Is the sun rising for the prairie-chicken in Wisconsin . . .

Status and Management of the Greater Prairie-Chicken in Wisconsin—2006

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INTRODUCTION

The purpose of this paper is to report on the past and present status of the Greater Prairie-Chicken *(Tympanuchus cupido pinnatus*) in Wisconsin. Much of this paper is an update of the report, Prairie Chickens & Grasslands: 2000 and Beyond [PCG2&B] (Toepfer 2003), funded and published by the Society of Tympanuchus Cupido Pinnatus, Ltd. (STCP). Significant portions have been taken directly from that report and a proposal titled: A Plan for the Genetic Restoration of the Greater Prairie-Chicken in Wisconsin, Capture, Release and Evaluation 2006–2010 written by the author for STCP (Toepfer 2005a). The history of the Greater Prairie-Chicken in Wisconsin is one of expansion, contraction, and more contraction, and is a microcosm of the history of the species in North America. If the Greater Prairie-Chicken is to have a future as a viable species in Wisconsin and in North America then range contraction will have to cease and expansion will have to occur—history will indeed have to repeat itself.

Originally native only to the southern prairies of Wisconsin, Greater Prairie-Chickens responded to European settlement in the 1800s and expanded their range throughout the state as suitable habitat was created by agricultural and timbering practices (Schorger 1944). Grange (1948) indicated that as late as 1941 prairie chickens were still present in every county in Wisconsin after which natural succession and the expansion of modern agriculture drastically contracted their range. Today just five subpopulations exist in five counties associated with the grasslands of four Wildlife Management Areas [WMAs] (Fig. 1) in central Wisconsin (Toepfer 2003, Anonymous 1993, Robbins 1991, Hamerstrom and Hamerstrom 1973, Grange 1948).

The Buena Vista/Leola subpopulation has been maintained through the management of state owned and managed "scatter pattern" of permanent grassland reserves. Most of these re-

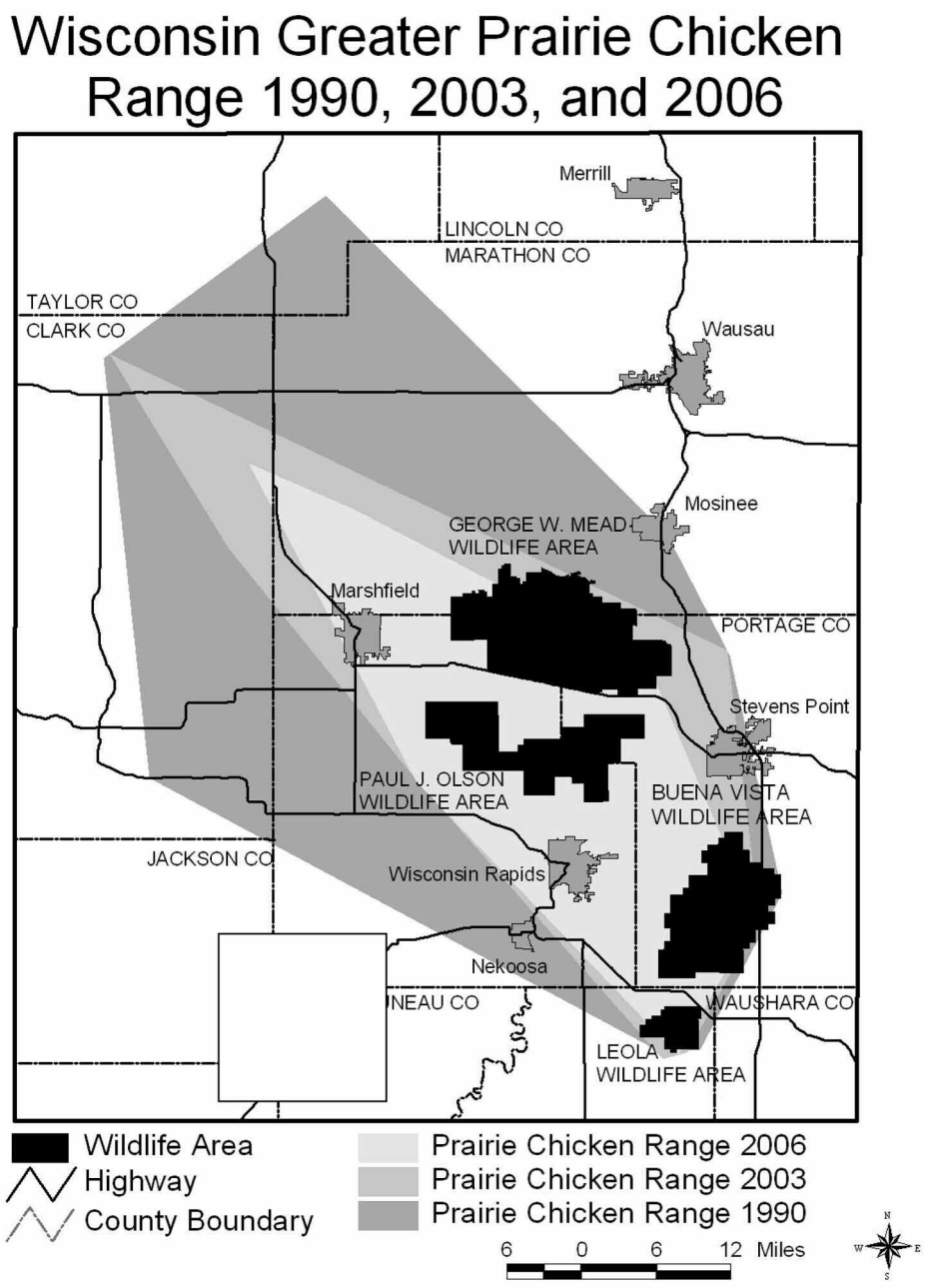

Figure 1. Contraction of Greater Prairie-Chicken Range Central Wisconsin, 1990, 2003, and 2006 and Wildlife Management Areas Central Wisconsin, 2006. Updated from Toepfer (2003).

serves (10,777 acres) were purchased specifically for Greater Prairie-Chickens as recommended by the Hamerstroms and Mattson in A Guide to Prairie Chicken Management between 1954 and 1969 (Berkhahn 1973). These lands were purchased by private organizations such as the Wisconsin Conservation League (WCL), STCP, Dane County Conservation League (DCCL), Wisconsin Society for Ornithology (WSO), and also the state of Wisconsin Department of Natural Resources (WDNR). An additional 1,220 acres have been purchased since 1969, mostly by the WDNR for a total of approximately 14,000 acres of permanent grassland reserves on Buena Vista (12,000 acres) and Leola (1,860). A small subpopulation at George W. Mead Wildlife Management Area has probably survived only through compatible management for waterfowl. The Paul Olson WMA and the Northern Range subpopulations are not managed for prairie-chickens (approximately 2,000 acres of reserves) and grasslands still exist on private lands there only because the wet clay soils restrict intense agriculture and haying (Warnke 2004, Anonymous 1993).

In the "Guide to Prairie Chicken Management," Hamerstrom, Hamerstrom, and Mattson (1957) stated: "Grassland is of vital importance to prairie chickens, the keystone in prairie chicken ecology. . . . Wherever one looks, the answer is the same: to save prairie chickens grasslands must be preserved and managed; there are no substitutes." The loss of suitable grassland habitat from most of their original range has resulted in the extirpation of the species throughout much of its range. Today only two small isolated remnant Greater Prairie-Chicken populations remain east of the Mississippi River; one in southern Illinois, and the second in central Wisconsin.

In summarizing the current status of the prairie grouse in North America, Robel (2004) indicated that "an aggressive plan" needs to be implemented to reverse the downward trend if there are to be "large viable populations 50 years from now." He was referring to populations with a "huntable surplus" not just a series of "minimum viable populations so bird watchers can observe males cavorting on leks in the spring." He emphasized that "unless aggressive management programs are implemented soon," Sage Grouse and Lesser Prairie-Chickens will follow the path of the Attwater's Prairie-Chicken, and the Greater Prairie-Chicken may not be far behind. Robel (2004) referring to Silvy's remarks (Silvy et al. 2004) stated, "Simply put, prairie grouse require prairie, lots of it." The "lots of it" was defined as "millions of hectares."

The current distribution of Greater Prairie-Chickens in North America is associated with grassland habitat that exists by an accident of geography or as the result of the development of permanent grassland reserves through active management. The accidents of geography I refer to typically consist of permanent grassland on private land and exist on the poorer soils that typically cannot be used for crop or hay production. When grazed, these lands have to be grazed carefully so that residual cover remains for grassland wildlife, especially prairie-chickens.

Prairie-chickens will not likely ever be associated with higher quality soils

because of their high value as cropland so they will through default be limited to the poorer soils that at this time are not profitable for agricultural production. Schwartz (1945) put all this in perspective over 60 years ago: "It is this grassland (permanent) when properly managed that furnishes their nesting, roosting, and other requirements. Thus the basic structure of the soil, its fertility, and topography set the pattern of land uses which in turn defines the present and future distribution and to a great extent the numbers of the prairie-chicken in Missouri."

