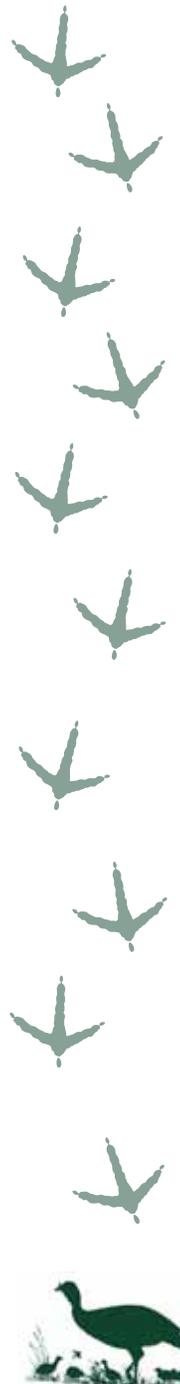
- 1) **First-choice drawing.** Resident landowners enter the drawing according to their preference points and rank; if a permit is available for their first-choice TMZ and time period combination, they are awarded a permit. If all of the permits have already been allocated for that TMZ/time period, or if the 30% landowner threshold has been reached, they are not awarded a permit and their application proceeds to Step 2, below.
- 2) **Second-choice drawing.** Remaining resident landowners, who were unsuccessful in the first-choice drawing, are again sorted by preference points and rank, and another drawing is conducted based on their second-choice TMZ and time period combination. Successful applicants are again awarded a permit, and those who are unsuccessful continue in the process.
- 3) Finally, resident landowners who have still not received a permit are again sorted by preference points and rank, and all of their remaining (third-choice and lower) TMZ/time period combinations are examined in sequence to see if any permits remain. Successful applicants are awarded a permit. Resident landowners who are unsuccessful during this drawing (which may occur if the 30% landowner permit threshold has been reached and/or the applicant provided a limited set of zone/time period preferences) re-enter the drawing in the same category as resident non-landowners with preference points.

Steps 1 through 3 are then carried out for hunters in the remaining categories (resident non-landowners, non-resident landowners, and non-resident non-landowners) in sequence and in identical fashion, until all applications have been through the drawing process.

Prior to 2006, any permits that had not been allocated through the drawing process were awarded to hunters as second permits during a second random draw. Beginning in 2006, however, remaining permits were made available for over-the-counter (OTC) purchase by any hunter.

Fall Season

The fall drawing is conducted as described above for the spring drawing. However, there are no separate time periods, so applications are reviewed based solely on the hunters' choice of preferred TMZ. Preference categories and preference points function as they do during the spring drawing.





Section 2



Ecology of Wild Turkeys in Wisconsin

Registration

Mandatory registration of harvested turkeys has been a mainstay of both the spring and fall turkey seasons in Wisconsin. Information provided via turkey registration allows biologists to measure a suite of important biological parameters within each TMZ for each turkey season:

- ✚ Total harvest
- ✚ Hen harvest during the fall season
- ✚ Age ratios (jakes:gobblers in the spring; juveniles:adult hens in the fall)
- ✚ Permit success rate (the percentage of permits filled)

Registration thus allows biologists to use harvest data to measure the “health” of our turkey flock within each zone. Recognizing that other factors (weather, permit levels, hunter behavior) also influence the number of turkeys harvested, total harvest and permit success rate likely are positively related to the size of the turkey population and thus changes in these metrics can be used to infer trends in turkey numbers within each zone. Biologists examine these data closely at the end of each hunting season, to see if they signal any problems that might warrant a management response.

Age ratios can provide an index to production. Though there are again sources of potential bias, such as hunter selection for adult gobblers, the percentage of adults in the spring male harvest, and the number of juveniles per hen in the fall harvest, may reflect levels of production the previous spring. These two measures are moderately correlated in Wisconsin, validating their potential utility as indices to production the previous spring. As well, both measures correlate moderately well with the number of poults observed per hen during the previous summer’s annual brood surveys.

Both of these harvest-derived production indices have declined steadily following the establishment of turkeys within each TMZ, and therefore suggest underlying density-dependent reproduction in Wisconsin’s turkey population. The existence of density-dependent reproduction would have important implications for harvest management.

From 1983 through the spring 2011 season, hunters were required to physically present harvested turkeys at a registration station. Starting with the fall 2011 season, turkey registration stations are no longer in operation, and hunters register their turkeys remotely via either online or phone-in systems. These remote systems provide increased convenience to hunters and reduce the costs and DNR staff workload associated with turkey registration. In addition, harvest information provided by the new systems is available in real-time, and data can be summarized more efficiently. Hunter compliance with mandatory registration requirements was estimated in 2012 using two independent techniques that compared the registration database with harvest as reported on 1) spring hunter surveys and 2) by a sample of >200 hunters contacted via phone. Both means of assessment revealed a compliance rate in excess of 91%, suggesting high hunter compliance under the remote registration systems currently in place in Wisconsin.





Section
2



Hunter Surveys

The Wisconsin DNR has been gathering information on the attitudes and satisfaction of turkey hunters for almost as long as there has been spring turkey hunting. Starting in 1986, WDNR Science Services staff began surveying a random selection of spring turkey hunters each year, asking various questions regarding proposed rule changes, season structure, participation, effort, hunter interference, equipment, and overall satisfaction with their turkey hunting experience (Box 6). The same type of information has been collected from a sample of fall turkey hunters since the start of fall hunting in 1989. These data have played an important role in the development of the current season structure and permit levels for both the spring and fall turkey seasons. The ability to monitor hunter attitudes toward proposed season changes, while monitoring interference and hunter satisfaction, is central to both past and future management decision (Figure 15).

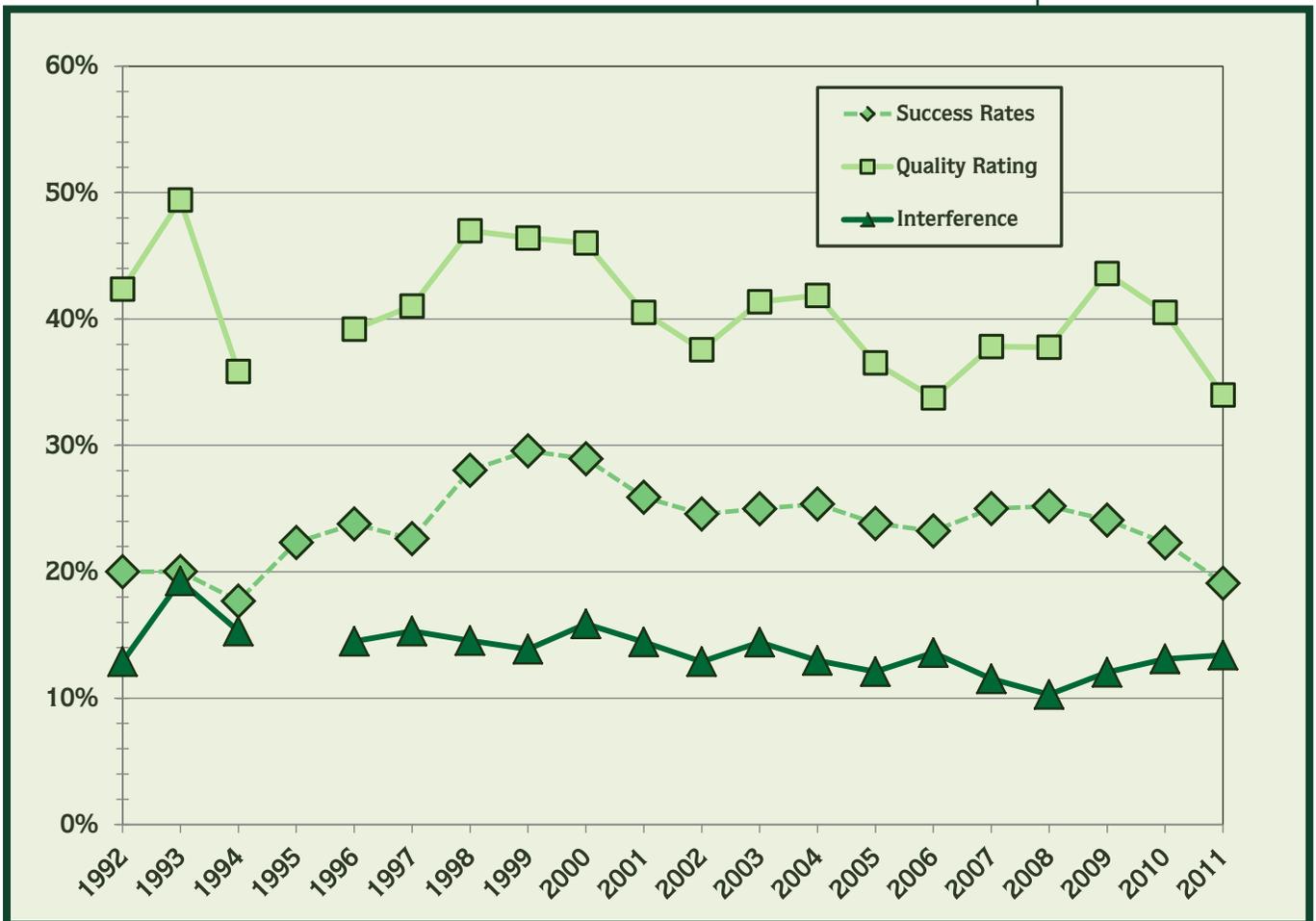


Figure 15. Spring season permit success rate, the percentage of spring turkey hunters reporting interference from other hunters, and the percentage reporting a high quality hunting experience, from 1992-2011 (no survey in 1995).





Section 2



Ecology of Wild Turkeys in Wisconsin

Early research in southwestern Wisconsin on hunter and landowner attitudes toward turkeys and turkey hunters formed the basis for many management decisions. This research suggested that landowners were much more tolerant of both turkeys and turkey hunters on their land, and hunters more tolerant of other hunters in the woods, than previously believed. This knowledge allowed biologists to increase permit levels and develop more liberal seasons without fear of reducing hunt quality or complicating relationships among hunters and landowners.

Hunters and landowners have played important roles in monitoring turkey abundance and reproduction as well. A landowner turkey poult survey was developed to monitor turkey brood production during the months of June, July, and August. The survey was expanded geographically in scope as turkeys spread across Wisconsin, and provided valuable estimates of annual production. Recent reductions in response rate and the move toward a management philosophy based on hunter satisfaction have reduced the utility of this survey and it was discontinued in 2012.

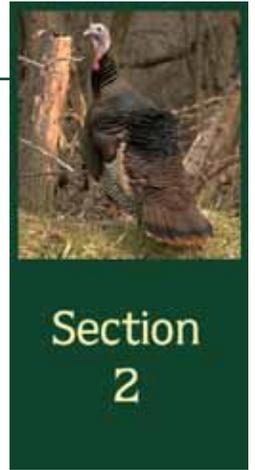
Starting in 1970, rural landowners throughout the state have also provided input on the wildlife species observed on their land throughout the year. Wild turkeys were added to this annual survey in 1988, and trends in sightings have since been useful in monitoring turkey range expansion and turkey abundance.

Deer hunters have played a role in monitoring turkey abundance as well. Since 1992, archery and gun deer hunters have been asked to report the deer and other wildlife they observe while actively deer hunting. Turkeys are usually second only to deer in both the number of sightings and the number of individuals observed, and regional observation data have proven useful in monitoring turkey range expansion and occupation.



WDNR photo





Since 1960, Wisconsin DNR employees have been asked to report game bird broods they see during the normal course of field activities over a 10-week period starting in early June. Wild turkeys were added to the list of species to be reported in 1988, and have been a part of the survey since. Data collected are used as an index to brood production (Figure 16), and in conjunction with other indices to monitor annual turkey brood production levels.

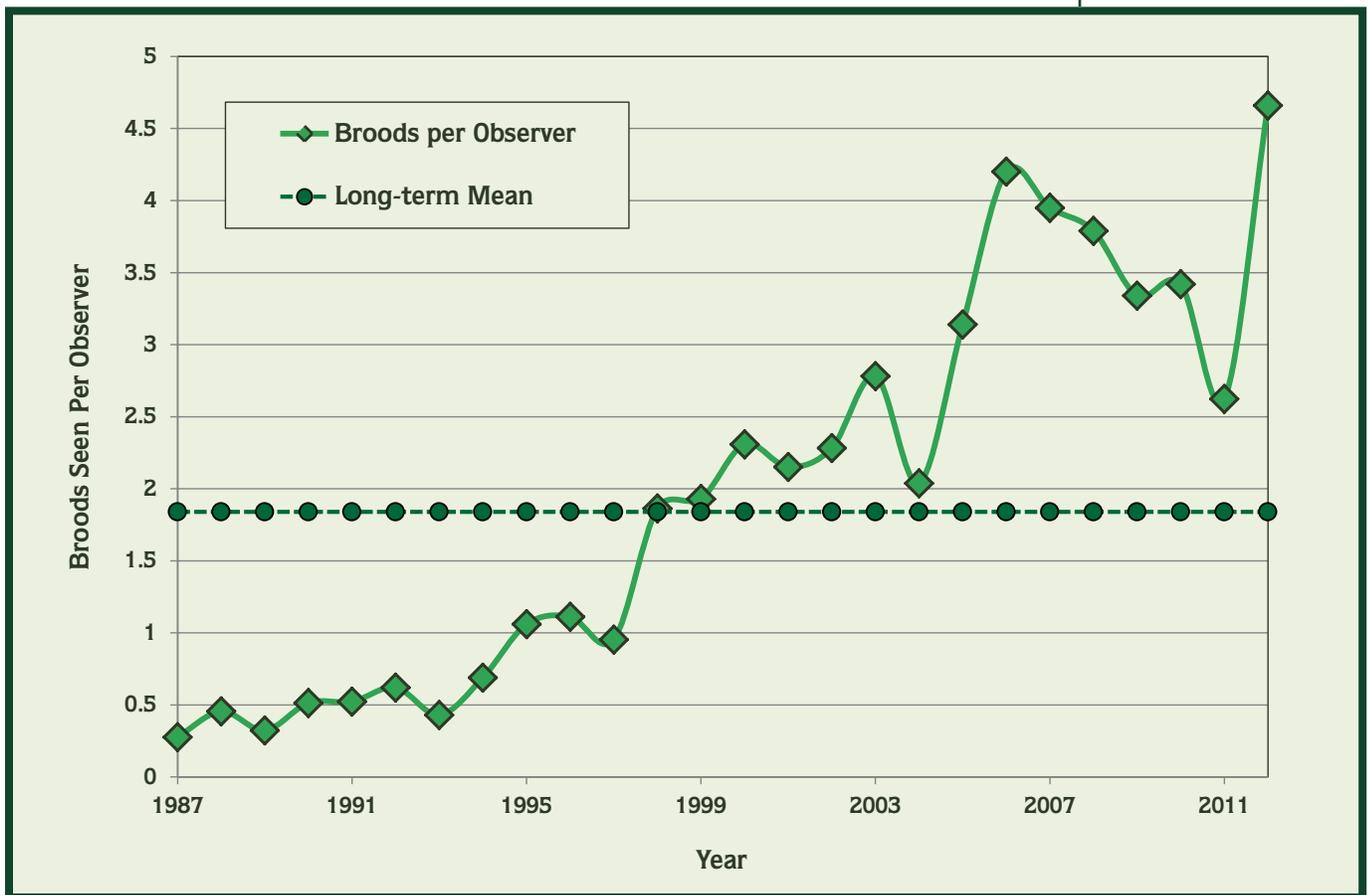


Figure 16. Wild turkey broods seen per observer from the 10-week brood survey, 1987-2012.

The ability to maintain a quality hunt with low interference and a reasonable chance to bag a bird is one the mainstays of turkey management in Wisconsin, and the monitoring of turkey hunters and their expectations will continue to be a key component of our state's turkey management program. Surveys that provide indices to turkey abundance and brood production will also continue to allow biologists to monitor overall turkey abundance and alter approaches to management as deemed appropriate.





Section
2

Box 6

PROFILE OF WISCONSIN'S TURKEY HUNTERS

Developing and maintaining a management framework that maximizes hunt quality and hunter satisfaction requires consistent and accurate measures of hunter attitudes and beliefs. Such information is gleaned from annual hunter surveys, and additional insight was provided via an intensive public input process that preceded the development of this plan revision. The following summary of the 2012 hunter surveys and the public input survey suggest how input from hunters can be used to evaluate management strategies. Such information provides a snapshot of hunter sentiments, and annual collection of such data allows changes or trends to be identified.



Spring 2012 Hunter Survey (n=3,356)

29% of respondents had <5 years of spring turkey hunting experience (22% had >16 years)

62% were "satisfied" or "very satisfied" with the current spring season framework (13% were dissatisfied)

14% participated in the Youth Turkey Hunt

88% felt it was "easy" or "somewhat easy" to find a place to hunt turkeys

Respondents hunted an average of 3.2 days during the spring season

53% of hunters passed on the first turkey that presented a harvest opportunity; the most popular reasons were "waiting for a better shot" (46%) and "waiting for an adult gobbler" (39%)

69% of hunters harvested a turkey before noon (50% before 9 a.m.)

5% of hunters reported shooting a turkey they were unable to retrieve

95% hunted turkeys primarily with a gun, 5% with a bow

continued in 1st column, next page

Public Input Survey (n=2,124)

81% felt the current seven-zone structure allows hunters adequate flexibility to hunt different locations

61% felt the seven-zone structure is an important component of managing turkey harvest

75% supported the current opening date (Wed. nearest April 13th) for the spring turkey season

55% supported opening spring time periods on Wednesday (next most popular day was Monday, at 9.9%)

Given various options, 76% of hunters supported the current six time-period structure

"Reducing hunter competition and interference rates" and to "better distribute hunting opportunity" were viewed as the most important benefits of having separate time periods during the spring season

84% felt that the current permit allocation system allows hunters a fair opportunity to hunt in their desired zone

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Section
2



Dan Small Outdoors, LLC

Spring 2012 Hunter Survey (continued)

Respondents spent 86% of their time hunting on private land, 14% on public land

81% felt that other hunters did not inhibit them from hunting where they wanted to, and 87% felt other hunters did not interfere with their chance to bag a bird

Fall 2011 Hunter Survey (n=2,887)

42% of respondents had <5 years of fall turkey hunting experience, 12% had >16 years

72% of hunters in zones 1-5 liked the extended (December) fall season (3% disliked)

Fall turkey hunters spent an average of 6.6 days hunting turkeys

3.5% of respondents shot a turkey they were unable to retrieve

69% of respondents primarily used a gun to hunt turkeys during the fall (31% bow)

30% of respondents hunted turkeys during the fall season "incidental to other hunting" (e.g. while bow hunting)

Public Input Survey (continued)

72% felt that the current permit allocation system allows hunters a fair opportunity to hunt during their desired time period

56% supported elimination of the fall turkey permit drawing (24% opposed)

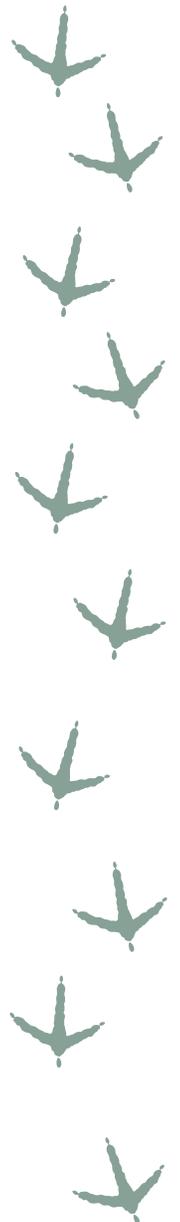
If a season bag limit were established for the fall turkey season, 51% of hunters would favor a limit of one turkey (30% favored a limit of two)

Hunters perceived weather to be the most important factor driving turkey population dynamics (predation was 2nd)

48% of hunters oppose giving resident and nonresident hunters equal preference for turkey permits (39% support)

50% of hunters support the landowner preference category (40% of non-landowners)

79% believe Wisconsin's Wild Turkey Stamp to be reasonably priced (\$5.25) and 70% felt the stamp program should be continued





Section 2



Health Considerations for Wisconsin Turkeys

Although infectious diseases are not known to have caused significant wild turkey population declines in Wisconsin, the risk of disease is ever-present. Human activities such as artificial feeding have the potential to concentrate wild populations, and the increased contact among turkeys can result in higher disease transmission rates. Further, interactions between domestic and wild turkeys can lead to the spread of disease, and this risk may be more pronounced in areas of high poultry production and/or areas with free-range domestic poultry.