Over fifty years ago Grange (1948) proposed: "If Wisconsin were to classify and dedicate from 1,000,000 to 5,000,000 acres of northern and central Wisconsin for the major land use purpose of producing prairie chickens and sharptails and accompanied this with adequate management, the future of these species would be bright".

CENSUS

Booming Ground Survey

The population information presented in this paper was obtained from annual booming ground surveys and cock counts conducted, coordinated, and/or compiled by various individuals 1950–2006 (Toepfer 2003). My methods follow the survey protocol established by Hamerstrom and Hamerstrom (1973) where the number of cocks per booming ground was determined from at least three morning counts per booming ground made just before and during the hen/breeding peak in April. Cocks displaying by themselves or singles were not included in the total by Hamerstrom and Hamerstrom (1973) because by definition a single cock does not constitute a booming ground or "lek" (Toepfer 2004). Nor does a single count of cocks observed booming at one location necessarily constitute a booming ground.

It is the norm to get variation in the number of cocks on a booming ground on different days and at different times of the day especially "early" versus "late" morning counts. Hence for many grounds the exact number of cocks cannot be determined and realistically and practically, one can only get a range of the number of "regular" cocks. The Hamerstrom's accounted for this by reporting a range of counts for each ground then provided three numbers/ground for each year, a range, maximum, and average of the range. The rounded average of the ranges was used to determine the annual changes in the number of cocks. (See Hamerstrom and Hamerstrom 1973, Table 1:11). The difference between the maximum and average number of cocks per year reported by Hamerstrom and Hamerstrom (1973) from 1950 to 1971 was 15.6% with a range of 6.9% to 29.3%.

In an effort to maintain continuity with the historical counts made from 1950-71 by Hamerstrom and Hamerstrom (1973), and those of R. K. Anderson (Anderson and Toepfer, 1994, 1999) from 1972–1993, the author and assistants on behalf of STCP have since 1996 conducted independent booming ground surveys and cock counts on the two main wildlife areas, Buena Vista and Paul Olson. These two areas contain over 78% of the prairie-chickens in Wisconsin. We have located booming grounds using GPS equipment to provide more accu-

rate locations than the forty-acre or quarter section locations used in the past or by other surveys. The areas reported for range changes were determined by measuring the size of a polygon created for the range by connecting the outermost points (Mohr 1947) created by the booming grounds. The counts presented here are consistent with the historical counts above and provide an ongoing overview of population cycles and trends as well as range contraction.

RESULTS AND DISCUSSION

Isolation and Range Contraction

The Greater Prairie-Chicken population in central Wisconsin has declined 30.6% (709–492 cocks) since 1990 and their range has contracted by half from 2,202 to 1,077 square miles (Toepfer 2003). Since 2003 and with the recent loss of the northernmost booming ground near Sportsman's Lake (Michele Windsor, personal communication) and the booming ground at Dewey Marsh (Dave Halfmann, personal communication), the range has continued to contract to the WMAs and in 2006 the range of booming grounds encompassed only 663 square miles.

The booming grounds at Neilsville (Jonas, personal communication) are gone and the Dewey booming ground which had 16 cocks in 1993 disappeared in 2003. Also gone is the Searles Cranberry ground (David Halfmann, personal communication), which had as many as 14 cocks, and the Mosinee airport booming ground which disappeared in 1993 (Tom Meier, personal communication). Figure 1 shows the Greater Prairie-Chicken range in central Wisconsin 1990, 2003, and 2006.

As indicated above the prairie-chicken range in Wisconsin has contracted from birds present in every county as late as 1941, to five subpopulations in just five counties in central Wisconsin. These contemporary subpopulations are now associated with four WDNR Wildlife Management Areas [Buena Vista/Leola and Paul Olson/Mead (Toepfer 2003, Anderson and Toepfer 1999, Hamerstrom and Hamerstrom 1973)] and with the private grasslands in the Northern Range near Unity. The Wisconsin Greater Prairie-Chicken population is totally isolated from the rest of the U.S. range and the nearest major population is about 350 miles away in northwestern Minnesota.

This contraction has not only occurred on a range-wide basis but also on all of the WMAs except Paul Olson where the booming ground range actually increased from 17 to 76 square miles 1962–2006. The booming ground range on Buena Vista has declined from a maximum of 72 square miles in 1951 to 37 square miles in 2006. Range contraction has been especially obvious on Leola WMA where the range has declined from 12 to 3 square miles 1950–2006 and the Mead declined from 27 to 17 square miles 1962–2006. The number of booming grounds on Buena Vista has also declined with contraction from 44 in 1951 to 25 in 2006. Today all of the booming grounds occur on or within a quarter mile of the state managed permanent grassland reserves. Booming ground habitat has also changed with 96% occurring on grassland cover in 1972 in contrast to 2006 where 48% were on plowed ground.

This change reflects the major loss of grassland on private land to plowed land.

The status of prairie-chicken in Wisconsin has reached the point where the subpopulations are now threatened, having become ecologically and genetically isolated from each other (Johnson et al. 2003, 2004, Toepfer 2003, Halfmann 2002, Toepfer 1988). This range contraction and isolation have resulted in a decline in numbers and a 29% reduction in genetic diversity since the early 1950s (Bellinger 2001, Bellinger et al. 2003). It was initially recommended by Palkovacs et al. (2004) and Toepfer (2003) that birds be translocated into the Wisconsin population to increase genetic diversity. A Wisconsin Conservation Genetics Advisory Committee subsequently corroborated these conclusions and indicated that "translocations are necessary for the long-term persistence of the Greater Prairie-Chickens in Wisconsin and given the overall reduction in genetic diversity throughout the Wisconsin Greater Prairie-Chicken range, interstate translocations should occur as soon as feasible." This committee of geneticists recommended that 30 to 40 hens from outside Wisconsin be translocated into the state for a number of years and that a control group of radio-marked birds be established to monitor survival and reproduction (Bouzat et al. 2005a, 2005b). They also indicated "The WDNR goal to acquire 15,000 acres of habitat over the next 10 years is in the right direction. However, it seems limited given the decline in numbers of Greater Prairie-Chickens over the last decades and the rates of habitat loss and fragmentation."

The fact that prairie-chickens have to be translocated into Wisconsin from the outside indicates that management has not been successful and that we as managers have failed to maintain a viable population in the state. The prairie-chicken in Wisconsin is currently considered a threatened species by the WDNR Bureau of Endangered Resources (BER) (Anonymous 1979). However, based on its isolation, small disconnected range, rapid range contraction, genetic state, and limited amount of grassland habitat, I believe it now warrants endangered species status in Wisconsin.

All of the contemporary Greater Prairie-Chicken samples used for Wisconsin genetic analysis were collected and provided by me through PCG2&B. The historic samples analyzed to compare genetic changes over time consisted of wings collected by the Hamerstroms during the last Wisconsin hunting seasons 1952–54. Quite contrary to what has been reported, these wings were not just found in their attic. The reader should know that they were very carefully archived in sealed wine boxes and entrusted to the author. The wings were cataloged by the author, hybrids and sharptails removed and individual wings segregated to township and range so they would be accurately classified and analyzed according to subpopulation by Dr. Peter Dunn and his students at UW-Milwaukee.

Population Trends

There have been booming ground counts of Buena Vista and Paul Olson reported by various individuals with UW-Stevens Point and the WDNR.

These reports have not included any methods and have provided only a single number of cocks per booming ground. In addition, likely because of changes in personnel and methods, these censuses have regularly missed booming grounds. In 2000, three booming grounds totaling 14 cocks were missed on Paul Olson. In 2001, ten booming grounds were missed; five on Buena Vista totaling 26 cocks, four on Paul Olson (8 cocks), and one in the Northern Range (3 cocks). In 2003, five booming grounds totaling 30 cocks were missed on the Buena Vista; two were major booming grounds with 10 and 11 cocks. It has recently been determined that there are no daily records for the booming ground cock counts provided by WDNR for Leola for at least the past 10 years and hence these data are weak. The author has at one time or another during the course of PCG2&B personally visited every booming ground in central Wisconsin. These discrepancies in census protocol and missed booming grounds ultimately fail to provide an accurate accounting of the state of the prairie-chicken in Wisconsin and are why STCP and the author have been conducting our own booming ground surveys and counts to maintain consistency and accuracy.

The general trend since 1990 has been for the Buena Vista to remain stable with an average of about 270 cocks. This population is down only 6.4% from 1990 but 52% below the last peaks of 550 cocks in 1981 and 1950 (Anderson and Toepfer 1999, Toepfer unpublished data). The Mead WMA population has declined 60.5% and Leola WMA 60% since 1990. The Northern Range population is all but gone, declining just over 90% from a high of 134 cocks in 1991 to just 12 in 2006 (Anderson and Toepfer 1999, Michele Windsor, Tom Meir, Ken Rosenthal, personal communication). The Paul Olson WMA, most of which is unmanaged, has been the exception. This subpopulation actually increased 20% between 1990 and 2006, and is the only population in Wisconsin with a statistically significant upward trend. Figures 2 and 3 show Greater Prairie-Chicken population trends in central Wisconsin for 1950-2006 and 1996–2006.

A series of Weighed Least Squares Linear Regression lines for the Greater Prairie-Chicken subpopulations in central Wisconsin (Toepfer 2005b) showed that the long-term (1950–2005) Buena Vista/Leola WMAs trend has been downward but not significantly (P=0.571). Paul Olson and Mead WMAs trends also are downward during the common period 1969–2005 but not significantly (P=0.409). Long-term the Buena Vista's trend is upward but is not significant (P=0.718) and as reported has to be considered stable. Both Leola (1950–2005) and Mead (1969–2005) have been in long-term decline and this trend is significant for Leola (P=0.002) but not for Mead (P=0.222). Population trends for McMillian and the Outlying Area (Northern Range) are separately downward (P= 0.001), and obviously when combined are significantly downward (P= 0.001), not positive as indicated by WDNR Warnke and Advisors (2004, Figure 7).

Ironically it is these least disturbed grasslands in the Paul Olson WMA of central Wisconsin, which are not managed for prairie-chickens, that have

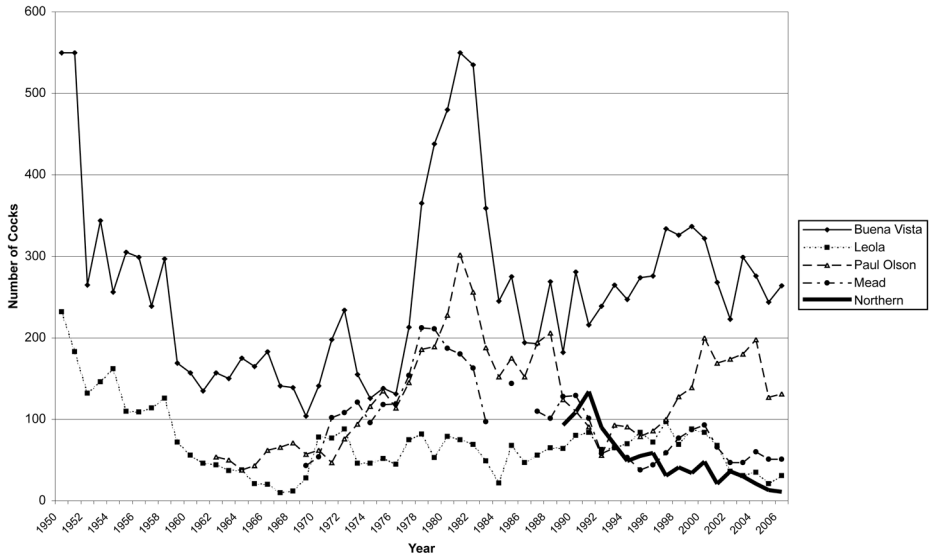

Figure 2. Greater Prairie-Chicken population trends (cocks) by area Central Wisconsin, 1950–2006.

been more successful than the intensively managed areas. From 1997 to 2006 the Paul Olson WMA Greater Prairie-Chicken population has increased eight out of ten years and the Mead has increased or remained the same seven times, while the intensively managed core Buena Vista and Leola WMAs have increased only five and four of the last ten years respectively. Only 4 miles separate the Buena Vista and Leola WMAs. The annual increases on Buena Vista/Leola since 1990 have never exceeded 18% (Low –23.1 to 17.7%) while Paul Olson/Mead have experienced increases as high as 45.8% and 66.1% (Range –40.5 to 66.1%). Greater Prairie-Chicken populations in Minnesota during this same period have increased by as much as 54.3% (Low–45.7%) (Wolfe 2004; Toepfer unpublished data), the Illinois population increased 56% in 2005 (Scott Simpson, personal communication), and the reestablished North Dakota population doubled between 2001 and 2002 even though 17 inches of rain which fell in 24 hours in June 2000 devastated that population (Toepfer 2003).

Since the largest increases of 62.5% and 71.4% in 1977 and 1978, annual increases on the Buena Vista since 1990 have not exceeded 20%. And during the last ten years the intensively managed Buena Vista and Leola subpopulations have increased in successive years only once and not at all, respectively. The Paul Olson and Mead subpopulations have increased in successive years five times and in four successive years 1997–2000, suggesting a possible correlation with local management activities. Differences in weather conditions are a pos-

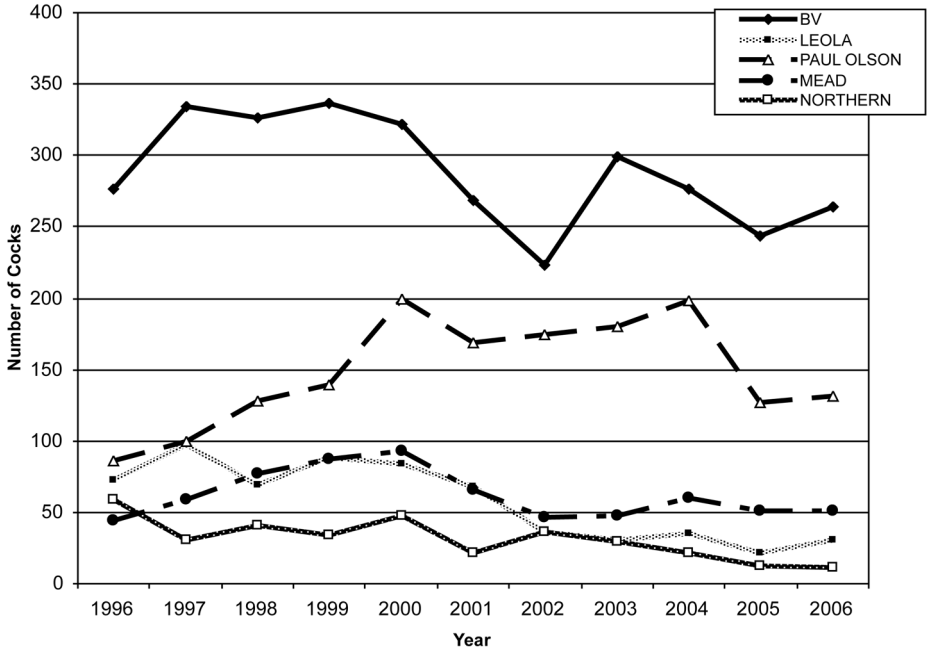

Figure 3. Greater Prairie-Chicken populations trends (cocks) by area Central Wisconsin, 1996-2006.

sible explanation for these differences but Paul Olson is only 12 miles from the Buena Vista.

These differences in population trends and patterns suggest that recent management practices on Buena Vista/Leola are having a negative impact and may even be suppressing reproduction and recruitment. In 1987 there was one more cock counted on the unmanaged Paul Olson than Buena Vista (194 versus 193). This resulted in concerns being raised by Hamerstroms and R. K. Anderson regarding too much disturbance and claims that the Buena Vista was being over-managed. Others even within WDNR have privately raised similar concerns that were ignored. The impact of "too much" management became more obvious recently when the grazing/mowing management regime to control brush between 2004–06 removed almost all of the cover in the grassland reserves surrounding three booming grounds (Meil, Zielinski, and South Bertottoo). These three grounds declined 97% from 27 cocks in 2004 when cover was eliminated to just two cocks in 2006 and the Meils and Zielinski booming grounds disappeared altogether in 2006. This is in total contrast to the overall population on Buena Vista, which declined only 5% from 2004 to 2006. The response to this was a STCP meeting with WDNR in August 2005 that resulted in a moratorium of all management disturbances (burning and grazing) except for food plots and spot brush mowing in the northeast-

ern half of the Buena Vista starting in 2006.

Nesting

The fact that nest success varies between management areas and decreases with the intensity of management gives one cause for concern. The nesting information presented here comes from Toepfer (2003). Nest success for the combined management areas showed that success was about 10% higher for the less intensively managed areas; 58.9% for 119 nests at Paul Olson and Mead versus 49.0% for 251 nests for Buena Vista and Leola or a difference of about 10%. Success was lower for the areas with the most state-managed permanent grassland reserves and most active annual disturbance regime (Toepfer 2003). Residual grass cover was present at all initial Greater Prairie-Chicken nests and it is important in nest site selection and success. Residual cover takes time to accumulate especially in the drier better-drained wetland soils on Buena Vista/Leola.