WDNR photo

The following section provides an overview of the diseases that have the greatest potential to affect Wisconsin's wild turkey population. Biologists and hunters alike should be alert for the presence of sick or dead turkeys on the landscape, so that disease occurrences can be identified and appropriate response measures taken, if warranted. Monitoring mortalities within our wild turkey population can help provide information on the impacts of disease and in turn lead to better management of these populations.

Bacterial Diseases

Avian Chlamydiosis

Chlamydiosis has not yet been reported in wild turkeys in Wisconsin, though studies have shown that both domestic and wild turkeys are susceptible to infection. *Chlamydia psittaci* is excreted through feces and nasal discharges, and can survive in the environment for several months. Most often, susceptible individuals become infected by breathing in the bacteria from dried feces or nasal discharges.

The severity of chlamydiosis can range from a minor disease affecting a few individuals to a severe outbreak causing multiple deaths. Often individuals show no signs of disease until they are physiologically stressed, at which point non-specific symptoms such as ruffled feathers, weight loss, and respiratory distress may appear. Diarrhea with green to yellow droppings may also be noted.

In the event that chlamydiosis is verified, sick birds should be collected and euthanized, and carcasses should be collected and disposed of. Incineration of carcasses can help

reduce the spread of infection. Human activity should be limited in an infected area as this can cause infected birds to disperse, resulting in the spread of the disease to new areas.

Avian Cholera

Avian cholera is a contagious disease caused by the bacterium *Pasteurella multocida*. In North America, avian cholera is commonly found only in Texas, north-central California, and areas of Nebraska. Although sporadic outbreaks have occurred in other areas, including Wisconsin, it is not currently a significant source of mortality in Wisconsin wild turkey populations.

The cholera bacterium enters the body through the lungs or through cuts on the skin. Though less common, the bacteria can also be transmitted through ingestion of contaminated food or water, including the scavenging of infected carcasses.

Because the disease rapidly incapacitates birds, sick birds are not typically seen during outbreaks. Infected birds that do exhibit signs may be weak and can often be easily approached. When captured, infected birds often die quickly, sometimes within a few seconds or minutes. Symptoms of cholera include nasal discharge and neurological signs including convulsions and erratic flight. Because the disease causes intestinal hemorrhaging, feces and feathers surrounding the vent will also frequently be stained with blood.

Treatment of avian cholera in wild populations is not practical, and management is the best method of control. Infected carcasses should be collected and incinerated to reduce the spread of the disease.

Avian Tuberculosis

Avian tuberculosis is a disease caused by the bacterium *Mycobacterium avium*. All species of birds appear to be susceptible to infection, though to varying degrees. The disease is uncommon in wild turkeys and is most often seen in captive or domestic populations.

Birds typically become infected through the ingestion of soil or other material that is contaminated with infected fecal material, or by scavenging the carcasses of infected birds. Though less common, aerosol transmission may also occur.

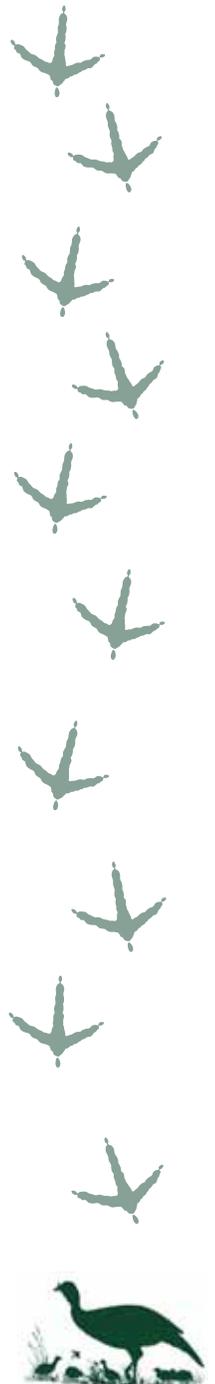
Clinically, avian tuberculosis is a prolonged, progressive disease, and signs of infection do not usually develop until late in the infection when individuals may become thin and appear inactive. Currently, there have been no known reports of avian tuberculosis in Wisconsin wild turkey populations.

Bordetellosis

Bordetellosis is a highly infectious upper respiratory disease caused by the bacterium *Bordetella avium*. Infection does not typically result in death, though deaths may occur if individuals are concurrently infected with other diseases or are otherwise stressed. The bacterium is easily spread and has the ability to survive in the environment for months.



Section 2





Section 2



Ecology of Wild Turkeys in Wisconsin

In domestic turkeys, the impacts of bordetellosis are well-known, though there is little information on the occurrence of this disease in wild populations. In domestic turkeys, infection typically results in the death of young poults. The bacterium normally infects the trachea, and, although this infection is usually mild and non-lethal, it commonly leads to more serious secondary infections.

Signs of infection may include sneezing, coughing, runny eyes, and open-mouthed breathing. Altered vocalization can occur later in the course of the disease and behavioral changes may be seen, including depression, huddling, decreased activity, and reduced appetite.

Mycoplasmosis

Mycoplasmosis is the general term for a bacterial disease caused by several species of bacteria in the genus *Mycoplasma*. Mycoplasmosis is more commonly a disease associated with domestic poultry, though wild turkeys are susceptible to infection. The prevalence of mycoplasmosis among wild turkeys in Wisconsin, however, is not currently known.

Birds infected with the bacterium act as carriers, having the ability to infect others. Transmission typically occurs through direct contact with an infected bird, though it can also occur through inhalation of infected dust or air droplets.

Domestic turkeys often show no, or only mild, signs of infection. Symptoms may include foamy eyes, excessive tearing, weight loss, and respiratory distress. In severe cases, death may occur.

Salmonellosis

Salmonellosis is a disease caused by several species of bacteria of the genus *Salmonella*. The bacteria live in the intestinal tract of infected birds and are shed through feces. The organism can be spread from an infected bird to a healthy bird through direct contact or through the ingestion of contaminated food or water.

Signs of salmonellosis in wild birds vary greatly and depend on age, the specific bacterial species involved, and environmental stressors. Infected birds may appear “fluffed-up” and may be shivering. In extreme cases, seizures, weight loss, and watery yellow- to green-tinged feces may occur. To date, there have been no reports of salmonellosis among wild turkeys in Wisconsin.

Staphylococcus

Staphylococcus is a bacterial disease caused by several species of bacteria, though in wild turkey populations, *Staphylococcus aureus* is the most common cause of disease. Staphylococcal bacteria are normally found on the skin and the mucous membranes of wild turkeys, but infection occurs when the bacteria enter the body through a break or abrasion. In wild turkeys, the common form of infection with the bacteria appears as an inflamed lesion on the foot often referred to as “bumblefoot.” If the bacterium enters the blood, blood poisoning may occur, though this generally only occurs in individuals whose immune systems are not fully functioning. This type of infection can result in sudden death.





Section
2

Viral Diseases

Avian Pox

Avian pox is a slow-developing, highly contagious viral disease in birds that is caused by several different types of the avipoxvirus. It has been observed in many species of birds, including wild turkeys. Avian pox outbreaks are most commonly seen during fall and winter, when birds are concentrated in flocks.

Avian pox is spread in a variety of ways, including vectors such as mosquitos and other biting insects. The virus has the ability to survive in the environment for months and can be transmitted if a bird comes into contact with a contaminated surface or through inhalation of infected airborne particles.

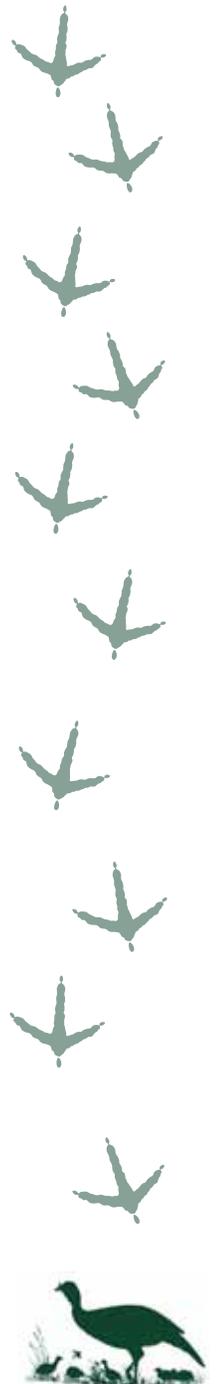
Infected individuals may express either of two different forms of the disease. Most commonly, infected birds develop wart-like growths on non-feathered areas, including the feet, legs, base of the neck, and the base of the beak. Birds may appear weak and show signs of labored breathing. Typically, this form of disease is not serious and will resolve without treatment. However, if the growths become enlarged and clustered, they may make it difficult for an infected bird to eat and/or breathe. Additionally, the wart-like growths can develop secondary bacterial and fungal infections that can lead to death.

The second form of the disease is known as “wet pox,” as the virus infects internal tissues. This form of the disease is most often seen in young turkeys, and produces lesions in the digestive and respiratory systems. This form of avian pox is not often reported in wild populations, though this is likely because infected individuals express less obvious outward symptoms. Wet pox may result in higher mortality among wild populations than the earlier-described form; however, scavenging of carcasses before they can be examined likely precludes diagnosis in most cases.

In Wisconsin, avian pox has the potential to be a significant mortality factor for wild turkeys. If avian pox is identified in an area, feeding should be stopped and feeders and other equipment that have come into contact with infected birds should be decontaminated with a 10% bleach solution.

Lymphoproliferative Disease

Lymphoproliferative disease, or cancer of turkeys, is a viral disease caused by the retrovirus Lymphoproliferative Disease Virus (LPDV). The virus was first detected in wild turkey populations in the United States in 2009. Since then, sporadic cases have been identified, though the significance of the disease in wild turkey populations is unknown. Currently, it is believed that the virus is transmitted horizontally between birds through direct contact. Clinical signs of disease are similar to those of avian pox. Scabby nodules on the featherless regions, including the legs and head, may be seen. Additionally, birds may appear disoriented, weak, and lethargic. The disease is rapidly fatal and often birds are found dead.





Section 2



Fungal Diseases

Aspergillosis

Aspergillosis is a disease most commonly caused by the fungus *Aspergillus fumigatus*. Large numbers of the spores are naturally found in nature. Birds are most susceptible to infection during periods of stress, as the body's resistance to disease is lowered. Aspergillosis appears occasionally in Wisconsin wild turkeys, although since it is not contagious it usually affects individual birds rather than entire flocks.

Birds typically become infected by inhaling or ingesting a large amount of fungal spores while feeding on or near a contaminated source. The spores become lodged in the air sacs and begin to develop within the bird. Aspergillosis spores are also often found on the surface of eggs. The spores have the ability to enter eggs and grow, infecting newly hatched chicks.

Aspergillosis may appear as an acute, severe disease or as a chronic or long-term disease. Acute cases are most often seen in domestic chicks that have just hatched. If clinical signs are present, infected chicks may show respiratory distress, loss of appetite, increased body temperature, and in some cases convulsions.

The chronic form of aspergillosis is more commonly seen in wild populations. Once a bird is infected, the fungus produces toxins that may damage various tissues and organs over time. The lungs and air sacs often become infected first, leading to a gradual reduction in respiratory function. Eventually, the fungus spreads to the other organs, including the brain. Birds chronically infected with aspergillosis may appear emaciated and have difficulty breathing. Birds may appear weak and depressed, and may separate themselves from the other birds and be observed with drooping wings. If the infection reaches the brain, the bird may show signs of loss of muscular coordination and twisting of the neck.

Aspergillus fumigatus grows best in warm, dark, moist conditions and is often found in damp waste grain. Birds should be discouraged from using areas where moldy agricultural waste products have accumulated.

Parasitic Diseases

Coccidiosis

Coccidiosis is caused by infection with cyst-forming protozoan parasites that typically invade the intestinal tract. Infections can produce tissue damage. Though more commonly seen in domestic turkeys, coccidiosis does have the ability to infect wild populations.

Coccidia protozoans are usually present in turkey populations, but disease occurs only after ingestion of a large number of the protozoa. Infected birds shed the parasite in their droppings, which contaminate feed, dust, water, litter, and soil. Infection with coccidiosis occurs rapidly and results in extensive damage to the intestinal system. Signs can range from no signs to severe diarrhea and mortality.



Section
2

In domestic turkeys, coccidiosis tends to be a problem when large numbers of birds are confined to limited space. The protozoan builds up in the environment when birds are overcrowded and use an area for a prolonged period of time. The disease risk increases when these conditions result in contamination of food and drinking water. In cases where wild flocks become concentrated and coccidiosis is suspected, flock dispersal may be the best means of control.

Histomoniasis

Histomoniasis is a parasitic disease caused by the protozoan *Histomonas meleagridis*. The disease is commonly referred to as “blackhead disease” because infection can result in a bluish or blackish appearance of the skin of the head. Histomoniasis is capable of causing mortality among wild turkeys. Current research shows that wild turkeys are infected with histomoniasis by living and feeding on abandoned chicken or domestic turkey farms.

The histomoniasis parasite is fragile and cannot live in the environment for more than a few hours. Typically, it requires the use of the parasitic cecal worm, *Heterakis gallinarum*, to infect its host. Though less common, it is also possible for a bird to become infected after ingesting the histomoniasis parasite via contaminated feed or water, or while picking gravel or preening itself. The organisms are eliminated from infected birds in their feces, either alone or within the cecal worm.

There are no specific clinical signs associated with histomoniasis. Wild turkeys may appear tired, have ruffled feathers, and often stand with drooped wings. Yellow-colored feces may be present. Young birds often die within two or three days after the first signs of illness, but older birds may suffer for several days before dying or starting a slow recovery. In wild turkeys, the disease is typically isolated, infecting the occasional individual rather than as a widespread outbreak.

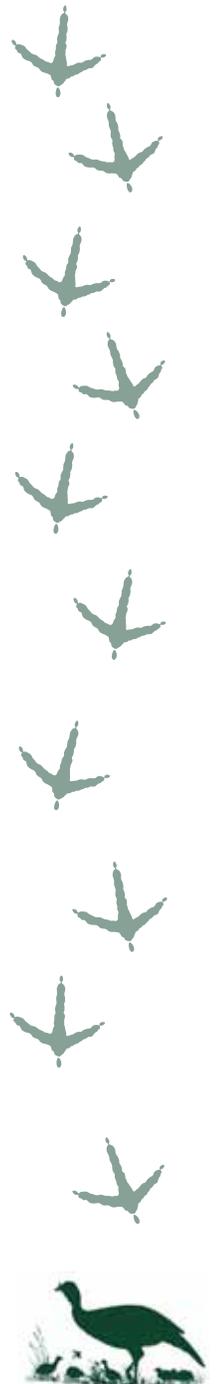
Toxins

The wild turkey is unlikely to be exposed to any serious environmental contaminant issues while in its natural habitat. Reports of wild turkeys being adversely impacted as a result of exposure to environmental contaminants are relatively rare in the scientific literature, although exposure to lead shot pellets and pesticides is known to occur. There have been documented cases of intentional poisoning of wild turkeys in Wisconsin, in which farmers believe turkeys to be responsible for agricultural damage. While it is possible for wild turkeys in Wisconsin to be exposed to contaminants, cases of exposure would be isolated. Based on the dietary habits of wild turkeys, it is unlikely they would accumulate levels of contaminants high enough to cause health concerns for hunters.

Aflatoxin

Aflatoxins are a group of toxic metabolites produced under favorable environmental conditions by the fungi *Aspergillus flavus* or *A. parasiticus*. These metabolites are potent liver toxins and carcinogens in animals.

Aflatoxin exposure in wildlife is most often associated with the consumption of contaminated nuts or agricultural grain. Documented wildlife mortality events caused by aflatoxins in the United States are few, and there have been no known cases of





Section 2

Ecology of Wild Turkeys in Wisconsin

aflatoxicosis in Wisconsin wildlife. While there have been studies documenting the presence of aflatoxins in grains intended for use as wildlife feed, all of these cases occurred in the southern states. While the likelihood of aflatoxicosis is low for wild turkeys in Wisconsin, it is recommended that wildlife feed be stored properly in order to avoid conditions which could promote fungal growth and toxin production.

Rehabilitation

Injured or apparently orphaned wildlife are occasionally encountered by members of the public. Although rehabilitating wild turkeys is not a common activity, the primary causes of admission to rehabilitation centers include physical injury, disease concerns, or orphan situations. Because the turkey is not listed as a species covered by the Migratory Bird Treaty Act, a Federal Fish & Wildlife Service rehabilitation permit is not required to rehabilitate turkeys; however, a state wildlife rehabilitation license is required.



Tracie Gephart



Turkey Damage

Wild turkeys are habitat generalists, and use a variety of habitats throughout the year. In agricultural landscapes, they can frequently be seen foraging in agricultural fields. It's therefore not surprising that as turkeys increased in number and expanded across Wisconsin, farmers began to express concern over perceived turkey damage to agricultural crops. In response to this rising concern, biologists sought to define specific impacts of turkeys on crops.