The Bottleneck

Bellinger et al. (2003) indicated that Wisconsin's Greater Prairie-Chicken population experienced a population "bottleneck" in the 1950s. This is not accurate as this is when the decline to the actual "bottleneck" began (Fig. 2). There have been two major population lows on the Buena Vista since 1950, one in 1961 (135 cocks) and a second in 1969 (104 cocks). There was also a low period from 1959–1977 where the population on the Buena Vista remained below 250 cocks (range 104–234 cocks) (Hamerstrom and Hamerstrom 1973, Anderson and Toepfer 1994, 1999). This long 19 year low period no doubt led to the decrease in genetic variation documented in the contemporary populations (Bellinger et al. 2003). The decline in genetic diversity was also precipitated by the loss of connectivity between subpopulations, especially between Buena Vista/Leola and Paul Olson/Mead, Halfmann (2002). Johnson et al. (2004) indicated that there was allelic/genetic exchange between Wisconsin subpopulations in the early 1950s but not today.

Cycles

Leopold (1931), Grange (1948), Keith (1963), and Hamerstrom and Hamerstrom (1973) all felt that prairie chickens populations were cyclic. In Figure 1 it is possible to detect four higher peaks approximately ten years apart from 1972 to present. Three peaks can also be seen in the Minnesota population 1980–2003 (Fig. 4). Whether the Wisconsin population is cyclic or not is moot because from a population security viewpoint one will be more concerned about management keeping the population lows as high as possible and well above any minimum number.

Minimum Population Size

How many prairie-chickens will be enough? The number of individuals realistically necessary to offset genetic drift and inbreeding in an isolated population varies and has been estimated at between 500–5,000 breeding individuals (Franklin and Frankham 1998). In prairie-chickens with their lek breeding system where only 10%

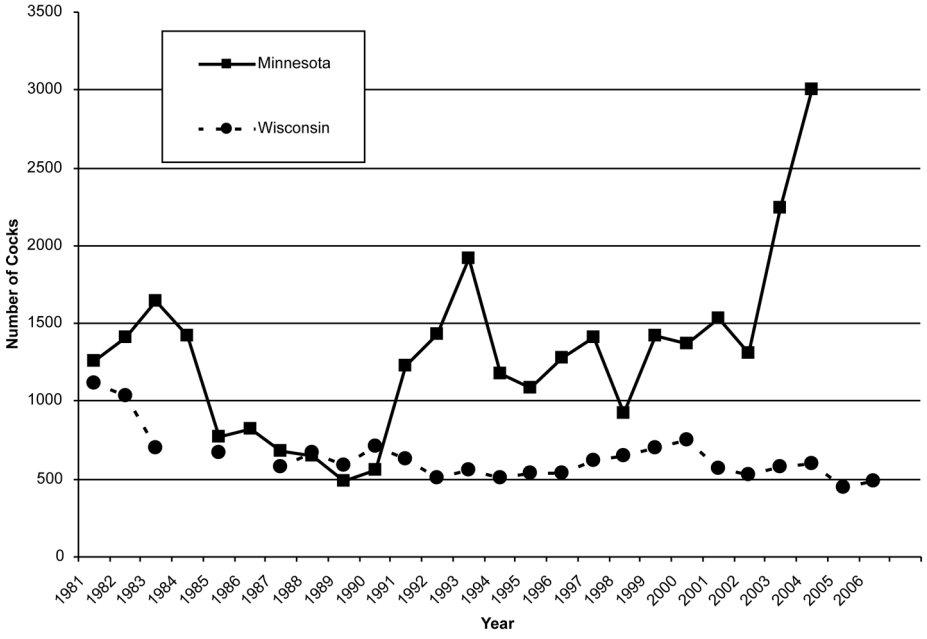

Figure 4. Greater Prairie-Chicken population trends (cocks) northwestern Minnesota and Wisconsin 1981–2006.

of the cocks breed (Robel 1970), the minimum number needed for maintaining 500 breeding birds would be about 2,500 individuals (Walk 2004).

Minimum numbers can be dangerous because they become "minimum" fixed goals for administrators and politicians that provide little security for a population. Total local recruitment failures have been documented in Greater Prairie-Chicken populations. In Minnesota in 1992 heavy rains caused significant declines of 45–50% the following year, and in 1996-97 the population declined by half due to severe winter weather and subsequent flooding.

Catastrophic weather also occurred in North Dakota in 2000 when 17 inches of rain fell in 24 hours resulting in a 50% population decline in 2001. Real or optimal management security, both genetic and catastrophic, for prairie-chickens will only be provided with a population greater than any calculated minimum number.

There are only two ways to manage populations for a natural catastrophe: hope for good luck, or, through management, spread the habitat and population out over a large enough range so the whole population will not be exposed to a single devastating natural or weather event (earthquake, tornado, blizzards, heavy rains, hurricanes, or prolonged drought) or disease. Annual Greater Prairie-Chicken mortality is approximately 50% so if a disease or weather catastrophe occurred that eliminated a year's recruitment the population would decline by at least 50%, and if

there were no production for two years in a row there would be a 75% decline, etc. Therefore, populations even in excellent habitat could quickly go well below any minimum in just a year or two.

Population security for Wisconsin's prairie-chickens will be accomplished only with more habitat and more birds spread out in a connected population over a larger area, like what we see in Minnesota, Kansas, South Dakota, and Nebraska. Of these, Minnesota has by far the smallest numbers of prairie-chickens and size of range (approximately 2,500 square miles), however its long narrow north to south distribution (approximately 150 by 5–25 miles) provides at least a degree of protection from catastrophic weather moving east to west. The Minnesota population also went through several short bottlenecks of approximately 500 cocks (Svedarsky et al. 1997). For reference, the Nebraska sandhills, one of the strongholds for prairie-chickens in the U.S. is 20,000 square miles or 12.1 million acres in size (Vodehnal 1999). The Buena Vista by contrast is only 73 square miles or 46,770 acres in size.

MANAGEMENT

The sportsmen of Wisconsin have always been very supportive of the Greater Prarie-Chicken, as much of the funding for management of the WMAs especially for Buena Vista/Leola comes from federal Pittman Robertson funds paid for primarily by sportsmen. However, it is obvious that this effort has not been enough, nor will the current support level be enough, to sustain a genetically viable population.

Robel (1980) over twenty-five years ago indicated, "Much research needs to be done before we can scientifically manage prairie grouse populations. Quantitative aspects of habitat are important and must continue to receive the attention of biologists working with prairie grouse. Continued efforts must be made to census grouse populations accurately and/or precisely. Of utmost importance, however is that research horizons must be expanded and efforts must be increased to initiate basic studies on grouse biology and grouse-habitat relationships." He warned, "that when remnant populations exist, little basic biologically oriented research is initiated by state agencies because of the low probability of the grouse populations developing into a huntable resource." Currently sportsmen and state wildlife management agencies have more interest in species that are abundant and can easily be hunted such as the Wild Turkey (*Meleagris gallopavo*), Ruffed Grouse (*Bonasa umbellus*), and the non-native Ring-necked Pheasant (*Phasianus colchicus*).

Much of the history of prairie-chicken management in Wisconsin has been outlined in other venues, most recently by Anderson and Toepfer (1999). At this time far more support for grassland restoration and management comes from federal programs within the U.S. Department of Agriculture (USDA), which are funded by taxes from all citizens. The over 36 million acres of grasslands in the Conservation Reserve Program (CRP) that have benefited grassland wildlife exists as a temporary scatter pattern of grassland intermixed with

prime or better agricultural land. In Wisconsin there were 666,844 acres of land enrolled in CRP in 1997 (Anonymous 1997) but very little within the current Greater Prairie-Chicken range. This grassland habitat will likely last only so long as these lands are not economically viable for agricultural or energy production—probably 10 or 20 years or until the GNP of China approaches that of the US and their demands for food and energy increase. Federal and state laws, and even leases on "permanent" conservation easements on private land can be quickly changed by legislation if there is a perceived greater national economic need for food, energy, and/or jobs. We tend to forget that CRP is a conservation program to conserve soil and water, not a wildlife habitat restoration program. So we here in Wisconsin and nationwide have a limited window of opportunity and obligation now to develop a national "permanent" grassland program comparable to the national wetland program. History tells us that habitat security for prairie-chickens and other grassland wildlife unfortunately will only be created through the establishment of permanent grassland reserves.

One of the biggest obstacles to grassland conservation has been and will continue to be the public's perception that if it is not growing a crop, trees, or contains houses it is just wasteland. We have had it pounded into us since we were very young that planting trees is conservation. We tend to forget that the millions and millions of acres of quality soils that we use to grow most of our crops were created by grasslands.

In the future the answer to successful wildlife habitat management and especially prairie grouse management lies in the Hamerstroms' concept of ecological patterning (EP) or a scatter pattern of essential/critical habitats; sage brush for Sage Grouse, wetland and grassland for waterfowl, and forest land for turkeys scattered through an agricultural landscape. This is because people along with wildlife have to live on the same land and that any landscape will have to provide food, water, cover, and energy for both. This will be an inescapable paradox "as complete competitors cannot coexist." Establishing large contiguous blocks of wildlife habitat, especially permanent grasslands necessary to sustain viable prairie-chicken populations, will not occur often if at all.