Biologists working for the Wisconsin DNR and U.S. Department of Agriculture investigated 28 turkey damage complaints from 1988-1990, and found that most damage blamed on turkeys was actually caused by other species. White-tailed deer accounted for 54% of the damage and raccoons another 25%; turkeys were only responsible for damage in 18% of the cases investigated. These authors also examined the food habits of turkeys during the growing season in Wisconsin in an effort to clarify their use of agricultural foods. Corn was important in the diet of turkeys during both spring and fall, but >90% of the corn consumed was waste grain. During the summer months, hens and their broods spend significant time foraging in hay or small grain fields. While 65% of the hens' diet consisted of oats, most were waste oats gleaned from the ground in wind-damaged or already-harvested fields. Poults, requiring high protein intake to fuel body growth, were feeding primarily on insects while in fields; waste grain made up only 23% of their diet. Interestingly, by eating herbivorous insects (e.g., grasshoppers) in alfalfa and other fields, poults may actually benefit farmers by reducing insect damage.

The assertion that turkeys are generally only responsible for a portion of the crop damage ascribed to them has since been generally supported elsewhere in the United States and Canada. A review of turkey damage to crops in the United States and Ontario, Canada found that most cases of turkey damage were classified as "light," although turkeys have caused moderate damage to stored corn silage in Wisconsin. Foraging turkeys are also known to cause significant damage to ginseng beds in central Wisconsin through their scratching behavior.

Though turkeys are not a source of widespread agricultural damage in Wisconsin, their foraging behavior can cause significant local damage. In 1999, the Wisconsin State Legislature added wild turkeys to the list of species for which farmers can request and receive damage payments. The Wisconsin Wildlife Damage Abatement and Claims Program (WDACP), a program administered by participating counties and overseen by the Wisconsin DNR, provides support for abatement activities intended to reduce damage caused by select wildlife species. For example, in 2011, 89 agricultural producers enrolled in the WDACP were supplied with temporary fencing



Section 2



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Section 2

Ecology of Wild Turkeys in Wisconsin

materials, issued turkey shooting permits, or provided propane cannons and/or other abatement tools to address verified turkey damage to agricultural crops. The WDACP also provides financial compensation for crops damaged by turkeys, supported by a \$1 to \$2 surcharge on Wisconsin hunting licenses. Between 2005 and 2011, an average of \$81,192 in turkey damage to agriculture crops was appraised annually through the WDACP. However, there is wide annual variation in this amount caused by the high value of ginseng. For example, 20 claimants had total appraised losses of \$18,562 in 2010, whereas 23 claimants had appraised losses totaling \$181,349 in 2009; much of this difference was due to a single high-value ginseng claim in 2009. During this seven-year period, an average of 23 turkey shooting permits were issued to landowners per year, resulting in an average annual harvest of 56 turkeys (Figure 17). This level of harvest

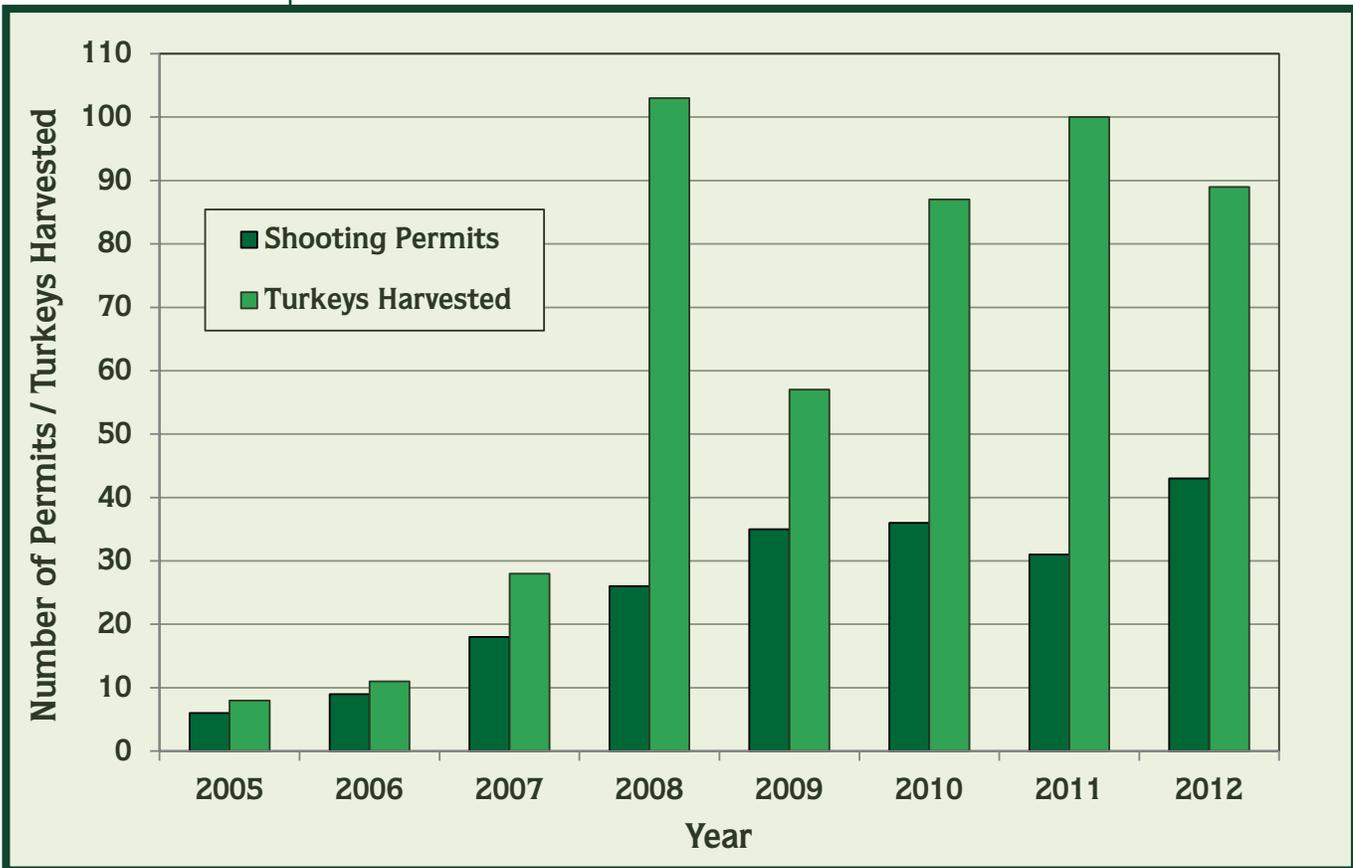
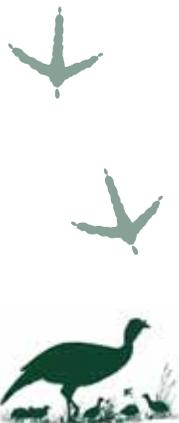


Figure 17. The number of shooting permits issued and the number of turkeys harvested under the Wisconsin Wildlife Damage Abatement and Claims Program, 2005-2012.



certainly does not impact statewide or regional turkey populations, but could impact turkey numbers locally if numerous turkeys are removed under an individual shooting permit.

It is clear that the presence of foraging turkeys in agricultural fields does not necessarily indicate turkey damage to those crops. However, it is also clear that turkeys can and do cause significant local damage to specific crops, principally corn silage stored in bunkers or bags, orchards, vineyards, and ginseng. The WDACP provides an effective means of

targeting and addressing concerns about turkeys as agents of crop damage, and helps to maintain the wild turkey as an important and appreciated component of our agricultural landscape.

Nuisance Turkeys

As Wisconsin's wild turkey population has increased, the number and frequency of "nuisance" turkey complaints have also risen, especially in urban and suburban areas where hunting is prohibited. Problems can be caused by single turkeys or entire flocks, and often reflect turkeys being attracted to food resources that are present in the local area.

Typical turkey nuisance complaints include:

- ✚ Turkeys leaving droppings around homes, patios, gardens, or on vehicles.
- ✚ Turkeys eating garden plants or scratching up landscaped areas.
- ✚ Turkeys "taking over" bird feeders.
- ✚ Aggressive or tame behavior of turkeys toward people or their pets.
- ✚ Turkeys pecking at windows (sometimes to the point of injuring themselves), most typical among gobblers during the breeding season in response to seeing their own reflection.
- ✚ Turkeys roosting or perching on decks, feeders, vehicles, rooftops, or large trees near homes.
- ✚ Turkeys being hit by vehicles, or disrupting traffic.

Legal hunting (gun or bow) is recommended wherever possible to help disperse birds and help them retain their wild behavior and wariness around humans. Municipalities that experience persistent turkey problems may want to work with local biologists to develop a strategy to address these issues. In areas where hunting isn't an option, many techniques are available to address nuisance turkey problems, and information describing such techniques is readily available. Literature pertaining to nuisance turkey issues, a list of agency contacts, and information on relevant grant opportunities can be found on the Wisconsin DNR website (<http://dnr.wi.gov/>; search for "nuisance wildlife").



Section 2



Dan Smith





Section 2



Ecology of Wild Turkeys in Wisconsin

The following are some basic tips for controlling nuisance turkeys:

- ✚ Never feed wild turkeys, either intentionally or unintentionally. It causes them to become habituated to people and can lead to many of the problems described above.
- ✚ Remove seed from the ground below bird feeders as often as possible, or use a feeder designed to keep the seed off the ground. If turkeys are still a problem, the best recourse might be to temporarily stop all feeding until the turkeys have moved from the area. Fencing in or redesigning the feeder may help.
- ✚ Never allow turkeys to become comfortable around people or pets.
- ✚ Other than legal hunting or harvest by special permit, killing or causing injury to wild turkeys is illegal. However, most harassment techniques are legal and may include loud noises, dogs on leashes, spraying with water, motion-activated sprinkler systems, and others. Always check with the local municipality or law enforcement agency for local ordinance restrictions (such as noise or weapon ordinances, fencing restrictions, etc.).
- ✚ If turkeys are pecking at windows, cover them or temporarily put something in front of them to remove them from view by turkeys.

Turkeys that threaten public safety may have to be destroyed. Keeping turkeys wild will help avoid these consequences.

In areas where the removal of turkeys with a shooting or trapping permit has been determined by the Department to be the best or only option, the local DNR wildlife biologist may issue a removal permit to a landowner or municipality. Approved turkey removal methods currently include shooting (firearms are preferred, using only non-toxic shot) and trapping (using live traps such as drop nets, rocket nets, and walk-in-type traps). Baiting is discouraged except where needed for large-scale removals. The euthanasia of all birds trapped is strongly recommended, with the meat used for human consumption where possible. Relocating turkeys is not recommended, since it may result in transferring the nuisance or damage problem to other landowners and may spread disease.

Economic Impacts

Revenue derived from hunters provides the single largest source of funding to support wildlife conservation in North America. These funds support the wise management of both game and nongame wildlife, protect and enhance critical wildlife habitat, and help ensure healthy wildlife populations for all future generations to enjoy. Wisconsin's turkey hunters alone provide over \$4.9 million in direct support for wildlife management and conservation efforts in the state. Revenue is derived from application fees and the sale of licenses and Wild Turkey Stamps (Figure 18). Stamp funds directly support wild turkey habitat improvement, research, and outreach efforts, as described in the following section. Turkey hunting license revenue and application fees contribute to the general Fish & Wildlife Account, which is the chief source of funding for fish



Section
2



and wildlife conservation programs in the state. In 2013, turkey hunters contributed 6.85% of the \$65 million in Fish and Wildlife Account funding generated through the sale of hunting and fishing licenses. Details on the broad spectrum of fish and wildlife management activities supported by hunters and anglers in Wisconsin can be found at www.dnr.wi.gov, keyword "Fish and Wildlife Account."

Turkey hunter expenditures in pursuit of turkeys during the spring and fall seasons also provide a stimulus for local economies. Surveys of a random sample of 2,200 spring and 1,600 fall turkey hunters in the state, conducted from 1989-1991, allowed biologists to estimate that hunters spent an average of \$280 on activities related to spring turkey hunting, and \$180 in the fall. Documented expenses included fuel, food, lodging, clothing, ammunition, and miscellaneous items. Correcting these expenditures for inflation, 134,072 active spring hunters contributed an estimated \$66.9 million, and 24,374 fall hunters an estimated \$7.7 million, to the local economy in pursuit of turkeys during the 2012 seasons.

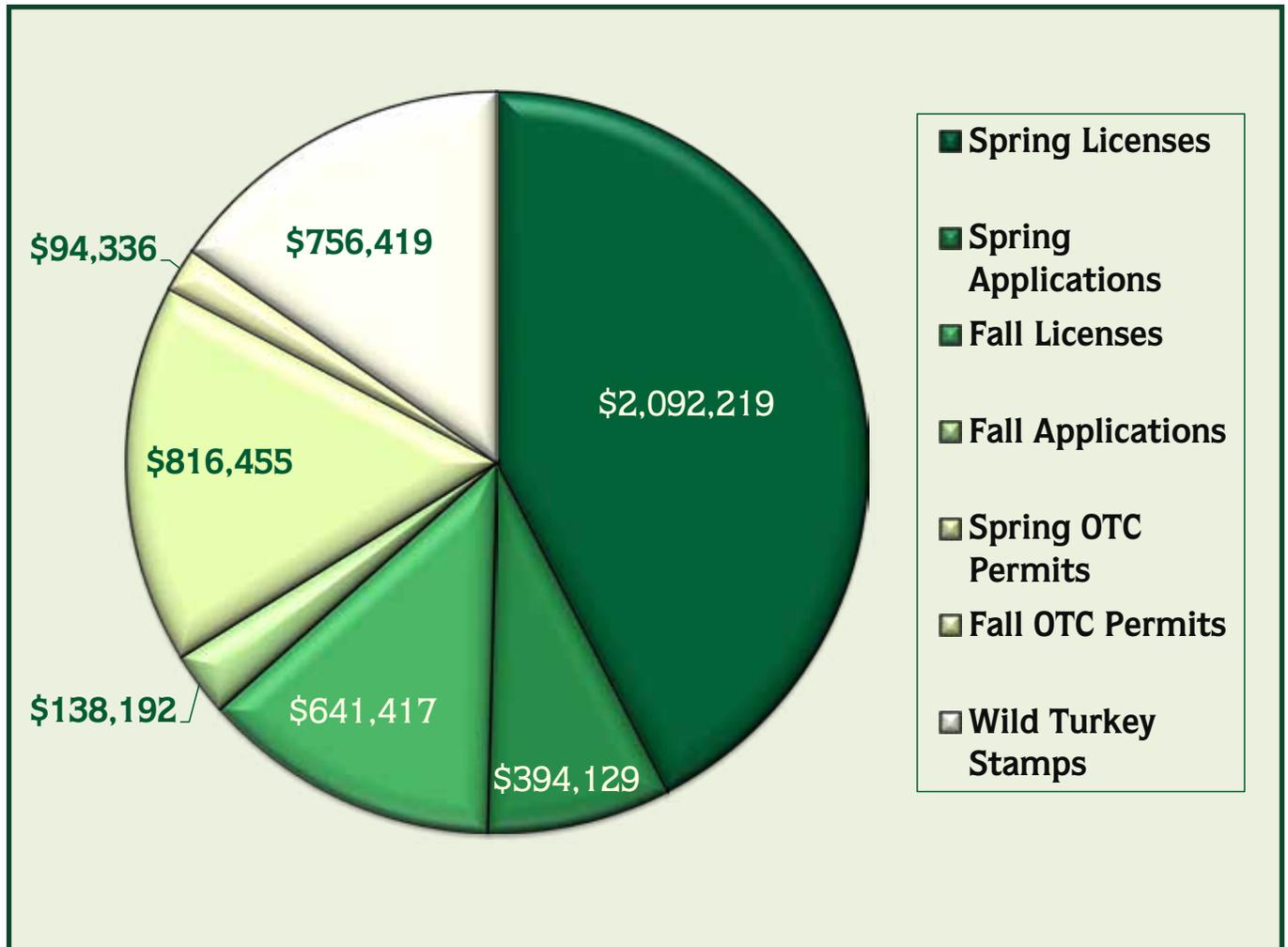


Figure 18. Revenue received in 2013 by the Wisconsin DNR from application fees for the spring and fall turkey seasons, and the sale of turkey permits awarded through the spring and fall drawings, over-the-counter (OTC) permits, Conservation Patron Licenses, and Wild Turkey Stamps.





Section 2



Wild Turkey Stamp Program

Hunters have played a key role in the successful restoration of wild turkeys to Wisconsin, and the evolution of the wild turkey management program, through their purchase of the Wild Turkey Stamp. Today, all turkey hunters are required to purchase the Wild Turkey Stamp in order to legally hunt turkeys in Wisconsin. Aside from hunters, many stamp collectors also purchase the stamp. According to Wisconsin State Statute, revenue from the sale of Wild Turkey Stamps is to be used only for “developing, managing, conserving, restoring, and maintaining the wild turkey population within the state,” and the program contributes almost \$750,000 annually toward these goals. The DNR Turkey Advisory Committee develops guidance that ensures stamp funds are invested in accordance with this statute, and in projects that address goals and objectives of the Wild Turkey Management Plan. The current process for allocating Wild Turkey Stamp funds was established in 1996, and from 1996-2013, over \$11.7 million in Wild Turkey Stamp funds have been invested in wild turkey conservation and management efforts throughout Wisconsin (Figure 19).