The Hamerstrom et al. (1957) habitat model shows that minimum populations of Greater Prairie-Chickens are associated with 10–40% permanent grassland with areas containing more than 40% permanent grassland supporting increasingly larger populations. Greater Prairie-Chicken populations occurred on a sustainable basis in areas with a minimum of 33% grassland, were considered abundant only where grass comprised 50–75% of the area, and had "low lingering" populations in 10–15% relatively undisturbed grassland. A prairie-chicken area should be no more than 10–25% scattered woodland. Prairie-chickens require grass and open space. They use trees for feeding and loafing but tend to avoid woodland patches. Booming grounds have moved and/or been abandoned due to woodland encroachment (Hamerstrom et al. 1957, Anderson 1969, Toepfer 1988). Likewise "new" booming grounds have shown up when

trees have been removed and more open space created (Toepfer 2003). The cutting of trees and creating larger treeless areas increased annual survival of cocks on one booming ground by 20% (Toepfer 2003). The latter information and its implications led to the cutting of almost all the large trees or potential raptor perches (Peterson 1979) on state managed land on the Buena Vista.

Prairie-chicken nesting, brood rearing, and year round night roosting habitat on the Buena Vista/Leola are provided almost exclusively by the permanent grassland reserves. Except during the summer (mid-May to mid-September) feeding occurs in food plots and private agricultural fields adjacent to the permanent grassland reserves managed by the state of Wisconsin (Toepfer 1988). The typical daily pattern for Greater Prairie-Chicken mid-September to late April is to feed twice a day in the private agricultural fields and fly to and from night roosts in the undisturbed taller grass or grass/forb cover provided by the undisturbed grassland reserves. The exception is the cocks which regularly visit the booming grounds before they feed during the morning during autumn and winter and then during both the morning and evening during the breeding season. This pattern persists today and has been well documented in numerous other telemetry studies (Robel et al. 1970, Toepfer and Eng 1988, Toepfer 1988) and documented in Wisconsin back to Grange (1948) and Hamerstorm and Hamerstrom (1949). The movements of prairie-chickens are best characterized as being associated with the habitat within and surrounding a complex of booming grounds (Toepfer 2003). The booming ground is the year-round center of prairie-chicken ecology; they nest, night roost, feed, and raise young all within a mile of a booming ground. What all this means is that the booming grounds and habitat surrounding them should be the focal point of management.

Not all grassland conservation programs benefit prairie-chickens. The Greater Prairie-Chicken was touted by the state as the "flagship" species for the Conservation Reserve Enhancement Program (CREP) in central Wisconsin (Anonymous 2004 and Warnke 2004). Unfortunately, grasslands enrolled in CREP are not highly beneficial to prairie-chickens because CREP rules required that the grasslands be within 1,000 feet of a riparian area, which in central Wisconsin means trees and shrubs. The presence of trees and shrubs has been shown to negatively affect nesting success (Keenlance 1998, McKee et al. 1998) and survival in prairie-chickens (Toepfer 2003). A review of over 150 CREP parcels totaling over 4,000 acres enrolled within the central Wisconsin prairie-chicken range indicated that the average size of the parcels was 24 acres and few of the parcels were near existing or historical booming grounds. Hamerstrom et al. (1957) indicated that in order to benefit prairie-chickens 40 acres should be the minimum size of a grassland reserve; today it is believed that the minimum parcel size should be 80 acres.

At this time 25% of the Buena Vista WMA consists of permanent grassland reserves (Warnke 2004). However, based on the distribution of booming grounds, the permanent grassland reserves make up just over 50% of the range of booming grounds. In 2006,

based on the current booming ground distribution, only about half of the Buena Vista proper is occupied by prairie-chickens in contrast to over 90% occupancy in 1951. This high grassland ratio on the Buena Vista makes it good habitat for prairie-chickens and based on the Hamerstrom model they should be abundant and they are. However the Buena Vista as we have seen is too small and has become a zoo population, or what Johnsgard (2002) refers to as a "museum population." Sample and Mossman (1997) provide no actual data or references but indicated that in their opinion, the Buena Vista was an ideal management unit for grassland birds, yet it has proven too small to sustain genetic diversity for the resident keystone species, the Greater Prairie-Chicken. These grasslands provide ideal habitat for grassland birds but only during the breeding season, as most of these birds are migratory and spend less than half of their lives on the breeding range.

Bergerud and Gratson (1988) have often been quoted for their description of the Greater Prairie-Chicken in Wisconsin as "probably the most intensively managed grouse in North America." However this is very misleading, and should instead state that the prairie-chickens on the Buena Vista and Leola are the most intensively managed grouse in North America, as over 78% of grassland reserves and almost all of the funding for management occurs on the Buena Vista/Leola WMAs. As we are now well aware neither the Buena Vista/Leola nor the Paul Olson/Mead WMAs were large enough to sustain populations with a healthy genetic diversity and we now have to translocate birds from outside Wisconsin to increase genetic diversity.

In recent years it has been indicated by some Wisconsin biologists that "A Guide to Prairie Chicken Management" by Hamerstrom, Hamerstrom, and Mattson (1957) is outdated. It has also been implied that due to changing land uses on Buena Vista more grassland reserves will be necessary. The main concern was that the Hamerstroms and Mattson recommended only 3,200 acres of grassland and that the 40-acre parcels were too small. This is true, but the Hamerstroms and Mattson emphasized that "flexibility was key" for any such plan to be successful, and that "if the area should be as thoroughly changed to plowed land as southern Wisconsin now is, the plan will fail in its present objective unless it were modified." One of these modifications was "to consolidate into fewer, larger, self-supporting units with a smaller total population." And that is exactly what the Hamerstroms and Mattson did. They designated the necessary additional grassland reserves for purchase through STCP, DCCL, WSO, and WDNR while they were employees of the WDNR, and managing the Buena Vista and Leola. In the process the prairie-chicken in Wisconsin was temporarily saved from extinction. Once one such grassland complex was developed (Buena Vista) then it would be necessary for management to expand into other areas such as the Paul Olson, Mead, and outlying areas to increase numbers to provide security and sustain connectivity.

When the recommendations of Hamerstrom and Hamerstrom (1973) to "immediately" expand prairie-chicken management into the outly-

ing areas away from Buena Vista/Leola were not implemented, it, by default, established a core management philosophy for the prairie-chicken in Wisconsin. This core management philosophy of the focus of management on one primary area became further entrenched in the 1990s when a proposal was prepared to establish a Habitat Restoration Area (HRA) with 20,600 acres of grassland reserves to make up 25% of the Northern Range (Stetsonville; 4,000 acres, Unity: 7,000 acres) and Mead (9,600 acres) (Keir and Meier 1990). This HRA was not approved, nor was a smaller proposed HRA at Unity, as outlined in the Wisconsin GPC Management Plan (Anonymous, 1995). This same core management philosophy, which focused on one area or several areas with permanent grassland reserves, was also used to manage or "save" prairie-chickens in Texas, Illinois, Missouri, Oklahoma, and North Dakota. This approach obviously did not work, as chickens have not fared well in any of these states either.

One question that lingers is why were the Hamerstrom's recommendations to expand management away from the Buena Vista/Leola ignored for so many years once a grassland reserve complex with over 10,000 acres was established? There would seem to be two main reasons. The first was that the population returned to 1950 levels in 1981 and there were highs on all the WMAs (Fig. 2) and everybody was happy that management seemed to have been successful. However, this in hindsight was an unusually high, temporary cyclic peak. Second the management plan in 1983 allocated no additional acreages to Paul Olson so all of it was allocated to the core area Buena Vista/Leola. Everyone was led to believe that this allocation restricted land purchases only to the Buena Vista/Leola and that no land could be purchased on Paul Olson unless the Wisconsin Natural Resources Board (NRB) changed the allocation. It should be noted that this management plan was actually for all three WMAs because the total allocated acreages were managed as a complex by one manager. Hence the acreage allocations for Buena Vista/Leola could have been shifted to Paul Olson administratively without NRB approval. Such a request was never made. This misled many, including STCP and the author, into thinking for years that land just could not be purchased on Paul Olson unless the management plan was rewritten and approved by NRB.

The Tale of Two States

A core management philosophy and fate of the Greater Prairie-Chicken in Wisconsin since 1973 is apparent in the land purchases and management focus. From 1973–2003 approximately 2,800 acres of grassland reserves or less than 100 acres per year were purchased with almost all of it on the Buena Vista/Leola. Since this time, and especially since 1981, the prairie-chiken population in Wisconsin has declined and contracted to the grasslands on the WMAs.