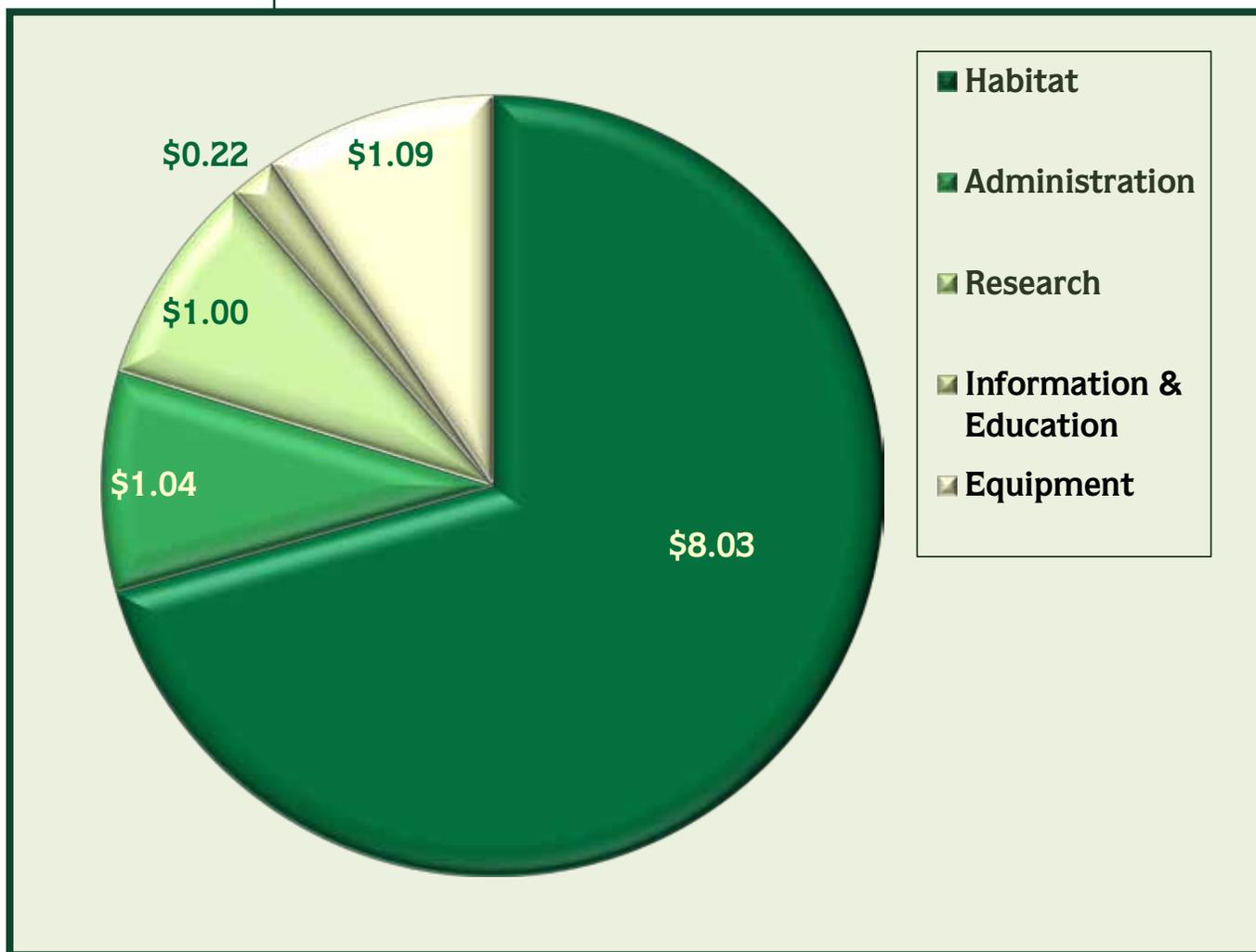


Figure 19. Investment of Wild Turkey Stamp funds in various categories related to turkey conservation in Wisconsin, 1996-2013 (millions of dollars). This \$11.7 million in funding was matched by an additional \$9.5 million in partner support.





Section
2

The overall impact of the Wild Turkey Stamp program is amplified via additional funding and services provided by partner groups. Wisconsin's Wild Turkey Stamp program has been very effective at fostering cooperative relationships with non-profit and conservation groups, private landowners, and both government and non-governmental organizations through this "cost-sharing" process, which stretches Wild Turkey Stamp dollars and allows more projects to be funded. The additional \$9.5 million in partner support for stamp projects pushes the net investment in wild turkey management over \$21 million between 1996 and 2013, with over 960 individual projects receiving funding.

Projects focused on creating or enhancing habitat for wild turkeys have historically received the majority of stamp funding, with over \$8 million (70.6%) invested in habitat efforts to date, and an additional \$1.09 million (9.5%) has been contributed towards the purchase of equipment necessary to undertake intensive habitat management efforts in the field. Examples of habitat work include forest management practices to encourage oak regeneration, the planting of trees, shrubs, and native grasses to provide needed foraging and brood-rearing habitat, and prescribed burning and mowing to maintain grassland areas.



WDNR photo

Over the 18-year history of the current Wild Turkey Stamp funding process, nearly \$1 million in funding (8.8% of total funding) has been dedicated to wild turkey research efforts. Information derived from this research has expanded our knowledge of basic wild turkey ecology and population dynamics, described the factors that limit turkey population growth in Wisconsin, isolated the impact of harvest, linked turkey population dynamics with landscape composition, and helped develop prudent approaches to habitat management.

Stamp funds have also supported the development of valuable education and outreach products, with over \$220,000 invested to date. Examples of outreach efforts include land management seminars for private landowners and a variety of educational efforts designed to provide information on the turkey management program in Wisconsin. Specific publications supported with stamp dollars include "The Wisconsin Turkey Hunter's Guide," "Managing Your Land for Wild Turkeys," "Wild Turkey Ecology and Management in Wisconsin," and this document. Stamp dollars have also contributed to the establishment of a safe and successful turkey season by supporting turkey hunter education clinics, which were held statewide every spring, until recently. Instructors reviewed turkey biology and management, hunting methods, regulations, hunter ethics,





Section 2

Ecology of Wild Turkeys in Wisconsin

and safety, and stressed good hunter-landowner relations. Over 1,150 turkey hunter clinics were held statewide, with total attendance surpassing 79,000 individuals.

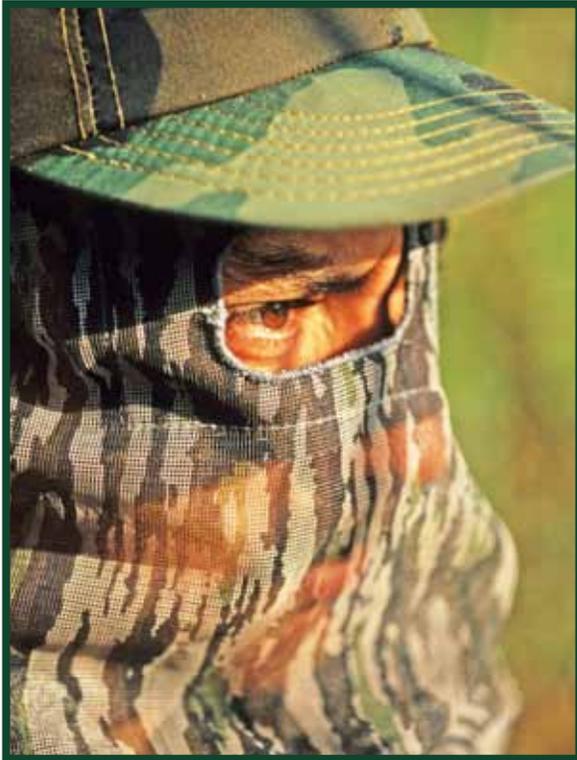
Finally, \$1.03 million (8.8%) has been invested in administration of the turkey management program itself. This includes administration of all stamp-funded projects, responding to the public and preparing news releases on turkey-related issues, creating and updating publications, coordination with the WDNR Turkey Advisory Committee, printing and mailing permits and regulations, and coordinating the Wild Turkey Stamp design contest.

Wild Turkey Stamp funds have been used in a variety of ways to benefit wild turkeys and their habitats in Wisconsin. There is little doubt that the positive effects from the purchase of the Wild Turkey Stamp will continue to accumulate in future years.





Section
2



WDNR photo



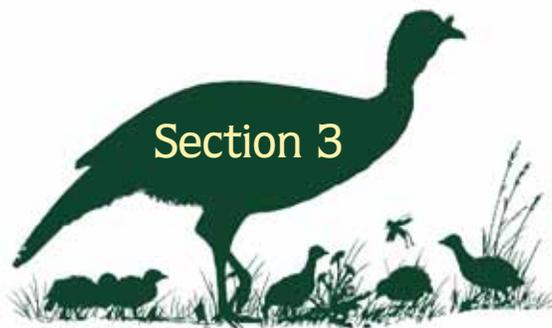
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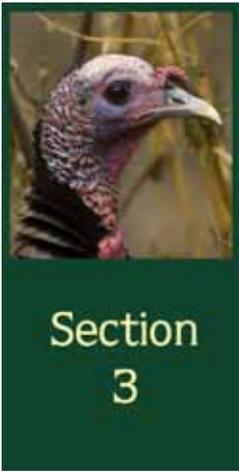




A PLAN FOR
THE FUTURE



Section 3



Program Goal

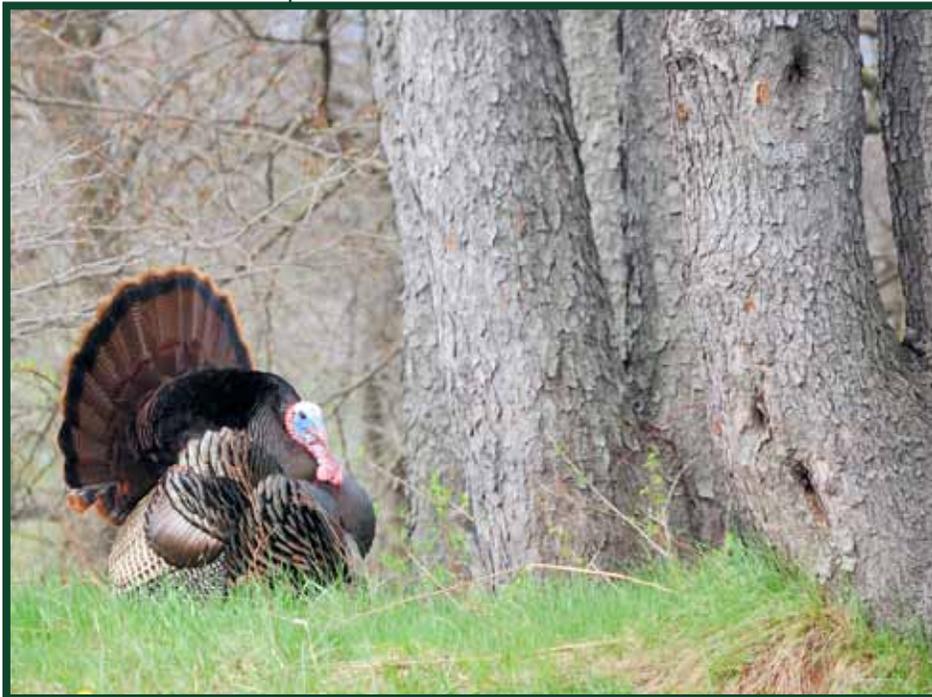
At the time the 1996 Wild Turkey Management Plan was developed, turkeys had not yet been restored to the northern counties, neither the spring nor fall hunts were statewide, and the focus regarding turkey population management was still largely on population expansion and increase. Today, turkeys are present in all Wisconsin counties, populations have stabilized, spring and fall seasons are statewide, and many changes have been made to season structure. We also have years of data regarding hunter attitudes and behavior. Hence, new challenges and opportunities exist that need to be addressed in this plan revision.

The over-arching goal of the turkey management program in Wisconsin is to:

Maintain healthy turkey populations in all suitable range, optimize quality turkey hunting opportunities in spring and fall, and promote a positive public image of our wild turkey resource.

To provide a framework for linking specific management actions with this very broad goal, this plan outlines a number of objectives that will allow managers to focus their energy and resources over the next 10 years. These objectives represent prudent, realistic, and achievable means of maintaining healthy turkey populations across the state and preserving hunt quality for Wisconsin's legion of turkey hunters. Strategies to proceed toward individual objectives are also discussed, along with means of addressing potential problems or obstacles that may be encountered and specific products stemming from these efforts. Many products will stem from existing procedures or

processes and hence will be relatively easy to develop; products of particular and/or immediate importance or that will require focused attention are designated "priority products."



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Objectives, Strategies, and Desired Products

Objective A: Protect turkey populations and optimize hunter opportunity and satisfaction.

Strategy A1: Continue mandatory registration of turkeys during both spring and fall seasons.

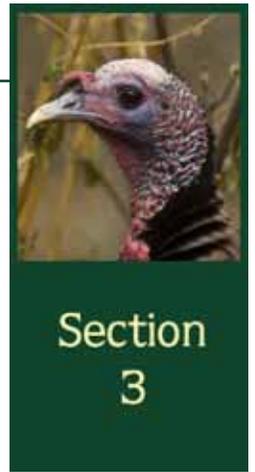
Wisconsin has required that successful hunters register their turkeys since the inception of the modern turkey season in 1983, and the initiation of remote registration systems (phone-in and online) in 2011 has since made registration more convenient for hunters. Information from registered turkeys allows biologists to track spring and fall harvest by sex and age class as well as through time and across zones. This information provides the best population-level data available to track harvest and to index trends in population size and annual recruitment. Mandatory registration should be maintained so that this critical information continues to be available to biologists.

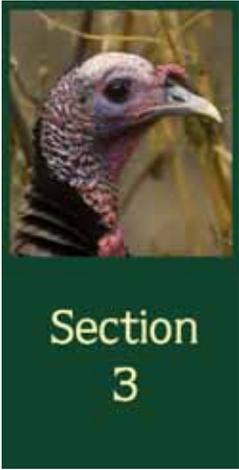
Priority product: Annual collection and summary of registration data, to include the sex and age of harvested turkeys, and the zone, date, county, and time of harvest.

Strategy A2: Use annual spring and fall harvest and permit success rates to assess the turkey population status within each Turkey Management Zone.

To properly manage harvest, managers require information not only on the level of harvest, but also on how the population in question responds to harvest. Clearly establishing the link between harvest rates and population dynamics is very difficult, primarily because it requires accurate annual estimates of population size. Since there is no estimate of the size of Wisconsin's wild turkey population, either statewide or within zones, harvest information provides perhaps our best index to detect and monitor changes in abundance. Given stable hunter effort, permit success should act as a suitable index to population size, with hunters harvesting turkeys in proportion to their abundance. Although hunter effort varies among years in response to weather during the hunting season and perhaps other factors, permit success rate can still be used as a tool to infer long-term population trends and detect annual changes in abundance within zones.

Modeling suggests that two fitness measures are particularly important in determining wild turkey population dynamics: 1) the recruitment of young into the breeding population, and 2) fall hen harvest. Further, excessive spring gobbler harvest (>35% harvest rate) can, over time, reduce hunter satisfaction by increasing the proportion of jakes within the male segment. The results of two separate radio telemetry studies in Wisconsin suggest that the harvest rate for gobblers during the spring season is below the level at which skewed male age ratios may influence hunter satisfaction. A more recent study also documented a hen harvest rate well below the level expected to impact abundance, and fall hen harvest has declined in recent years such that current hen harvest (hens/mi² of forest cover) appears minimal. Therefore, under current season





Ecology of Wild Turkeys in Wisconsin

frameworks and hunting pressure, neither spring nor fall harvests likely impact future hunt quality or turkey population trends at the scale of our turkey management zones.

Though current spring and fall harvest rates appear sustainable, biologists should continue to monitor zone-specific harvest levels and permit success rates in order to both track population trends and provide meaningful annual feedback for hunters.

Priority product: Annual review of zone-specific harvest, permit success rate, and trends in these parameters by the WDNR Turkey Advisory Committee, in conjunction with other information, to infer and detect population changes that may indicate a management response.

Strategy A3: Use annual spring and fall harvest data to monitor recruitment.

Age ratios derived from harvest data (the percentage of adult gobblers in the spring; poult per adult hen in the fall) are significantly related to one another, and both are also significantly related to poult:hen ratios from the previous summer's 10-week gamebird brood survey. As such, they provide valid measures of annual recruitment in Wisconsin's turkey flock and help biologists interpret and understand annual variation in harvest and permit success rate. Little information is available, however, to assess how accurately hunters can determine the age and sex of birds they've harvested; such information would be valuable and methods should be explored regarding how it might be collected.

Product: Annual review of zone-specific age ratio data from fall and spring harvests and 10-week brood survey data by WDNR Turkey Advisory Committee to monitor recruitment levels.

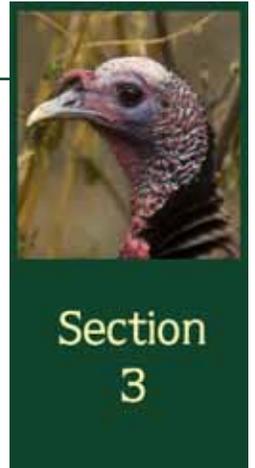
Product: Explore means of assessing the ability of hunters to accurately sex and age wild turkeys.

Strategy A4: Monitor unusual mortality events and diagnose cause when possible.

Although current spring and fall harvest levels do not limit the growth of Wisconsin's wild turkey population, other factors such as extreme weather or disease may lead to local population declines. Documenting any such unusual mortality events, and diagnosing the causal agent when possible, would better equip biologists to develop an appropriate management response, if such is warranted. However, documenting such die-offs is difficult, as they may occur in remote areas or during times of the year when few people are in the woods (e.g., winter), sick or dead turkeys may be killed or scavenged by predators before being found, and individuals may not report observed unusual mortality events.

Increasing public awareness of the importance of such episodic mortality to turkey population dynamics would increase reporting rates, and better documenting such events would increase our understanding of their occurrence and distribution in Wisconsin. Such tools would also provide additional information to biologists when describing local turkey population trends and establishing permit levels.





Product: Mention of the potential importance of winter weather and disease to turkey populations in annual press releases, with requests for individuals to report unusual mortality events to the local DNR biologist.

Product: Greater use of the wildlife health database, in which local biologists can quickly record reported and confirmed unusual turkey mortality events, including the location, date, number of turkeys involved, suspected cause, and disposal of carcasses.

Strategy A5: Monitor hunter attitudes regarding spring and fall season frameworks and maintain approval rates above 70% in all zones.

Ensuring a high-quality experience for Wisconsin's turkey hunters has been central to the development of our current fall and spring season frameworks. Annual hunter surveys provide ample feedback regarding hunter opinions and the level of approval for current season design, and offer our best opportunity to gauge sentiment from a representative sample of hunters. While individual comments are important to consider, changes to current season frameworks require accurate estimates of how particular components are received by the majority of hunters. Recent spring hunter surveys suggest that >84% of turkey hunters statewide approve of the current spring season structure (range among zones: 76%-88%). Biologists should continue to monitor annual hunter survey results and utilize additional questions on the survey, web-based surveys, and/or communication with partner groups (e.g., NWTF has >11,000 members statewide) to determine which season framework components are reducing hunter approval within zones. The design of current surveys should be reviewed and modified, if necessary, to provide high resolution regarding hunter perceptions of specific components of spring and fall season structures. For example, specific questions might be included to address the permit allocation process, season timing and length, etc. Given the current high level of approval for season frameworks, changes should only be recommended if supported by the majority of hunters through the current Wisconsin Conservation Congress advisory process or other rigorous public input methods.

The WDNR Turkey Advisory Committee should also continue to independently explore means of modifying season frameworks in order to simplify and standardize regulations and/or expand opportunities for hunters. For example, it would be possible to add a seventh week of spring hunting that always included Memorial Day weekend, if the opening day of the spring season was set as the second Wednesday in April rather than the Wednesday nearest April 13. Doing so would provide additional hunter opportunity, and make the opening date more consistent with that of other hunting seasons in Wisconsin. Such potential changes should only be implemented, however, pending hunter support as documented via the above assessment tools.

Product: Annual review of Spring and Fall Turkey Hunter Questionnaire information by the WDNR Turkey Advisory Committee, to assess hunter satisfaction with various components of the turkey management program.

Product: When satisfaction falls below the threshold, hunters will be queried to gauge their level of support for various alternatives as determined by the committee.





Section 3



Product: Continue to assess alternative season frameworks that would enhance hunter opportunity and/or increase hunter satisfaction, including assessment of a standardized opening date of the second Wednesday in April and addition of a seventh week of spring hunting.

Strategy A6: Maintain a high-quality hunting experience by managing hunter numbers to keep interference rates below 30%.