Minnesota by contrast, through leadership of Minnesota Department of Natural Resources (MDNR) and the Minnesota Prairie Chicken Society (MPCS), during this same time frame purchased a total of at least 56,000 acres of grassland habitat or 1,890

acres/year within their prairie-chicken range. These lands were purchased by MDNR, The Nature Conservancy (TNC), and US Fish and Wildlife Service (USFWS). In addition approximately 170,000 acres of grassland habitat in CRP were added, as the state of Minnesota, unlike Wisconsin, designated their prairie-chicken range as a CRP priority area. All this grassland has resulted in an increase from about 500 cocks in 1985 to 3,200 in 2003, a six-fold increase (Fig. 4). The Greater Prairie-Chicken population data for Minnesota come from the MPCS Prairie Chicken Inventory (Wolfe 2004) (Also see Svedarsky et al. 1999). However the Minnesota population despite the large amount of grassland is not as secure as one would think. This is because most of the grassland habitat has been created through CRP and if this program were lost or modified it would negatively influence Greater Prairie-Chicken numbers and distribution. The loss of CRP in Minnesota could create large gaps in grassland distribution especially between Polk and Norman County and connectivity would be lost creating a situation similar to what occurred in Wisconsin that resulted in a significant loss in genetic diversity.

Hamerstrom et al. (1957) state "Prairie-chicken management is primarily grassland management, no grass, no chickens" and now, as we have seen in Minnesota and other states, more grass means more chickens. Since 1973 Minnesota took to heart the Hamerstroms' recommendations to expand management away from the core areas and applied the concept of ecological patterning exactly as intended. For now at least, Minnesota has become the real success story in grassland management for prairie-chickens.

This is exactly what Hamerstrom et al. (1957) indicated was required here in Wisconsin because management could not purchase the whole Buena Vista for economic and political reasons. They felt that it would be just as ecologically and cost effective to purchase and manage portions of the critical limiting habitat type (permanent grass, used for nesting, brood rearing, and night roosting) rather than the whole area. With this done, management could then let the adjacent private land provide the rest (open space and food in the agricultural fields) at no cost to management. This is in contrast to purchasing the whole area or one large block and leaving management to provide everything for Greater Prairie- Chickens. When management in Wisconsin failed to expand grassland management into the outlying areas it adapted a core management philosophy by default which focused land purchases, funding, and management activities on the Buena Vista/Leola so by the late 1970s, the Greater Prairie-Chicken in Wisconsin was destined to become what Johnsgard (2002) referred to as a "museum" population.

None of this has come as a surprise to those who were paying attention, especially STCP, to declining prairie-chicken populations in the late 1980s in other states such as Illinois, Oklahoma, Missouri, and Texas and to the increases that were occurring in Colorado, Minnesota, and even Kansas, Nebraska, and South Dakota where tens of thousands of acres of grassland were being added through CRP (Svedarsky et al. 2000). Some managers in Wisconsin in the early 1990s

said everything in the state was fine despite concerns raised by the Hamerstroms and R. K. Anderson about too much disturbance on the Buena Vista. In the early 1990s I met with the STCP Council and indicated that indeed the prairie-chicken in Wisconsin was in trouble and the Hamerstroms and R. K. Anderson supported this contention. This concern was presented to the WDNR, and STCP was criticized at the time and were told that everything was fine and all that was needed was to "fine tune" management on the Buena Vista and further research and concerns regarding genetics were only of "academic" interest. This was the general belief despite the translocation occurring in Illinois at the same time to offset inbreeding (Bouzat et al. 1998; Westemeier et al. 1998a, 1999). I began working with STCP in April 1996 and developed the research project Prairie Chickens and Grasslands; 2000 and Beyond to document the status of Greater Prairie-Chicken in Wisconsin (Toepfer 2003).

Pheasants and Prairie-Chickens

There are other areas in Wisconsin with goals for the development of significant amounts of grassland habitat that could support Greater Prairie-Chickens: The WDNR Glacial Ridge Habitat Restoration Area (38,000 acres); the Western Prairie Habitat Restoration Area (20,000 acres); and the Blue Mounds-Blanchardville Prairie and Savanna Area. Although these areas may, or will, have grasslands, they have limited potential for prairie-chickens because they are isolated and have relatively high densities of Ring-necked Pheasants, which negatively impact prairie-chicken production via nest parasitism (Kimmel 1988, Vance and Westemeier 1979, Westemeier et al. 1998b, Toepfer et al. 2005a). At certain densities hen pheasants lay their eggs in prairie-chicken nests and pheasant eggs hatch at 23 days and chickens at 25 days. In west-central Minnesota in 2006, 40% of 19 chicken nests contained pheasant eggs, 11 nests hatched and none fledged chicken chicks. The pheasant has to be considered a serious threat to the Greater Prairie-Chickens in Wisconsin and Minnesota, as the competition between the two species is not only biological but also political. Greater Prairie-Chickens are not hunted in Wisconsin and are no longer a popular game bird nationally because they are not abundant and are difficult to hunt.

One of the main factors that has kept pheasants from moving north into the Wisconsin and Minnesota prairie-chicken range is winters with deep snow and cold. Such cleansing winters dramatically reduce pheasant numbers and distribution. However, if warming trends continue (resulting in open mild winters, i.e., global warming) we can expect the pheasant to quickly move northward into the Wisconsin and Minnesota prairie-chicken range. In recent years pheasants have shown up at the Mead, the furthest north WMA with prairie-chickens. And pheasant numbers and distribution are expanding (Tom Meier, personal communication). The mix of undisturbed grassland and agriculture in the Wisconsin prairie-chicken range, especially on Buena Vista/Leola, will make for ideal pheasant habitat. The indiscriminate release of pen-reared pheasants by anyone at any place, will serve only to compound these problem. There will al-

ways be a very serious and real threat of released pen-reared pheasants introducing disease and parasites into grassland bird populations. Over time, increases in pheasant numbers in the prairie-chicken range will become more and more of a threat. A decision will have to be made whether to keep pheasants out of the prairie-chicken range, or even eliminate them as has been done in Illinois Greater Prairie-Chicken management areas (Scott Simpson, personal communication). At this time research needs to acquire a better understanding of the niche separation between prairie grouse and pheasants.

FUTURE

The biggest threats to prairie-chickens in Wisconsin as well as in the United States are apathy and ignorance. Ecologically the main threat will be "unchecked human population growth" resulting in the loss of even more grassland habitat, which will only lead to further fragmentation and loss of connectivity. If Greater Prairie-Chickens are to have any future as a genetically viable population in Wisconsin it will be accomplished only through the addition of tens of thousands of acres of interconnected, undisturbed, grassland reserves in a scatter pattern within the open agricultural landscape between Paul Olson and the Mead, at the Mead, and to the northwest of the Mead in what is called the Northern Range. This open agricultural landscape contains approximately 1,670 square miles or 1.06 million acres.

The connectivity aspect or movement of individuals and hence gene flow between these grassland patches that Hamerstrom and Hamerstrom (1973) promoted for prairie-chickens will have to be created as a scatter pattern in a gerrymandering fashion across or within existing agricultural landscapes. Large contiguous blocks of wildlife habitat, especially grasslands that can sustain a viable prairie-chicken population, will not likely occur in Wisconsin because of the checker-boarding of private land ownership. Hence, grasslands created through purchase, easement, or government programs will have to be developed, one parcel at a time as willing sellers or program participants are located. Failing this, the state will have to periodically translocate birds from larger populations to maintain genetic diversity.

Management Plans—PCG2&B and WDNR

The recent Wisconsin Greater Prairie-Chicken Management Plan 2004-2014 (Warnke and Advisors 2004) is definitely a step in the right direction. This plan calls for the additional purchase of 15,000 acres of grassland reserves to the central Wisconsin prairie-chicken range. However, 1,500 acres of this total (10%) is to be added to the Buena Vista leaving 13,500 for the rest of the range. Unfortunately the acreage goal of this plan will maintain prairie-chickens in Wisconsin away from the Buena Vista only at the low end or at "marginal or lingering levels" (Hamerstrom et al. 1957). In addition, A Feasibility Study and Environmental Analysis for the Central Wisconsin Grassland Conservation Area (Anonymous 2004) calls for a "portion of the 13,500 acres to

be leased to local farmers for hay, pasture land, and cropland to maintain the agricultural landscape." This could take a significant amount of grassland habitat away from grassland birds further reducing the percentage of permanent grassland reserves away from the Buena Vista.

These plans also indicated that there are 7,300 acres of grassland for prairie-chickens on the Mead WMA. If this were the case then the ratio of grassland would be higher than on the Buena Vista and the Mead should have more than just 50 cocks. The amount of grassland on Mead in fact is only 1,910 acres (Tom Meier, personal communications) and is in line with the 50 cocks counted there in 2006. Much of the so-called grasslands on Mead are wetland sedge of little or no value to prairie-chickens for nesting and brood rearing, and only used during the winter for night roosting cover.