Providing a quality hunting experience is a primary goal of Wisconsin's turkey management program, and controlling interference rates by spreading permits out in space (zones) and time (separate time periods) has been key to achieving this goal. Interference rates reported on spring hunter surveys are consistently well below 30%, and hunters express high satisfaction with their hunting experience. Those hunting exclusively on public land tend to report higher rates of interference and lower hunt quality than those hunting on private land (Figure 20).

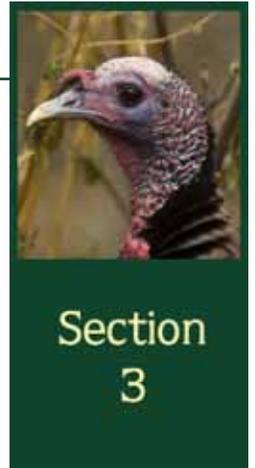
Priority product: Annual estimates of hunter interference rate, by zone, via appropriate questions on the Spring Turkey Hunter Questionnaire.

Product: If the reported interference rate exceeds 30% in any zone, explore adjustments to permit levels or the permit allocation process to reduce hunter density.

Strategy A7: Adjust fall permit levels only as necessary to protect the turkey population during periods of population decline that are unrelated to annual variation in weather conditions.

Fall permit availability has increased or remained stable in all zones since the first fall season in 1989; Wisconsin has never reduced fall permit levels to protect turkey populations, since current fall hen harvests are low and likely well below the threshold where they might be considered to have a significant influence on long-term trends in turkey abundance. Although adjusting permit levels during the fall season, including season closure, should remain an option in response to significant and/or long-term population declines within zones, permit levels will not be adjusted in response to annual population swings. We accept that turkey populations will fluctuate from year-to-year, and that the primary driver of such changes is natural variability in weather conditions during both the critical spring reproductive period and winter. Reducing permit levels in response to annual changes in abundance will have minimal impacts on future turkey population growth, but would significantly reduce hunter opportunity. The reduction of fall permit levels should be based on clear documentation of unusual downward trends in turkey abundance that can be linked to either the effects of elevated fall hen harvest or the presence of exceptional and perhaps unidentified population stressors (e.g., disease).





Population modeling will also provide greater insight into the potential impact of fall hen harvest on the dynamics of Wisconsin's turkey population, and may allow a more refined application of permit-level reduction as a tool to protect our turkey population.

Product: Semi-annual meetings of the WDNR Turkey Advisory Committee to determine permit levels for the spring and fall seasons. Discussions will include assessment of all relevant information pertaining to zone-specific turkey populations and hunter satisfaction.

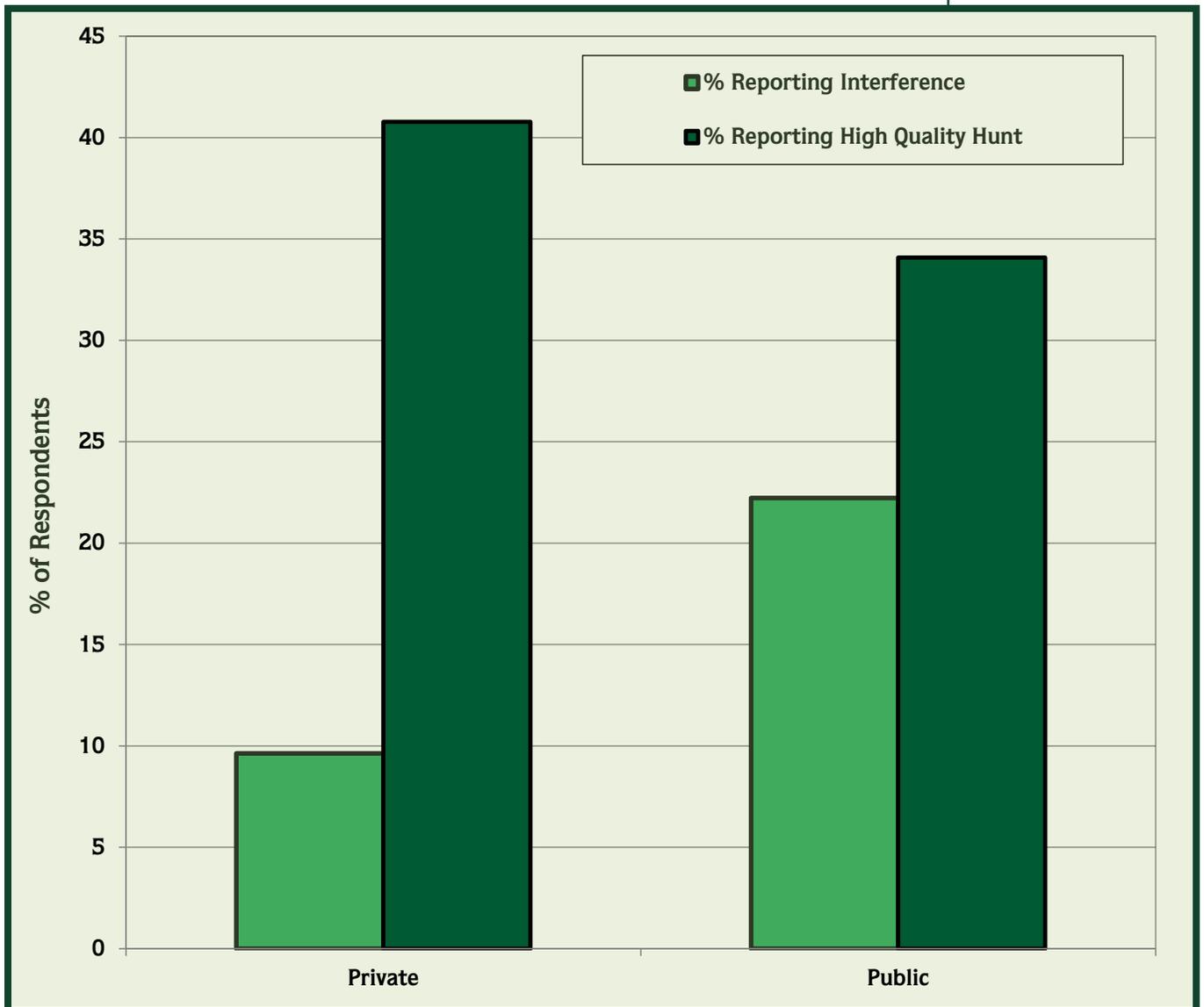
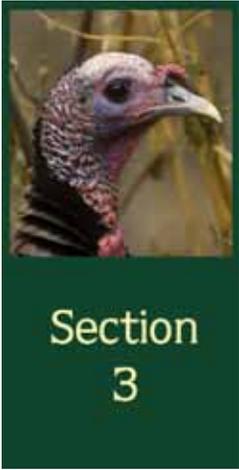


Figure 20. Perceptions of interference and hunt quality for spring turkey hunters who hunt exclusively on either public or private land. Results are averages from the 2008-2011 spring turkey hunter surveys. Results for hunters who hunt on both public and private land were intermediate.





Strategy A9: Define the factors important in determining hunter satisfaction.

Hunter surveys provide significant information regarding turkey hunter motivations and behavior, a reasonable measure of their overall satisfaction with the turkey hunting experience in Wisconsin, and a ranking of specific factors that contribute to that satisfaction. Researchers from the Wisconsin DNR and UW-Madison are utilizing these data to develop a model that identifies the factors most important in producing a satisfying hunting experience. Once complete, this research will inform managers about hunter motivations, allow them to explain annual variation in reported hunter satisfaction, and potentially identify strategies that will improve hunt quality for Wisconsin's turkey hunters.

Product: Research providing a rigorous assessment of the factors that influence levels of hunter satisfaction with Wisconsin's turkey season.

Strategy A10: Refine estimates of habitat availability within each TMZ.

Permit numbers are set within zones (and time periods during the spring season) in part to regulate hunting pressure. This helps to ensure a quality experience for individual turkey hunters by minimizing the chance for interference from others. The metric used to estimate hunting pressure is the number of permits allocated per zone (and time period) per square mile of forest cover as determined from 1992 WiscLand imagery. The high hunter satisfaction and low interference rates reported throughout the history of Wisconsin's modern turkey hunt indicate that this method has worked well to distribute hunters across space and time. However, it assumes that hunters are evenly-dispersed throughout the forest cover present. In reality, turkeys are not evenly distributed on the landscape, and hunters will tend to focus their efforts in areas where turkeys are relatively common. The current method therefore provides a coarse means of distributing permits, and fails to incorporate two factors.

First, research in Wisconsin has clearly revealed a nonlinear relationship between turkey abundance and the amount of forested habitats on the landscape, with turkey densities peaking in landscapes with between 30% and 70% forest cover. Northern and central forest areas with >70% forest cover hence provide less suitable habitat than indicated by the current measure of turkey habitat. Permits may be over-subscribed in these areas if based solely on the amount of forest cover available, since turkeys and turkey hunters may become concentrated in specific areas with relatively more open habitat, potentially reducing hunt quality by increasing the chance for interference among hunters.

Secondly, estimating habitat availability simply as the total amount of forest cover within zones fails to incorporate how the dispersion of that habitat might influence the distribution of turkeys and turkey hunters. For example, significant interference might be expected if 10 hunters were to simultaneously hunt a single 100-acre woodlot, whereas spreading those hunters across 10 separate 10-acre woodlots would likely negate the impact of interference. This phenomenon may explain why TMZ 2, with less than half the forest cover of other zones, typically has high hunter success rates yet reported interference rates only slightly greater than other zones.



Given that hunters concentrate their hunting activities where turkeys are present, revising estimates of turkey habitat availability within zones will allow more refined estimates of hunter densities within zones and time periods. This will increase the ability of managers to control hunter densities, and to evaluate the impact of varying permit levels on reported interference rates. A more accurate estimate of turkey habitat availability will require data linking turkey distribution to specific habitat metrics at fine scales. While radio telemetry studies can provide high-resolution estimates of habitat use and selection, attaining this information across the varied landscapes of Wisconsin is time-consuming and cost-prohibitive. Utilizing gobbler surveys to index turkey abundance, and linking these surveys spatially to landcover data in a GIS, provides a more prudent approach capable of providing information that could be used to model turkey habitat availability within each turkey management zone. Refining estimates of turkey habitat availability in such a fashion should be conducted in the short term, and the development of methodologies to accomplish this is listed as a priority for future research.

Product: Research to clarify how landscape composition influences turkey distribution.

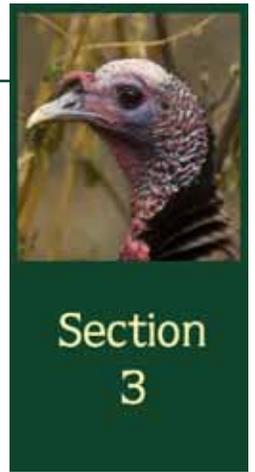
Product: Refined estimates of turkey habitat availability within each TMZ.

Strategy A11: Increase turkey hunter access to private lands, primarily in TMZ 2.

More than with many other forms of hunting, a quality spring turkey hunt requires that hunters have access to land with little pressure so that they can locate and work gobblers without interference. As such, high access to land relative to hunter numbers is important. Though the majority of Wisconsin turkey hunters hunt private land, low availability of public land may inflate interference rates, reduce hunt quality, and present an obstacle to hunter recruitment and retention efforts. In Wisconsin, land available for public hunting is relatively less available in TMZ 2 than in other portions of the state (Figure 21, next page), and a disproportionately high number of resident turkey hunters reside in this region. Efforts should be made to improve access to private lands in this area.

Priority product: Examine other means of increasing private lands access in areas where it may be limiting turkey hunter satisfaction and/or recruitment efforts.

Product: Turkey Hunter Access Program (THAP) or other programs, supported with Wild Turkey Stamp revenue, to increase access to private lands in TMZ 2 during the spring season.



Ryan Brathal





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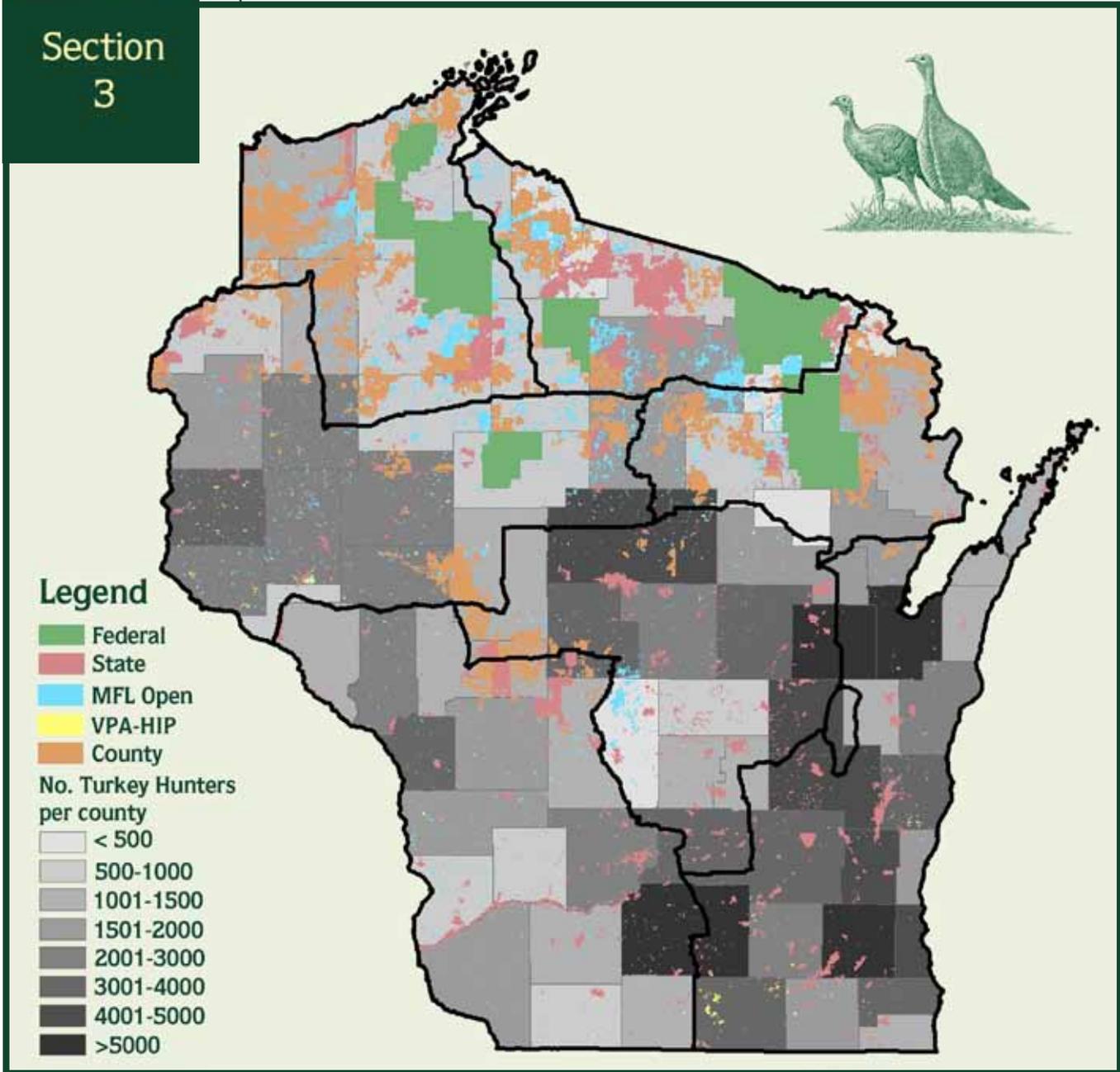


Figure 21. Ownership of land available for public hunting in Wisconsin (federal, state, and county lands, and private lands open to hunting via enrollment in the Managed Forest Law [MFL] program or Voluntary Public Access – Habitat Incentives Program) and the number of turkey hunters residing in each county.



Strategy A12: Evaluate the performance of and hunter satisfaction with and understanding of spring and fall turkey permit drawing systems.

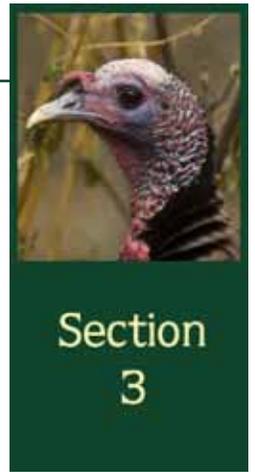
As mentioned, controlling hunter densities has been central to maintaining high hunt quality in Wisconsin. The spring and fall drawings which are used to allocate permits amongst zones and spring time periods must ensure fair and equal access to permits to maximize opportunity and produce hunter confidence in the system. Separate spring time periods also may provide landowners with the flexibility to allow more hunters access to their land during the course of a season. Input received from >2,000 hunters on a 2012 public input survey suggests that the majority feel that the current spring drawing system provides fair access to permits in preferred zones (84%) and time periods (72%). Survey respondents also expressed support for how both the resident and landowner preference categories are implemented (Box 6). In general, since hunters are able to list multiple zones and time periods on their permit application, the vast majority (>95%) receive a permit through the drawing process, and over-the-counter sales of remaining permits provide additional hunting opportunity. Permit availability does not therefore limit overall spring turkey hunting opportunity. However, the system does limit opportunity to hunt during early time periods, and some hunters express frustration when not able to draw an early-season permit. Continued monitoring of hunter satisfaction with the spring drawing process should be recommended.

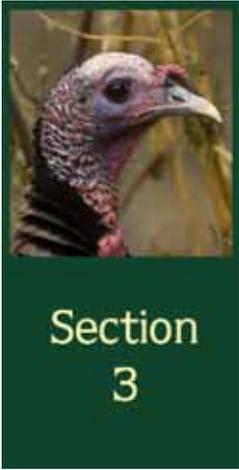
The permit allocation process is designed to fairly distribute permits, given that demand for permits exceeds availability. Hunters pay an application fee in order to have a chance to draw a permit through the drawing process. However, in recent years the availability of permits during the fall season has exceeded demand in TMZs 1, 3, and 4, and nearly equaled demand in TMZs 2 and 5. The fall drawing, therefore, has limited utility in some TMZs, in that hunters pay an application fee to enter the drawing yet are assured a permit. Eliminating the fall drawing and enacting over-the-counter license sales may therefore be a viable strategy in these zones. Such a change would necessitate enacting a season bag limit to protect the turkey population from excessive harvest, and the majority of hunters surveyed in 2012 support a fall season bag limit of one turkey (Box 6). Since hunter demand for permits routinely exceeds availability in TMZs 6 and 7, the drawing still serves to fairly allocate permits in these zones. An evaluation of the fall permit drawing process and alternative permit allocation strategies is warranted. Consideration should be given to how alternate strategies may impact overall permit sales and subsequent harvest levels. For example, Minnesota observed a near-doubling of fall turkey permit sales and harvest when their fall drawing was eliminated in favor of over-the-counter sales in 2012.

Product: Annual review of spring hunter surveys to assess hunter satisfaction with and understanding of the spring drawing process.

Product: Annual review of the spring drawing data for trends in drawing success by zone and time period.

Product: Detailed assessment of the current fall permit drawing and potential alternatives, to include harvest and fiscal implications of adopting over-the-counter license sales.





Objective B: Improve habitat for wild turkeys within the confines of broad land management goals.

Strategy B1: Define spatially-explicit turkey habitat enhancement goals for Wisconsin that recognize potentially competing goals for other wildlife species.

Land cover varies appreciably across Wisconsin, as does habitat suitability for turkeys. Clearly recognizing specific factors that limit turkey populations by region, and defining habitat goals that address them, will therefore help to maximize the benefit derived from habitat improvement efforts. On a broad scale, recent information regarding how turkey abundance varies according to the ratio of open to forested cover suggests that manipulating this ratio, where appropriate, provides the best means of increasing habitat suitability for turkeys. However, this requires a landscape-scale approach and the significant alteration of current habitat conditions (e.g., addition or removal of forest cover) that should only be undertaken in full recognition of other land management goals. Because turkeys are a generalist species capable of utilizing mature forest cover of any type for roosting, a diversity of forested and open habitats as nesting cover, and areas with a dense herbaceous ground layer (hayfields, forest trails, idle grasslands) for brood-rearing cover, site-specific habitat management efforts that simply modify existing plant communities or alter species composition are not likely to increase carrying capacity. However, appropriate site-level habitat efforts can maximize the utility of certain habitats for turkeys, and provide food resources during critical times (e.g., brood-rearing, winter).

Specific recommendations for turkey habitat enhancement in various Wisconsin landscapes are as follows:

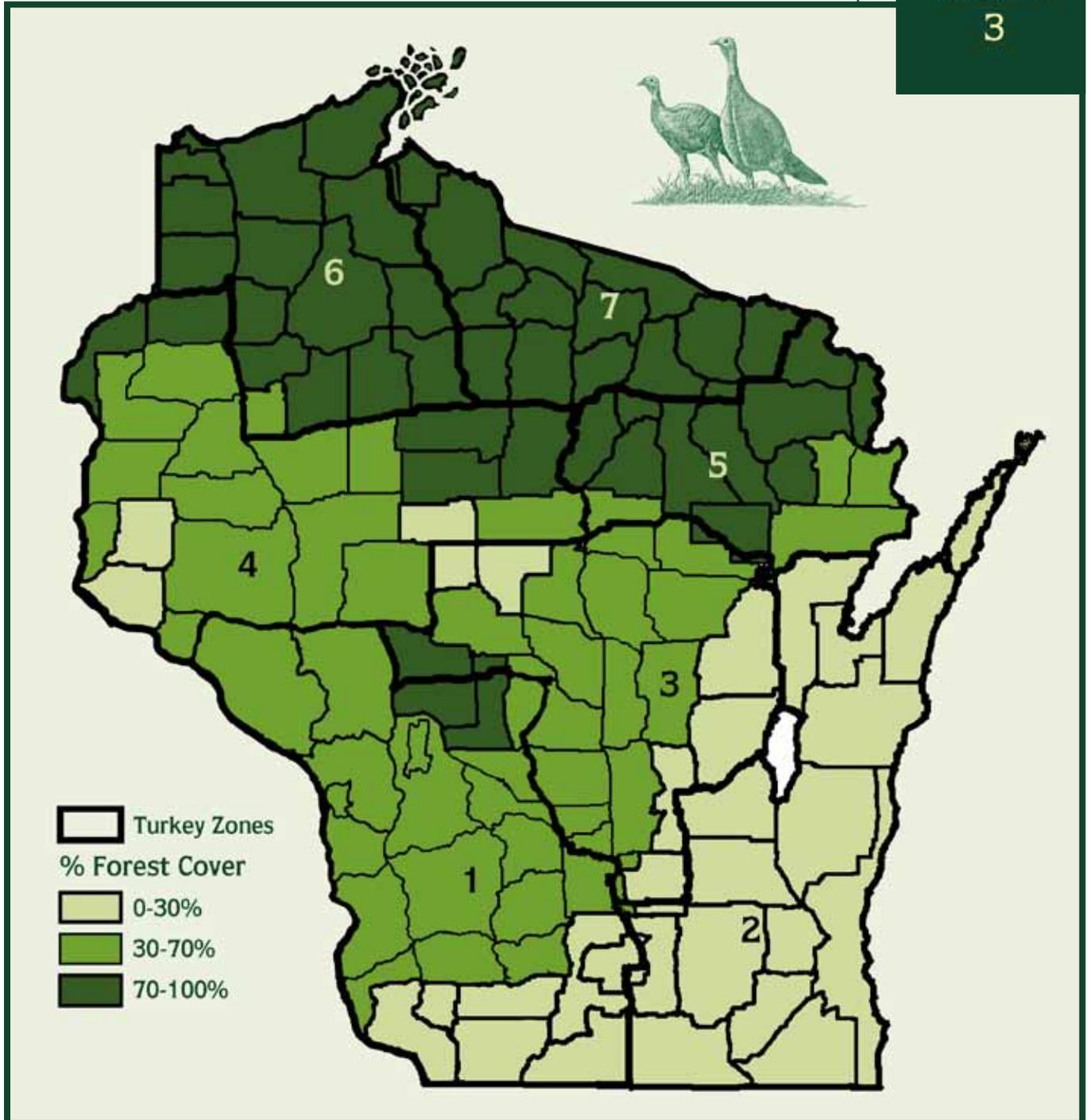
- ✦ In areas of northern and central Wisconsin where closed-canopy forests cover >70% of the landscape (Figure 22), a lack of brood-rearing habitat likely imposes limits on turkey population growth, as turkey poults depend upon the abundant insect populations found in areas with a significant herbaceous ground layer to promote rapid body growth. Where there is little agricultural activity, winter food availability may further limit populations, especially in years with significant and prolonged snow cover. Creating or maintaining openings should therefore be the priority habitat management approach for turkeys in this region. However, the establishment of new openings should fit within the objectives of current forest management plans, and managers should consider how openings influence habitat suitability for other wildlife species or guilds (e.g., forest-interior songbirds). Establishing and maintaining grassland habitat where feasible, especially in areas without existing idle grass or hayfields, would also increase the availability of brood-rearing cover. To augment winter food supplies, the establishment of native fruiting shrubs should also be promoted, especially species that retain fruit or catkins on branches into late winter (e.g., winterberry, American high-bush cranberry) and/or produce nuts or catkins (e.g., hazelnut).

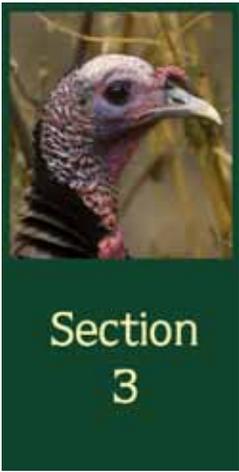




Section
3

Figure 22. Percent forest cover by game management unit in Wisconsin. The abundance of wild turkeys appears to be influenced by this measure, with greater numbers in areas with 30-70% forest cover.





Ecology of Wild Turkeys in Wisconsin

✚ On the other extreme, forests cover <30% of the landscape across much of southeastern Wisconsin and portions of the northeastern and west-central parts of the state (Figure 22). Forests in these areas tend to be highly fragmented, small in size, and interspersed in a landscape devoted largely to agriculture. Herein lies a conundrum in that, though the absolute amount of forest cover in these regions would suggest low turkey abundance, harvests in representative zones (e.g., TMZ 2) have been high and stable in recent years. As well, TMZ 2 has had the highest permit success rate. This may be due to hunters being better able to locate or pattern turkeys in the relatively open landscape. Alternatively, turkey abundance may be influenced by the dispersion of forest cover as well as its total abundance on the landscape; i.e., small patches of forest cover dispersed throughout an open landscape may provide adequate roosting habitat to support high turkey abundance. No research has been conducted on turkeys in this portion of the state, and little is known about how the dispersion of forest cover influences their distribution or movements. This is a ripe area for future research, and such research is recommended.

Given the documented relation between forest cover and turkey abundance, reforestation efforts would appear to be a prudent means of providing more suitable turkey habitat in the area. Such efforts should be implemented cautiously, however, as they may confound concurrent efforts aimed at providing habitat for wildlife species adapted to grassland ecosystems. Though private landowners may choose to establish any cover on their land, biologists should be cognizant of how planting trees in certain areas on public lands might impact existing grassland restoration and management goals.

Tree planting should not be promoted within areas that have explicit grassland restoration goals. For example, tree planting should not be promoted in Bird Conservation Areas (BCAs) established to expand the habitat base for grassland birds. Efforts should be made to identify these, and other, local grassland restoration projects when considering reforestation efforts. Even small inclusions of trees in these landscapes can reduce habitat suitability for grassland birds adapted to open landscapes, and allow incursion by woodland predators (e.g., perching hawks, raccoons). Once established, trees will

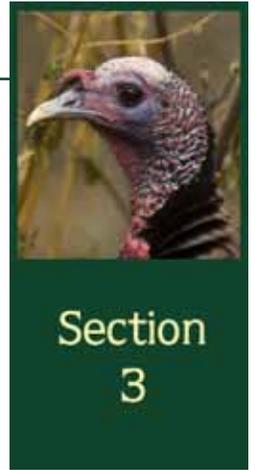
continue to impact efforts to manage for open landscapes throughout the life of the stand, and biologists should hence be cognizant of both current and future landscape-level management plans that may be confounded by forest cover.

Outside of areas devoted to grassland restoration, reforestation can be an effective means of increasing habitat suitability for turkeys, especially if very little forest cover exists in the area. Though seedling planting and direct seeding offer the ability to quickly establish forest cover of a desired species composition, biologists and landowners should consider allowing forest cover to develop



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through natural succession. Though this will delay the onset of a closed canopy forest and the development of roost trees, there is significant wildlife value from early seral stages of succession. Once land is idled, turkeys will utilize pioneer herbaceous communities as nesting and brood-rearing cover. Developing shrublands will also be utilized for nesting and may provide significant winter food. As a mature forest develops, it will also be more diverse in terms of structure and species composition, providing niches for more wildlife species while still yielding desired roosting habitat for turkeys. Where the planting of seedlings or direct seeding is selected, oaks are an obvious choice for turkeys given the food value of the eventual acorn crop.

Reforestation efforts to expand roosting habitat for turkeys in open landscapes may also be designed to provide additional ecosystem services. Proper placement and composition of plantings might allow them to also serve as shelterbelts or to protect riparian areas along waterways. When considering the establishment of forest cover in these open landscapes, biologists and landowners should consider how the practice might address multiple goals simultaneously.



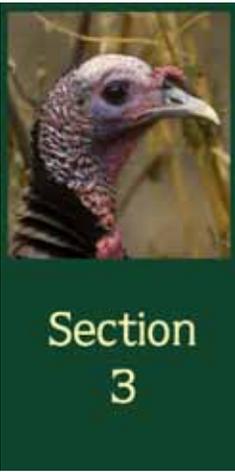
Although manipulating the ratio of open to forested cover appears to be the best strategy for increasing carrying capacity for turkeys, local habitat efforts can help to ensure that cover and food resources are well interspersed and available during appropriate times. Such efforts may also serve to alter turkey movements so that they are more visible or accessible to landowners or hunters. As turkeys are very much a generalist species, virtually any natural or agricultural habitat can provide needed resources at some point during the annual cycle. Locally, managers should determine which cover type or resources may be limiting turkey use of particular areas, and seek to provide habitats that will address this deficit. Since turkey hens utilize a wide range of habitat for nesting, nesting cover will usually not be limiting. However, in agricultural areas with little forest cover, hayfields may serve as “ecological traps,” with high nest and hen mortality associated with hay mowing activities. In these areas, the establishment of idle areas would provide secure nesting cover.

While research in Wisconsin has clarified how turkey abundance is influenced by the ratio of open to forested cover, expressing this ratio at scales finer than that defined in Figure 22 would lead to an increased ability to focus management in areas where it would be most likely to achieve population-level benefits for turkeys. For example, depicting this ratio at the township or section scale may allow managers to more specifically target local areas with <30% or >70% forest cover.

Priority product: Application of appropriate habitat management efforts that recognize region-specific limiting factors for turkey populations.

Product: Develop a more detailed map that depicts open : forested ratios at multiple scales (section, township, and Game Management Unit) that would increase our ability to focus efforts to improve habitat conditions for wild turkeys in Wisconsin.





Strategy B2: Continue to promote and support oak regeneration and management on public and private lands.

Oak forest communities provide habitat for a diverse wildlife community, and acorns serve as an important food source for wild turkeys during fall and winter. Oak communities are also diverse structurally, and the multi-level canopy with normally well-developed understory vegetation provides habitat for a variety of wildlife species. However, oaks are relatively shade-intolerant, and in the absence of specific disturbance regimes these communities are rapidly being replaced in Wisconsin by more shade-tolerant forest communities (e.g., maple/basswood forests). Current forest inventory data reveal an age distribution dominated by oak stands in the 35-95-year age classes (Figure 23), with insufficient regeneration to allow oak to persist on most sites in the state. Further, 85.6% of our state's oak forests are on private land, where social acceptance of appropriate silvicultural techniques (e.g., intensive harvest, prescribed fire) may present an obstacle to the development of management plans conducive to oak regeneration.

Recently, a number of initiatives have focused attention and provided support for oak regeneration efforts on private lands in the state:

↓ **Dedicated Wild Turkey Stamp funding.** The FY14-15 Wild Turkey Stamp guidelines mandated that 45% of stamp revenue be utilized to support oak regeneration practices on public and private land across approximately the southern two-thirds of Wisconsin. This will help to provide private landowners and public land managers with the funds necessary to incorporate practices (e.g., Timber Stand Improvement, prescribed burning, seedling planting) that favor oak into forest management plans. Additionally, funding is available to support research aimed at clarifying social obstacles to the adoption of oak regeneration practices on private lands.

↓ **Driftless Forestry Network.** Formed in 2011, this broad partnership among the Wisconsin DNR, American Forest Foundation, Aldo Leopold Foundation, and others has the goal of greater engagement by private landowners in forest management. Key objectives are to identify barriers to engagement by private landowners and develop targeted outreach and communication strategies. This effort will help to target outreach efforts on private lands, and foster broader adoption of oak regeneration techniques.

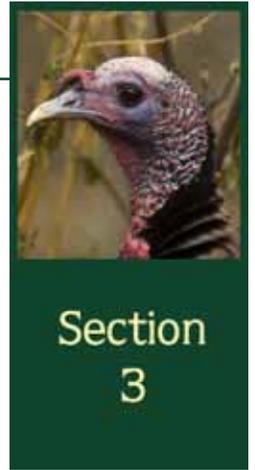


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Steve Maslowski, USFWS






Driftless Area Landscape Conservation Initiative. Approved as a national Landscape Conservation Initiative by USDA-NRCS in 2012, this effort aims to focus federal funding on four primary conservation goals in the Driftless Area. One of these goals is to improve forest diversity, and significant funds will be available to landowners annually from 2012-2017 that will allow them to adopt oak-friendly management practices in their woodlands.


Oak Focal Landscapes defined by NWTF. The Wisconsin Chapter of NWTF has established a Driftless Area focal landscape in which funding will be used to support silvicultural practices that favor oak regeneration. The Driftless Area focal landscape is regionally significant because it encompasses four states (WI, MN, IA, & IL) and because it was the site of initial wild turkey restorations in the region. Combined with the other approaches discussed above, these funds will provide a synergistic approach involving multiple partners to addressing the goal of maintaining oak forests as a vital component of our forested landscape in Wisconsin.

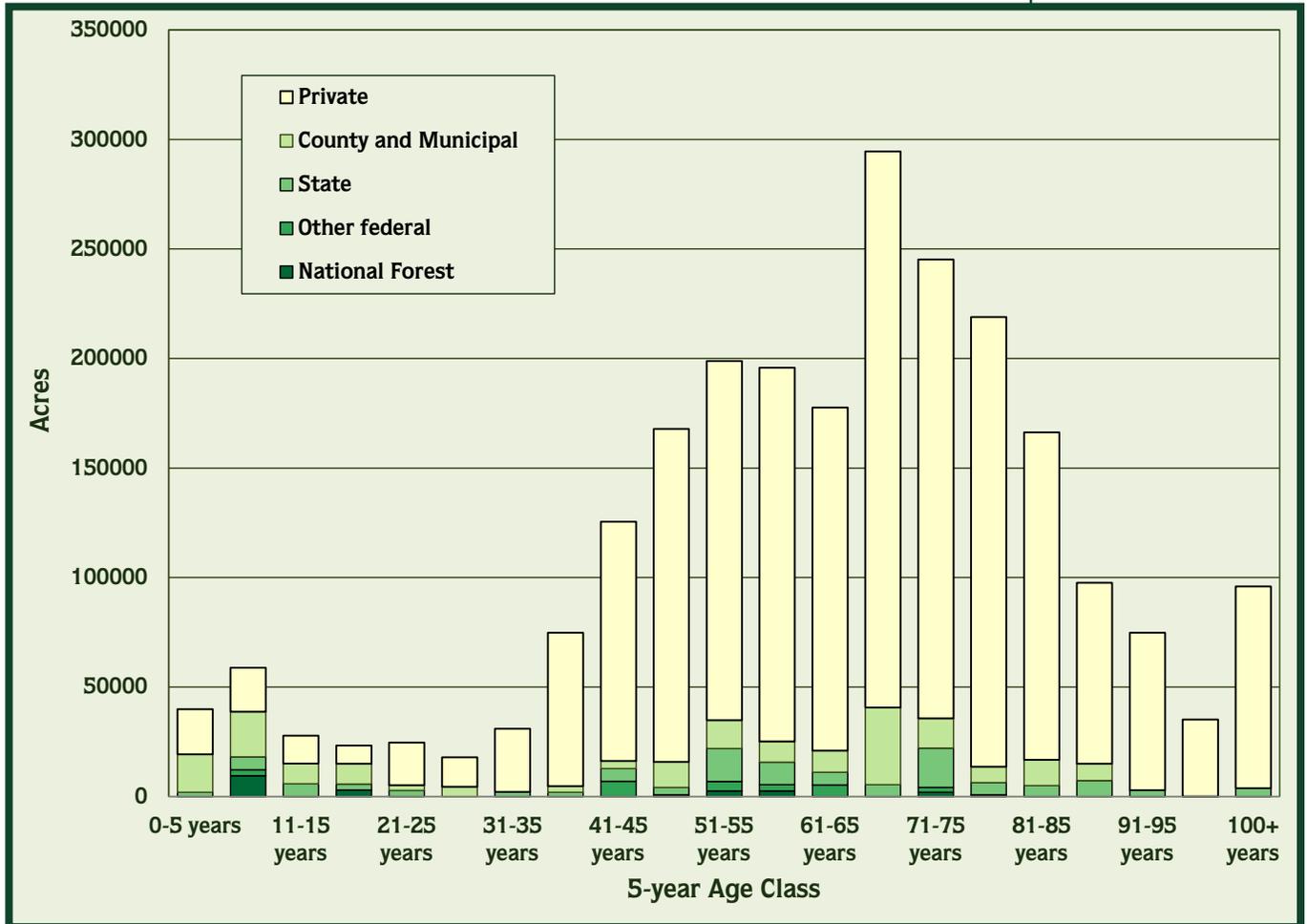
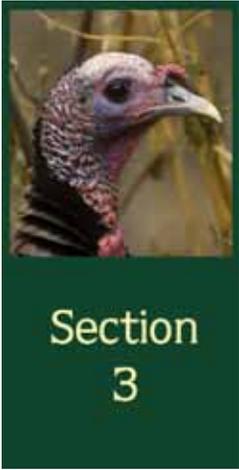


Figure 23. Acres of oak/hickory forest in Wisconsin, by age class and ownership (Forest Inventory and Analysis data, 2011).