Ironically the goals of the Central Wisconsin Grassland Conservation Area (CWGA) (Anonymous 2004) to add 13,500 acres of "grassland habitat" could indeed be met on paper and even greatly benefit certain grassland birds yet have little impact on prairie-chickens. In order to benefit prairie-chickens grassland habitat parcels will have to be of a minimum size, located near existing or historical booming grounds, and will have to be managed in a manner as to maintain undisturbed grassland cover for nesting, brood rearing, and night roosting cover.

The recommendations made by me in PCG2B essentially would have added 31,000 acres and created three grassland complexes similar to the Buena Vista within the current prairie-chicken range, one each at Paul Olson, Mead, and the Northern Range. This would have increased the total grassland reserves from 10 to 18%. However, more important it increases the acreage of permanent grassland reserves in Wisconsin for Greater Prairie-Chickens from 4% to 21.3% in the areas away from the Buena Vista/Leola. At this point Buena Vista/Leola would account for only 28% of the grassland reserves within the prairie-chicken range. This is in contrast to the plan by Warnke and Advisors (2004) to add 15,000 acres to the central Wisconsin range, which increases the amount of permanent grassland reserves from 10 to 17%, with about 46% of the reserves located on Buena Vista/Leola.

In all likelihood we will not be able to save or create enough grassland habitat on Paul Olson because of the rapid increase in housing developments and the prairie-chicken population will continue to contract to the Buena Vista/Leola where 78% of the grassland reserves currently exist. Others, this author, and many within WDNR cannot envision a grassland corridor of any significance being developed in the agricultural landscape northwest of the Buena Vista and then across the Wisconsin River to reconnect to Paul Olson. This means the only realistic way the Buena Vista/Leola and Paul Olson/Mead populations can be biologically reconnected today is by increasing productivity on Buena Vista by modifying and improving management to increase density to a threshold point where individuals (primarily young of the year hens) will naturally disperse between these areas. In northwestern Minnesota when populations have in-

creased for several years, young of the year radio-marked hens have dispersed 10–32 miles.

When the goal of only 15,000 acres in Warnke and Advisors (2004) was questioned by STCP and the author, a WDNR administrator indicated that it represented the most they as an agency felt they could accomplish, given their very real constraints on dollars and personnel. Hence these grassland acreage goals in Warnke and Advisors (2004) are not based on the biological needs of the Greater Prairie-Chicken and are contrary to what was recommended by the Prairie-Chicken Committee established by WDNR to develop a Greater Prairie-Chicken recovery plan.

In the three years since the recommendations in PCG2&B were made, we have gained a better understanding of the number of prairie-chickens necessary to sustain a viable population. As indicated above, any minimum population number should take into account 2-3 years of reproductive failure. Thus in order to maintain the minimum population size of 2,500 birds necessary to maintain the genetic health of an isolated Greater Prairie-Chicken population (Walk 2004), a target population of 10,000 individuals would be needed to withstand 2 years of reproductive failure, assuming an average annual survival of 50% (Toepfer 2003), an average of 10 cocks per booming ground, and approximately 450 acres of grassland/booming ground as per the Buena Vista grassland ratio. Considering the above, over 225,000 acres of biologically interconnected grassland reserves would be necessary to sustain genetic diversity of Greater Prairie-Chickens in Wisconsin. Morrow et al. (2004) indicated that there are currently 70,000 acres of coastal grassland available for Attwater Prairie-Chicken and that the long-term recovery habitat goal for them in Texas is the management of 300,000 acres of costal prairie (Mike Morrow, personal communication).

However, on the positive side for Wisconsin and prairie-chickens in general one should keep in mind the message from Walk (2004) regarding prairie-chickens in Illinois: "The recovery potential of the Greater Prairie-Chicken in Illinois is very good and is limited only by human motivation to provide adequate habitat."

Other Concerns

The annual mortality from prairie-chicken collisions with electric transmission lines in Wisconsin along roads can be relatively high at 6–14% (Toepfer 1988, 2003). The ideal solution to reduce such mortality would be to bury the wires. This was done successfully through STCP in 2004 along a three-mile stretch of County Highway F along the west edge of the Buena Vista. Alternatives to burying the wires include placing food plots so birds do not have to negotiate such wires when flying between known night roosting cover and feeding areas (Toepfer 1988), or placing markers on the wires to make them more visible to the birds.

Recent research has documented significant mortality (40%) on Lesser Prairie-Chickens colliding with barbed wire fences (Wolfe, 2006). This has raised concern by some here in Wisconsin about fence-related mortality. This type of mortality in Wisconsin for

radio-marked birds was very low at 0.6% or just two birds from 1996–2003 (Toepfer 2003). In addition, most of the fence wire currently used on the state grassland reserves is electric fence and the WDNR technicians that have put out and taken in hundreds of miles of wire during the last ten years can recall finding only one dead chicken near these fences (Ken Rosenthal, personal communication). The explanation for the dramatic difference in the mortality rate due to fences between the two species is quite simple; Lesser Prairie-Chickens fly much lower than Greater Prairie-Chickens, making them more susceptible to colliding with barbed wire fences (Don Wolfe, personal communication).

For the past several years, concern has been raised by local residents and biologists that dog training (not the dog trials) on Buena Vista is becoming pervasive, and that dog trainers have begun to share information on where broods are located and then work multiple dogs on the hens with broods. This could be controlled through permits and by putting certain areas off limits and/or allowing training on alternate days (see Toepfer 2003).

Pesticides are a concern. However, at this time based on cholinesterase depression, we know that Greater Prairie-Chickens both in Wisconsin and Minnesota are exposed to organophosphate and carbamate insecticides sprayed in agricultural fields. Cocks have a higher exposure rate than hens (Toepfer 2003). This is because cocks spend more time in agricultural fields during periods of aerial spraying while visiting their booming grounds (May-June) and during the peak of the summer molt (July–September). It is not uncommon for radioed birds to feed and then night roost in potato or soybean fields during the summer. Several radio-marked hens have taken older broods and fledged chicks to agricultural fields in Wisconsin. In Minnesota it is common for hens with broods to leave the CRP grasslands and take half-grown chicks to nearby adjacent soybean fields and raise them. Some hens have actually moved broods to soybean fields immediately after hatching and successfully fledged young. We have found no direct mortality as a result of pesticides being sprayed on prairie-chickens while in agricultural fields.

There has been concern raised about disease, especially West Nile virus. However all disease surveys to date (1998–present) show no disease problems in Wisconsin, Minnesota, North Dakota, and Illinois. The West Nile virus is present but the prairie-chickens that have tested positive were healthy and, unlike Sage Grouse, all have survived the exposure (Paul-Murphy et al. 2003). The incidence of internal parasites today is less than reported in past studies (Toepfer 2003).

TRANSLOCATIONS

The goal of any future prairie-chicken translocation should be to increase genetic diversity (genetic rescue/infusion) or to expand the existing range, not to establish new isolated populations. Lewis et al. (1961) indicated that minimal movement away from the release sites is key to a successful translocation. Historically prairie grouse have been very difficult to establish as the birds tend to wan-

der away from their release sites (Toepfer et al. 1990, Moe 1999, Toepfer 2003). The first known translocations occurred in the 1860s when Greater Prairie-Chickens were translocated to the east coast to supplement declining Heath Hen numbers (Phillips 1928). Briefly, prairie-chickens translocated during the breeding season into unoccupied habitat, especially hens, tend to wander away from the release sites with only 25–33% establishing within two miles of their release site (Toepfer 1988, 2003, Toepfer et al. 1990). Several radio-marked hens released during April have ended up 50, 80, and even 90 miles from their release sites. However, when released during the breeding season into occupied habitat (supplementation) they are more likely to stay, with about 50% establishing within 2 miles of their release site as the translocated birds are attracted to resident birds (Toepfer et al. 2005b). The development of the summer translocation, releasing birds during the summer molt when they are less mobile, has greatly improved our ability to establish prairie-chickens in vacant and occupied habitat with 80-90% establishing within 2 miles of the release site (Toepfer 2003).

Prior to 2006, the only Greater Prairie-Chicken translocations occurred in Wisconsin between 1973–77 (Toepfer 1976, 1988) using pen-reared bird and wild birds in an attempt to reestablish prairie-chickens at the Crex Meadows WMA. This project was evaluated and published in Toepfer (1988), Toepfer et al. (1990), and summarized by Evrard (2004). All of the telemetry data in this later paper come from Toepfer (1988). Evrard (2004) indicated that this reintroduction project likely failed because the releases were not spread out. This is partially true, as we have learned that one has to spread birds out over a large area to reestablish a prairie-chicken population (Toepfer 2003). However the release area lacked upland grass and its shrub grass habitat was used more by Sharp-tailed Grouse (Toepfer 1988).