Ecology of Wild Turkeys in Wisconsin

Given the importance of oak communities to wild turkeys and other wildlife species, these and other efforts to promote sound oak management practices should be supported. Priority should be given to efforts that promote adoption of oak management practices by private forest landowners, since the vast majority of oak forests occur on private land (Figure 23).

Priority product: Collaborate with partner organizations to support current (e.g., Driftless Area Landscape Conservation Initiative, Driftless Forestry Network) and potential efforts to engage private landowners in active forest management that benefits oak communities.

Priority product: Continue to utilize Wild Turkey Stamp revenue to support oak regeneration practices on both private and public lands.

Strategy B3: Utilize easement programs to protect agricultural/forested land.

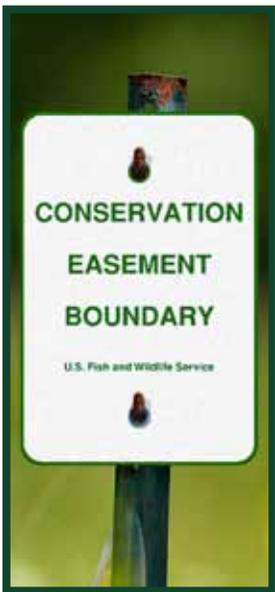
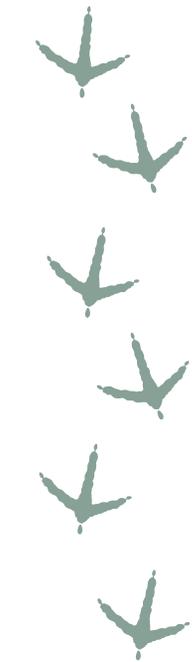
Development within forested and agricultural landscapes directly reduces the amount of potential turkey habitat present. Easement programs allow landowners to be compensated for agreeing to protect their lands from development in perpetuity. Working with staff from federal, state, local, and non-governmental organizations (e.g., land trusts) to promote existing easement programs (e.g., Grassland Reserve Program, Wetland Reserve Program, Forest Legacy Program, Farm and Ranchland Protection Program) addresses long-term goals for the protection of natural and agricultural communities important to turkeys.

Product: Engage staff from federal, state, and county agencies, land trusts, and other organizations to support and implement conservation easement programs in Wisconsin.

Objective C: Develop education and outreach tools to communicate effectively with hunters, landowners, and the public regarding turkey population ecology and management issues.

Strategy C1: Provide public access to the Wild Turkey Management Plan.

Wisconsin turkey hunters have a keen interest in turkey ecology and management, are actively engaged in hunter recruitment and retention efforts, and their activities are directly impacted by decisions related to turkey season structure, permit allocation, and the turkey management goals established in this document. Through hunter surveys and public input processes, they also help develop policy related to turkey management issues. This document, intended to provide a comprehensive review of the turkey management program in the state and to document prudent management goals over the next decade, is therefore of keen interest to these hunters and other citizens interested in Wisconsin's turkey resource. Publication and wide distribution via hard copy and the internet provides an excellent opportunity for outreach and education, and to further engage the public in turkey-related issues. This plan should therefore be posted on the



Wisconsin DNR website, and hard copies made available at all Wisconsin DNR Service Centers and local offices.

Product: Wide availability of this document, via the Wisconsin DNR website and hard copies available at Wisconsin DNR Service Centers and local offices.

Strategy C2: Continue to communicate with the public regarding turkey seasons, harvest, and management issues.

Wisconsin's turkey hunters are interested in turkey population issues and actively engaged in season structure and management issues. Regular communication has been key to providing hunters with information regarding upcoming seasons, permit and harvest levels, and pending or proposed changes to season structure. Efforts should be made to maximize the delivery of relevant information via press releases, the Wisconsin DNR website, focused educational articles and publications, staff presentations at Learn to Hunt and other local events, and through frequent communications with partner groups (e.g., NWTF, Conservation Congress).

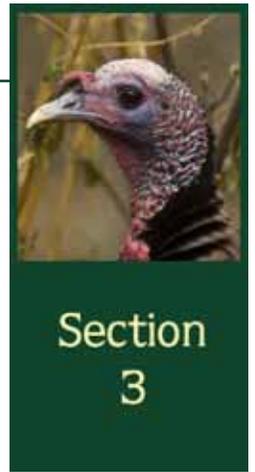
Priority product: News releases featuring timely and relevant information regarding upcoming or recent turkey seasons or potential changes to turkey season structure.

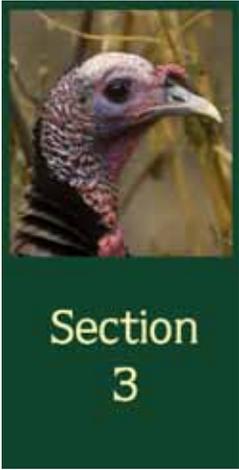
Priority product: Regularly updated information on the Wisconsin DNR website regarding upcoming application deadlines, harvest summaries, or potential changes to turkey season structure.

Priority product: Regular collaboration with partner organizations (e.g., NWTF-WI, Wings Over Wisconsin, Wisconsin Conservation Congress) regarding turkey management issues.

Strategy C3: Educate hunters about the factors impacting turkey populations.

Like all wildlife species, turkey population size fluctuates through time. Hunters must have accurate information regarding the role of harvest in turkey population dynamics if they are to understand and support agency decisions regarding annual permit allocations. In essence, hunters may believe that harvest drives population size, and hence expect the state agency to restrict permit availability when population declines are perceived. However, current fall turkey harvests in Wisconsin likely do not impact turkey population growth rates, and annual fluctuations in population size are primarily determined by weather-related variation in spring production levels. Reducing fall permit availability would therefore reduce hunter opportunity without a compensatory increase in subsequent turkey numbers. Educating hunters regarding turkey population dynamics, especially research regarding the specific roles of weather and harvest, would increase hunter understanding of the rationale behind management decisions and lead to better public acceptance of and confidence in the turkey management program.





Ecology of Wild Turkeys in Wisconsin

Priority product: Press releases, interviews, and other forms of communication that link management decisions or changes in harvest, hunter success, and population size to supporting research.

Strategy C4: Continue to work with partners to support outreach education and Learn to Hunt programs.

Over 130,000 hunters annually pursue turkeys in Wisconsin, and many are actively engaged in turkey management issues and/or hunter recruitment through participation in conservation organizations such as NWTf, Wisconsin Conservation Congress, Wings Over Wisconsin, local conservation clubs, and others. Clear and frequent communication between Wisconsin DNR staff and these organizations will help to ensure that information important to turkey management in the state is available and understood by hunters and citizens interested in our turkey resource.

Priority product: Encourage attendance by WDNR staff at meetings of local conservation organizations, and respond positively when such groups make requests for input or information.

Product: Attendance by WDNR Upland Program staff at all NWTf-WI state chapter meetings.

Product: Attendance by WDNR Upland Program staff at all Conservation Congress statewide and Upland Game Study Committee meetings.

Product: Encourage and support WDNR staff collaboration with partner organizations to support Learn to Hunt Turkey programs.



WDNR photo

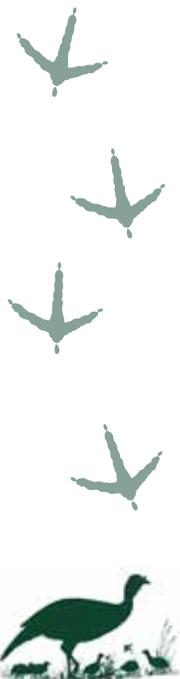
Objective D: Minimize negative interactions between wild turkeys and the public.

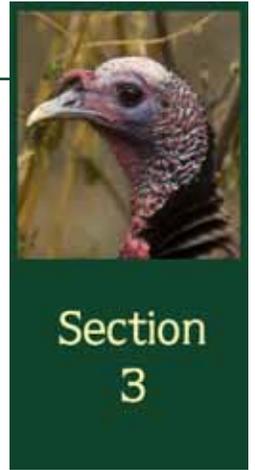
Strategy D1: Continue the current Wildlife Damage Abatement and Claims Program (WDACP).

By providing abatement assistance and compensation for documented crop damage, the WDACP provides an invaluable means of directly addressing negative interactions between turkeys and agricultural producers. As such, it helps to maintain a positive image for turkeys among the landowners who are responsible for stewardship of the majority of turkey habitat in the state.

Product: Continued eligibility for abatement assistance and compensation via WDACP for producers who experience agricultural damage attributable to wild turkeys.

Product: Ready availability, via the WDNR website and in hard copy at WDNR Service Centers, of literature pertaining to wild turkey damage management (e.g., UW Extension's "Wild Turkey Ecology & Damage Management").





Strategy D2: Communicate with municipalities regarding options for addressing nuisance turkey issues in urban/suburban environments.

Reports of negative interactions between people and turkeys in urban and suburban areas have increased in recent years, with individuals and municipalities more frequently requesting information on how best to address these issues. Often, harassment of the turkeys or habitat modification would be sufficient to address problems, but individuals often express interest in techniques involving lethal control or translocation. Providing information regarding the costs and benefits associated with various abatement measures in developed areas would facilitate more rapid and effective response by individuals or local agencies when problems arise, and maintain turkeys in a positive light.

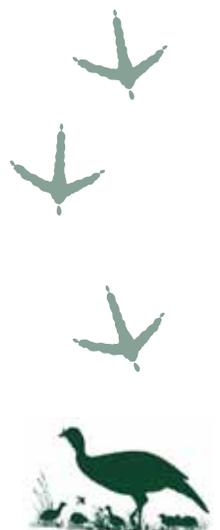
Product: Development and distribution of a pamphlet and/or other media, via collaboration with animal damage specialists, that outlines turkey ecology in urban or suburban areas, the costs, benefits, and likely effectiveness of various control techniques, and the legal and social considerations involved. Such information should be made available via the WDNR website, at DNR Service Centers, and be sent to all local governments in regions where nuisance issues exist.

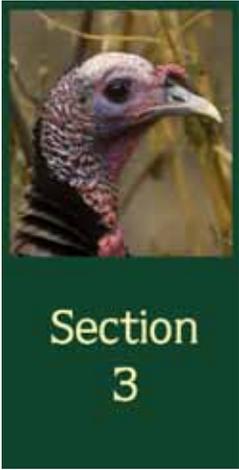
Objective E: Invest Wild Turkey Stamp funds to maximize benefits for turkeys, turkey management, and turkey hunting in Wisconsin.

Wisconsin State Statute 20.370(1)(ht) states that all proceeds from the sale of Wild Turkey Stamps must be used for “developing, managing, preserving, restoring, and maintaining the wild turkey population in the state.” Though this provides broad authority for investment of these funds, WDNR staff work with partner groups to ensure that goals and funding allocations are based on sound science and reflect specific contemporary turkey management priorities.

Strategy E1: Define clear, region-specific habitat enhancement objectives that address factors limiting wild turkey population growth and abundance.

Since turkeys are habitat generalists, a wide array of management practices might provide habitat usable by turkeys; however, stamp funding should be focused on those practices that address factors likely limiting turkey growth and abundance in various regions of the state. Recent research describing how turkey abundance is linked to the relative amount of forest and open habitats on the landscape, for example, suggests that maintaining and/or enhancing forest openings and trails, planting fruit-bearing shrubs, and establishing warm-season grasslands would increase biological carrying capacity in heavily-forested portions of northern and central Wisconsin (Figure 22). Though not clearly linked to measures of wild turkey fitness or abundance, oak forests are known to provide turkeys with important fall and winter food sources, and are declining extensively across Wisconsin due to forest succession (Figure 23). Improving access to brood-rearing cover and winter food in heavily-forested areas, and supporting





Ecology of Wild Turkeys in Wisconsin

forest management practices that foster oak regeneration, should continue to be habitat priorities for the Wild Turkey Stamp program. As new information alters our understanding of wild turkey/habitat relationships in Wisconsin, stamp funding priorities should be adjusted as well.

Priority product: Continued investment of Wild Turkey Stamp funds to support oak regeneration practices.

Priority product: Biennial review of turkey habitat management priorities and development of focused Wild Turkey Stamp application guidelines that reflect these priorities.

Product: Continued investment of Wild Turkey Stamp funds to support the development and maintenance of forest openings, trails, grasslands, and fruiting shrubs in regions of the state with >70% forest cover.

Strategy E2: Invest Wild Turkey Stamp funding in the support and promotion of the tradition of turkey hunting in Wisconsin.

Maximizing the recreational opportunities afforded by our wild turkey resource requires that obstacles to engagement by both experienced and novice hunters be identified and removed. Wild Turkey Stamp funding can and should be used as a tool to increase access to hunting land, and to support hunter recruitment and retention efforts.

Product: Continued availability of Wild Turkey Stamp funding for programs that increase access to lands for spring and/or fall turkey hunting.

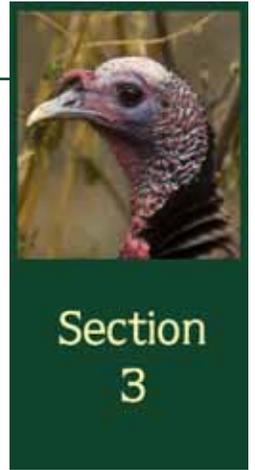
Product: Continued availability of Wild Turkey Stamp funding for hunter recruitment and retention initiatives, with priority given to those that strive to engage individuals unlikely to otherwise be exposed to hunting.

Strategy E3: Invest Wild Turkey Stamp funding in the support of coordination and administration of the wild turkey management program.

Managing Wisconsin's wild turkey population involves coordinating the input from numerous partner organizations, organizing the annual Wild Turkey Stamp artwork contest, managing Wild Turkey Stamp project budgets, developing press releases, videos, social media, and other communication items, engaging with partners at external meetings, responding to inquiries from the public, and coordinating the efforts of the WNDR Turkey Advisory Committee. Wild Turkey Stamp funds should be used to help support staff involved in these endeavors.

Priority product: Allocation of a maximum of 15% of Wild Turkey Stamp funds to support staff coordination and administration of the wild turkey management program.





Strategy E4: Invest Wild Turkey Stamp funding in order to address contemporary biological and social information needs.

Research has significantly improved our understanding of wild turkey ecology and population dynamics in Wisconsin, and led to better approaches to managing harvest and more focused habitat management goals. Further opportunities exist for research to address questions of relevance to wild turkey management (see next objective), and Wild Turkey Stamp funds should be available to support quality projects. Surveys of both spring and fall hunters have also provided exceptional feedback regarding the attitudes, preferences, and beliefs of state turkey hunters, providing managers with the ability to maintain or modify the wild turkey season framework or the permit allocation process to ensure a satisfying hunting experience.

Product: Continued availability of Wild Turkey Stamp funding to support relevant field research that will improve our ability to manage Wisconsin's wild turkey resource.

Product: Availability of Wild Turkey Stamp funding to support annual surveys of spring and fall turkey hunters.

Objective F: Conduct research as appropriate to address specific needs related to turkey management in Wisconsin.

Effective management of Wisconsin's turkey resource requires accurate information regarding how our turkey population responds to variation in habitat conditions, weather, harvest, and other factors. Maintaining the high quality of turkey hunting in Wisconsin depends in part on a healthy turkey resource, but also requires understanding of how changes in season frameworks and permit allocation would impact hunters. Research designed to address specific information needs can therefore improve our ability to allocate permits, regulate harvest, implement meaningful habitat management programs, and produce a season structure that is responsive to turkey hunter interests. The following are priority areas of future inquiry and recommended research projects for the wild turkey management program in Wisconsin:

Issue F1: Gobbler distribution in northern Wisconsin may be uneven, resulting in highly localized hunting and harvest pressure.

Since we currently use the amount of forest cover to index the amount of usable turkey habitat present in each turkey management zone, the number of permits allocated to each zone is in part determined by the total amount of forest cover present. Portions of the vast forest in northern Wisconsin, however, may not support the annual needs of turkeys due to a lack of open habitats that provide brood-rearing cover and winter food



Chris Pollentier





Section 3

Ecology of Wild Turkeys in Wisconsin

sources. Therefore, turkeys—and hence turkey hunters—may be more concentrated in this region than our coarse assessment of habitat availability would suggest. Better understanding of turkey distribution in this landscape, and how this distribution is influenced by habitat composition, would hence increase our ability to adjust permit levels to both manage harvest and control hunter densities.

Project: Evaluation of gobble distribution in northern Wisconsin and its implications for harvest management (ongoing; expected completion date of December 2015).

Project: Linking gobble distribution in northern Wisconsin with habitat composition and its implications for habitat management.



Steve Oehlenschläger

Issue F2: Impacts of harvest on population growth for wild turkeys in Wisconsin.

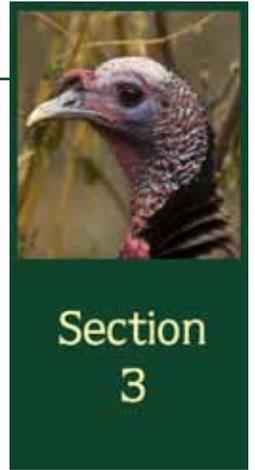
Population modeling can provide reasonable estimates of the impact of harvest on long-term turkey population trends, but it requires accurate estimates of model input variables (nesting rate, nest and pout survival, etc.), and must incorporate information regarding the impact of harvest on survival and the relationship between reproductive and/or survival rates and population size. Research in Wisconsin has provided estimates of important reproductive and survival measures, and research elsewhere suggests that models can be simplified by assuming that harvest is additive to natural sources of mortality. A high priority for future investigation involves the development of density-dependent population models

that incorporate vital rate estimates from Wisconsin field studies; these models can be used to more accurately define the impact of fall hen harvest on population dynamics. Incorporating recent data that suggests a link between specific vital rates and landscape composition will also foster more refined harvest management that embraces the variable habitat conditions that exist among Wisconsin's turkey management zones.

Project: Development of a demographic model that evaluates the sensitivity of population growth rate to key reproductive and survival metrics and harvest management scenarios (in progress; expected completion date December 2014).

Project: Use results from the demographic model to develop and implement experimental harvest management scenarios in order to maximize turkey hunting opportunities across multiple zones and/or habitat conditions.





Issue F3: Tailoring the Wisconsin turkey management program to optimize opportunity and meet turkey hunter expectations.

The goal of providing high-quality opportunities for Wisconsin’s turkey hunters can only be partly achieved through habitat work, harvest management, and other initiatives that provide for a healthy turkey population. Clearly understanding hunter expectations and the factors that determine satisfaction with the hunting experience are also part of a critical strategy for achieving this goal. Annual surveys of spring and fall turkey hunters provide an invaluable set of data that can be utilized alongside other tools to assess hunter satisfaction and suggest how management (season frameworks, permit allocation, etc.) might be adjusted to optimize quality hunting opportunities for hunters.

Project: Use annual turkey hunter survey data and additional social science tools (e.g., focus groups) to develop an in-depth look at how turkey hunter expectations have changed over time and whether the current harvest framework is meeting hunter demands and can continue to do so in the near future.

Issue F4: The influence of the amount and dispersion of forest cover on turkey distribution in TMZ 2 is not well understood.

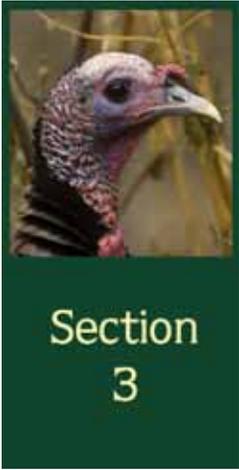
Though forest cover is relatively less abundant in southeastern Wisconsin than in other regions of the state, TMZ 2 hunters routinely have the highest harvest success rate. This suggests that hunters are more effective in this more open landscape and/or that turkey abundance and distribution are influenced by the dispersion of forest cover as well as the overall amount of forested habitat on the landscape. Since permit availability is to some extent determined by the total amount of forest cover present, this leads to high competition for permits in this region of high human density. Better understanding of how turkeys are distributed in this area relative to the dispersion of forest cover (i.e., the size and isolation of forest patches) would therefore lead to more informed decisions regarding how permit levels are likely to influence both the local turkey population and hunter densities.

Project: Determine how turkey distribution relates to the amount and dispersion (including the effect of patch size, isolation, etc.) of forest cover in southeastern Wisconsin.



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Summary Comments:

The Next Decade for Wild Turkey Management in Wisconsin

This document marks an important step forward for wild turkey management in Wisconsin, as it embraces the challenges and opportunities of the current era, in which:

- ↓ turkey populations have stabilized statewide after decades of continued growth and expansion;
- ↓ populations will fluctuate in size annually around carrying capacity, with such swings based on annual spring and winter weather patterns;
- ↓ statewide spring and fall seasons allow over 130,000 hunters take to the field to pursue turkeys each year;
- ↓ we have greatly increased our knowledge of the ecology, population dynamics, and habitat use of wild turkeys in Wisconsin, and formed a better appreciation for how landscape composition influences abundance;
- ↓ information from annual hunter surveys has provided clear insight into the factors important in determining levels of hunter satisfaction;
- ↓ current frameworks for both the spring and fall seasons are well supported by hunters, and surveys allow annual tracking of hunter sentiments regarding the current permit allocation process, zone structure, and format for spring time periods so that alternative approaches can quickly be assessed and implemented as suggested by science and hunter preference; and
- ↓ nuisance turkey issues in urban and suburban areas are becoming increasing common.

Successful management of wild turkeys in Wisconsin is indeed both an art and a science. Of paramount importance is the need to incorporate the best science available into appropriate harvest management and habitat enhancement programs to ensure healthy turkey populations across the varied landscapes of Wisconsin for the enjoyment of future generations. Relevant and focused research has provided significant improvements in our ability to both monitor and manage the impact of harvest, and to better understand how turkey populations respond to variation in weather and habitat composition. We will continue to utilize research as a tool to expand our knowledge of Wisconsin's wild turkey resource, and use it to improve our ability to sustain healthy turkey populations in the state.



Addressing both positive and negative interactions between wild turkeys and people is and will continue to be an important component of turkey management in Wisconsin. As wild turkeys have expanded across the state and become engrained in our wildlife community, the interface between this prominent wildlife species and humans has been defined through four primary channels: 1) hunting, 2) perceived and real agricultural damage, 3) nuisance turkeys in urban and suburban landscapes, and 4) aesthetic appreciation of wild turkeys as a common wildlife species. The “art” inherent in our future approach to turkey management will require that we readily assess and respond to public opinion, and incorporate the very important human dimension into our management strategies. Annual hunter surveys and engagement with relevant partner groups (e.g., NWTf, Wisconsin Conservation Congress) allow us to accurately define this interface for spring and fall turkey hunters, and hence provide the ability to incorporate the human dimension into the design of hunting seasons. The existing Wildlife Damage Abatement and Claims Program also allows us to directly assess and respond to reports of agricultural damage. Increasing reports of nuisance turkeys will require us to better engage individuals and municipalities so that proactive response mechanisms can be developed that address nuisance issues, yet protect local turkey populations and maintain public support and appreciation for wild turkeys on the landscape. Incorporating the human dimension into management strategies will best be achieved via an educated and informed public; outreach efforts that provide relevant information to concerned citizens will therefore be important to prudently addressing all turkey/human interactions and maintaining the aesthetic appeal of wild turkeys across our varied landscapes.

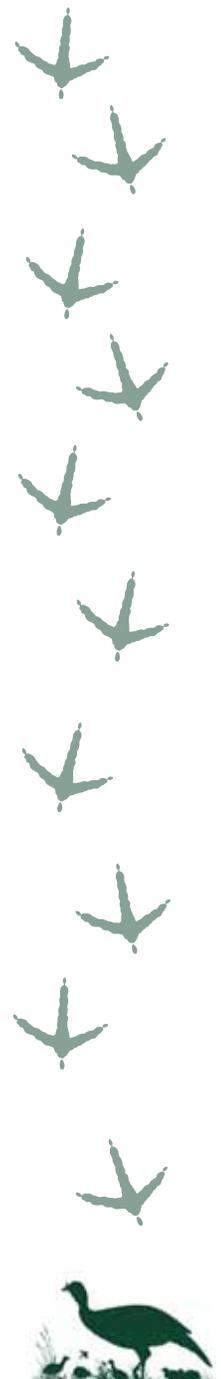
The goals and strategies outlined in this document are designed to provide a path forward that ensures healthy turkey populations for all future generations to enjoy, taking into account the best scientific information as modified by specific public issues and concerns. Restoration of wild turkeys to Wisconsin was accomplished through a strong partnership that included professional biologists and relevant non-governmental organizations, but most importantly the legion of passionate hunters, dedicated landowners, and interested citizens of Wisconsin. Continued success of the wild turkey management program will depend upon open communication among all such partners. This document provides the path forward, but embarking upon that path will require us to work together and adapt to all future opportunities and challenges.



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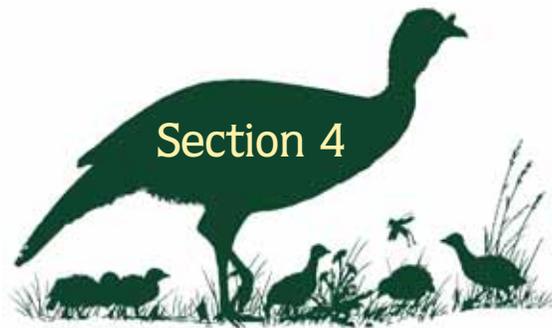
Section 3







SUGGESTED READING





Suggested Reading



Ecology of Wild Turkeys in Wisconsin

- Anderson, A.A. and Vanrompay, D. 2000. Avian chlamydiosis. Scientific and Technical Review of the Office International des Epizooties. 19:396-404.
- Badyaev, A.V., Etjes, W.J., and Martin, T.E. 1996. Age-biased spring dispersal in male wild turkeys. *The Auk*. 113:240-242.
- Brown, C.L. and Vander Zouwen, W.J. 1993. Wisconsin turkey hunter's guide. Wisconsin Department of Natural Resources. Madison, WI. 40pp.
- Chamberlain, M.J., Leopold, B.D., and Burger, L.W. 2000. Characteristics of roost sites of adult female wild turkeys. *Journal of Wildlife Management*. 64:1025-1032.
- Davidson, W.R. and Doster, G.L. Avian Pox: A disease that can affect any bird. National Wild Turkey Federation. Wildlife Bulletin 24.
- Dickson, J.G. 1991. The Wild Turkey: Biology and Management. Stackpole Books.
- Evrard, J.O. 1993. Were wild turkeys found historically in northwest Wisconsin? *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters*. 81:59-63.
- Fischer, J.R., Jain, A.V., Shipes, D.A., and Osborne, J.S. 1995. Aflatoxin contamination of corn used as bait for deer in the southeastern United States. *Journal of Wildlife Diseases*. 31: 570-572.
- Friend, M. and Franson, C. 1999. Field manual of wildlife diseases: general field procedures and diseases of birds. U.S. Geological Survey Biological Research Division. Information and Technology Report 99-001.
- Gustafson, E. J., Parker, G. R., and Backs, S. E. 2011. Evaluating spatial pattern of wildlife habitat: a case study of the wild turkey (*Meleagris gallopavo*). *American Midlands Naturalist*. 131:24-33.
- Healy, W. M. and Powell, S. M. 1999. Wild turkey harvest management: biology, strategies, and techniques. U.S. Fish & Wildlife Service. Biological Technical Publication BTP-R5001-1999. 97pp.
- Hubbard, M. W., Garner, D. L., and Klaas, E. E. 1999. Wild turkey poult survival in southcentral Iowa. *Journal of Wildlife Management*. 63:199-203.
- Hubbard, M. W., Garner, D. L., and Klaas, E. E. 1999. Factors influencing wild turkey hen survival in southcentral Iowa. *Journal of Wildlife Management*. 63:731-738.
- Hughes, T.W., Tapley, J.L., Kennamer, J.E., and Lehman, C.P. 2007. The Impacts of Predation on Wild Turkeys. *Proceedings of the National Wild Turkey Symposium*. 9:117-126.
- Kane, D.F., Kimmel, R.O., and Faber, W.E. 2007. Winter survival of wild turkey females in central Minnesota. *Journal of Wildlife Management*. 71:1800-1807.

- Kennamer, J.E., Kennamer, M.C., and Brenneman, R. History of the Wild Turkey in North America. National Wild Turkey Federation. Wildlife Bulletin #15.
- Kreager, N., Wainman, B.C, Jayasinghe, R.K., and Tsuji, J.S. 2008. Lead pellet ingestion and liver-lead concentrations in upland game birds from southern Ontario, Canada. *Archives of Environmental Contamination and Toxicology*. 54:331–336.
- Kubisiak, J.F., Rolley, R.E., and Paisley, N.R. 2001. Wild turkey ecology and management in Wisconsin. Wisconsin DNR.
- Lechmaier, M.R. 2008. Survival and Relative Abundance of Adult Male Wild Turkeys in West-Central Wisconsin. M.S. Thesis. University of Wisconsin. Madison, WI. 82pp.
- Lint, J.R., Leopold, B.D., and Hurst, G.A. 1995. Comparison of abundance indexes and population estimates for wild turkey gobblers. *Wildlife Society Bulletin*. 23:164-168.
- Lobner, E. (ed.). 1998. Managing your land for wild turkeys. Wisconsin Department of Natural Resources. Madison, WI.
- McGhee, J.D. and Berkson, J.M. 2005. Estimation of a nonlinear density-dependence parameter for wild turkey. *Journal of Wildlife Management*. 71:706-712.
- McGhee, J.D., Berkson, J., Steffen, D.E., and Norman, G.W. 2006. Density-dependent harvest modeling for the eastern wild turkey. *Journal of Wildlife Management*. 72:196-203.
- Nettles V.F. 1976. Organophosphate toxicity in wild turkeys. *Journal of Wildlife Diseases*. 12:560–561.
- Norman, G.W. and Steffen, D.E. 2003. Effects of recruitment, oak mast, and fall-season format on wild turkey harvest rates in Virginia. *Wildlife Society Bulletin*. 31:553-559.
- Oberlag, D.F., Pekins, P.J., and Mautz, W.W. 1990. Influences of seasonal temperatures on wild turkey metabolism. *Journal of Wildlife Management*. 54:663-667.
- Paisley, R.N. and Kubisiak, J.F. 1994. Food habits of wild turkeys in southwestern Wisconsin. Research/Management Findings No. 37. Wisconsin Department of Natural Resources. Madison, WI. 4pp.
- Paisley, R.N., Wright, R.G., and Kubisiak, J.F. 1996. Use of agricultural habitats and foods by wild turkeys in southwestern Wisconsin. *Proceedings of the National Wild Turkey Symposium*. 7:69-73.



Suggested Reading





Suggested Reading



Ecology of Wild Turkeys in Wisconsin

- Paisley, R.N., Wright, J.F., Kubisiak, J. F., and Rolley, R. E. 1998. Nesting ecology of eastern wild turkeys in southwestern Wisconsin. *Journal of Wildlife Management*. 62:911-916.
- Payer, D.C. and Craven, S.R. 1994. Wild turkeys: a problem for Wisconsin farmers? University of Wisconsin Extension. Madison, WI. 19pp.
- Perez, M., Henke, S.E., and Fedynich, A.M. 2001. Detection of aflatoxin-contaminated grain by three granivorous bird species. *Journal of Wildlife Diseases*. 37: 358–361.
- Pollentier, C.M. 2012. Influence of landscape features on wild turkey population dynamics in southwest Wisconsin. M.S. Thesis. University of Wisconsin. Madison, WI. 124pp.
- Poppenga, R.H., Ziegler, A. F., Habecker, P.L., Singletary, D.L., Walter, M.K., and Miller, P.G. 2005. Zinc phosphide intoxication of wild turkeys (*Meleagris gallopavo*). *Journal of Wildlife Diseases*. 41:218–223.
- Porter, W.F., Tangen, R.D., Nelson, G.C., and Hamilton, D.A. 1980. Effects of corn food plots on wild turkeys in the upper Mississippi Valley. *Journal of Wildlife Management*. 44:456-462.
- Porter, W.F., Nelson, G.C., and Mattson, K. 1983. Effects of winter conditions on reproduction in a northern wild turkey population. *Journal of Wildlife Management*. 47:281-290.
- Raffel, T.R., Register, K.B., Marks, S.A., and Temple, L. 2002. Prevalence of *Bordetella avium* infection in selected wild and domesticated birds in the Eastern USA. *Journal of Wildlife Diseases*. 38:20-46.
- Roberts, S.D. and Porter, W.F. 1998. Relation between weather and survival of wild turkey nests. *Journal of Wildlife Management*. 62:1492-1498.
- Roberts, S.D. and Porter, W.F. 1998. Influence of temperature and precipitation on survival of wild turkey poults. *Journal of Wildlife Management*. 62:1499-1505.
- Rolley, R.E., Kubisiak, J.F., Paisley, R.N., and Wright, R.G. 1998. Wild turkey population dynamics in southwestern Wisconsin. *Journal of Wildlife Management*. 62:917-924.
- Schorger, A.W. 1942. The wild turkey in early Wisconsin. *Wilson Bulletin*. 54:73-82.
- Schorger, A.W. 1966. The wild turkey: its history and domestication. University of Oklahoma Press. Stillwater, OK. 625 pp.
- Schweitzer S.H., Quist, C.F., Grimes, G.L., and Forester, D.L. 2001. Aflatoxin levels in corn available as wild turkey feed in Georgia. *Journal of Wildlife Diseases*. 37: 657– 659.

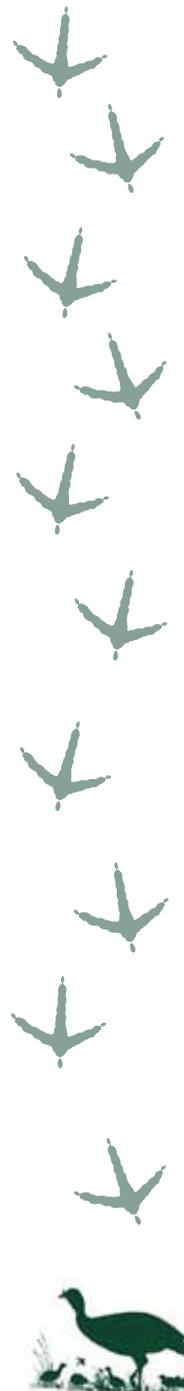
- Spalding, M.G. and Forester, D.J. 1993. Disease monitoring of free-ranging and released wildlife. *Journal of Zoo and Wildlife Medicine*. 24:271-280.
- Spraker, T.R., Adrian, W.J., and Lance, W.R. 1987. Capture myopathy in wild turkeys (*Meleagris gallopavo*) following trapping, handling and transportation in Colorado. *Journal of Wildlife Diseases*. 23:447-453.
- Swanson, D.A., Meyer, G.E., and Stoll, R.J. 2001. Crop damage by wild turkeys in Ohio. *Proceedings of the National Wild Turkey Symposium*. 8:139-143.
- Tefft, B.C., Gregonis, M.E., and Eriksen, R.E. 2005. Assessment of crop depredation by wild turkeys in the United States and Ontario, Canada. *Wildlife Society Bulletin*. 33:590-595.
- Vangilder, L.D. and Kurzejeski, E.W. 1995. Population ecology of the eastern wild turkey in northern Missouri. *Wildlife Monographs*. No. 130.
- Weaver, J.K. and Mosby, H.S. 1979. Influence of hunting regulations on Virginia wild turkey populations. *Journal of Wildlife Management*. 43:128-135.
- Wright, R.G., Paisley, R.N., and Kubisiak, J.F. 1989. Farmland and habitat use by wild turkeys in Wisconsin. Fourth Eastern Wildlife Damage Control Conference. University of Nebraska – Lincoln.
- Wright, R.G., Paisley, R.N., and Kubisiak, J.F. 1996. Survival of wild turkey hens in southwestern Wisconsin. *Journal of Wildlife Management*. 60:313-320.

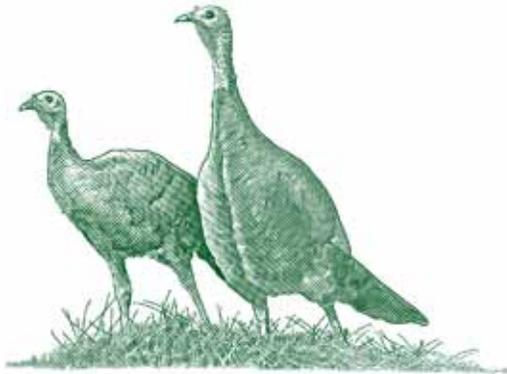


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Suggested Reading





Wildlife Management

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Design and Layout: Mary Kay Salwey, Wildlife Conservation Education Program
Wisconsin Department of Natural Resources

Cover Photo: Bruce MacQueen



Wildlife Management
WM-585-2015