Grassland was initially inflated by a drought at Crex Meadows in 1976–77 to the point where the impoundments were bone dry in the refuge or release area. This almost doubled the amount of grassland for nesting and especially brood rearing. The 20 wild prairie-chicken hens translocated from Minnesota in 1977 fledged 19 young. From 1977 to 1978 the Crex population experienced its only increase from 17 to 25 cocks and from this point on it declined to two cocks in 1989, three in 1991, and none in 1992—13 years after the last birds were released (Evrard 2004). The Sharp-tailed Grouse population during this same time frame increased from 16 cocks in 1974 to 84 in 1989 and 115 in 1996 (Evrard et al. 2000). The real value of these Wisconsin translocations was that we conducted the first experiments with the summer translocation and documented some of the problems of using pen-reared birds.

Ammann (1957) indicated that once Sharp-tailed Grouse (*Tympanuchus phasianellus*) became more abundant than Greater Prairie-Chickens the latter usually disappeared in five to six years, and Toepfer et al. (1990) indicated that at least 12 isolated areas that historically had both species were taken over by sharptails. Crex Meadows and the surrounding area is better suited for Sharp-tailed

Grouse and should be managed for sharptails as they are in just as much trouble in Wisconsin as prairie-chickens. In hindsight the presence of prairie-chickens only complicated the management situation at Crex Meadows and realistically just created another isolated prairie grouse population susceptible to inbreeding.

FORTY HENS OF DESTINY—GENETIC RESCUE

Between 14–25 September 2006 forty adult hen Greater Prairie-Chickens, all from northwestern Minnesota and all radio-marked, were released at four locations on the Buena Vista Marsh to increase genetic diversity. This project was initially based on a proposal written by Peter Dunn UW-Milwaukee and me and presented to the Genetics Panel and WDNR to translocate Greater Prairie-Chickens to increase genetic diversity (Dunn and Toepfer 2004). This plan was updated in 2005 with A Plan For The Genetic Restoration Of The Greater Prairie-Chicken in Wisconsin, Capture, Release and Evaluation 2006-2010 (Toepfer 2005a) for STCP and submitted to WDNR for a permit in December 2005. This was done because STCP indicated, as it had for the previous two years, that it would fully fund and conduct the entire translocation and evaluation effort.

These forty hens were initially captured on booming grounds (Toepfer et al. 1988) in April 2006, radio-marked, and then recaptured by night-lighting during mid-September. All the birds flew well at release and all were radio-marked. Survival and establishment so far has been very good. As of the end of April 2007, six and half months post-release, 36 of the 40 hens can be accounted for: 28 (70%) were alive, eight were dead (most fed upon by raptors), and four were missing, one since its release. Of the 28 alive, 24 (85.7%) were on the Buena Vista and 4 were on Leola. The latter four had moved 5.0 to 11.2 miles from their respective release sites. Overall, 63% were within 2 miles of their respective release sites (mean, 2.8 miles, range 0–11.2 miles). All of the radio-marked birds have been observed moving, feeding, and night roosting with resident radioed birds. The development of the summer Greater Prairie-Chicken translocation protocol and translocation of Greater Prairie-Chickens from Minnesota to Wisconsin in 2006 was conducted by STCP, the author, assistants, and partners with funding from STCP and WDNR.

In anticipation of the translocation of hens from northwestern Minnesota we trapped and radio-marked 142 resident Greater Prairie-Chickens on the Buena Vista to serve as a control group in order to evaluate survival and reproductive parameters to compare these with the translocated Minnesota hens as outlined by Toepfer (2005a). Survival of resident control birds since mid-September has also been good at 72% (adult cocks 65.4%, immature cocks 78.5%, adult hens 73.1%, and immature hens 77.8%). As was done with the translocated birds, blood was taken for disease and genetic analysis. Blood for disease was provided to the WDNR and the genetic samples will be given to Dr. Peter Dunn, UW-Milwaukee, for genetic analysis (Dunn and Toepfer 2004). At the end of April 2007 there were 82 radio-marked Greater Prairie-Chick-

ens alive and accounted for on the Buena Vista (77) and Leola (5). Personnel from WDNR and a graduate student from UW-Madison are now responsible for the evaluation and have also monitored the radio-marked birds since January 2007 without support from STCP.

The key to survival of transplanted birds is successful establishment of individuals, as extensive orientation movements represent responses of individuals, not groups, to being placed in an unfamiliar area. Thus, in a translocation venture, most principles of population dynamics are not operating, and the population will not be functional until the translocated individuals establish themselves and reproduce (Toepfer et al. 1990). The next adjustment that the radio-marked hens from Minnesota had to make occurred in mid-March 2007 as adult and immature hens began to establish their territories. It is likely that some of the translocated hens will not be able to establish themselves on the Buena Vista and will disperse to the outlying areas to breed and nest.

I would sincerely hope everyone realizes that we have now forever changed the Greater Prairie-Chicken population in Wisconsin. It will never ever be the same. The prairie-chickens that the Hamerstroms, and our parents, and grandparents knew, and that STCP and the state of Wisconsin initially attempted to save are gone forever, genetically extinct. This now becomes "a new beginning." To put this all in perspective, this is simply the result of not creating enough grassland habitat to sustain a large enough prairie-chicken population to maintain a "healthy" genetic state.

However, that said, there is even a much bigger fear in all this and that is that conservationists and especially the general public will come to believe that all we have to do is translocate a few animals to fix the problems of small declining populations. Translocating animals is a cheaper and easier fix than addressing the **real problem**, which is not enough habitat. We can never lose sight of the fact that "enough" well-managed habitat will always be the key factor in the survival of any population. The recovery of the timber wolf (*Canis lupus*), Bald Eagle (*Haliaeetus leucocephalus*), American alligator (*Alligator mississippiensis*), and many other species was less complicated since it did not require the restoration of literally millions of acres of degraded habitat. We just had to stop killing them and remove DDT.

The translocation of a few prairie-chickens will indeed increase genetic diversity temporarily, as we will soon see in a paper about to be published on the results of the Greater Prairie-Chicken translocations the author initiated in Illinois in 1992 and 1993 (Westemeier et al. 1999, Rubin 1994, Toepfer 2003). However, without adding habitat, all this will only be a temporary easy fix to the symptom that is "loss of genetic diversity" and its associated biological problems. This approach can only result in the establishment of a series of isolated Greater Prairie-Chicken populations that will have to be periodically supplemented forever with the release of birds from larger populations; essentially creating a series of "zoo populations." The only long-term solution will be to increase the amount of grassland habitat and maintain "connectivity" between existing subpopulations as recommended by Hamerstrom and Hamerstrom in

1973. What Hamerstrom et al. (1957) stated almost 50 years ago warrants repeating: "Grassland is of vital importance to prairie chickens, the keystone in prairie-chicken ecology. . . Wherever one looks, the answer is the same: to save the prairie-chicken, grasslands must be preserved and managed for them. There are no substitutes."

The current WDNR Greater Prairie-Chicken Management Plan ten-year grassland acquisition goals will only increase the range wide permanent grassland reserve ratios for all the areas (Buena Vista, Leola, Paul Olson, Mead, and the Northern Range) from 10 to 17%. The Buena Vista/Leola area will still contain 46% of the grassland reserves dedicated to Greater Prairie-Chickens in Wisconsin. In the areas away from the historical core management area (Buena Vista/Leola) acquisition goals will only increase the ratio of grassland reserves from 4 to 13%. So at best, what we can expect with the future addition of these 15,000 acres of grassland reserves, at a cost of 15 to 25 million dollars, a "low lingering" Greater Prairie-Chicken population (Hamerstrom et al. 1957) in Wisconsin. This small population however will have to be periodically supplemented with releases from out-of-state birds from larger populations forever.

One only needs to review the conservation status of grouse in Europe to see where we are truly headed in Wisconsin and North America. In Europe the status of grouse has reached the point where the strategy from now on will be to prevent some of the small isolated populations from just going extinct (Storch 2000). This will mean conservation genetics via translocations similar to what was done in 1992 in Illinois and what STCP started last September in Wisconsin.

To the plight of the prairie-chicken we must add all the prairie grouse and associated grassland species but in Wisconsin I would be remiss if I did not mention the Sharp-tailed Grouse which is currently just as threatened as the Greater Prairie-Chicken, both ecologically and genetically, and is heading into the "shadows" despite approximately 60,000 acres of federal and state managed fragmented "habitat."

Unless there are dramatic changes in land use or a Herculean effort to save and add 100,000 acres of grassland in the "outlying areas" in central Wisconsin the current Greater Prairie-Chicken range will continue to contract like a vise to the Buena Vista/Leola. It is here where the Greater Prairie-Chicken will likely make its last stand in Wisconsin, and survive, but only as an isolated remnant "zoo" population. Such a small isolated population of only 500 birds with a 125 square mile range of booming grounds will be highly susceptible to natural catastrophes and will once again have to be periodically supplemented with the release of birds from larger populations to maintain a healthy genetic diversity. Hence the most valuable prairie-chickens to the people of Wisconsin in 2006 no longer reside on the Buena Vista but in Kansas, Nebraska, South Dakota, and Minnesota. To say anything else would just serve to mislead the public.

"A little repentance just before a species goes over the brink is enough to make us feel virtuous. When a species is gone we have a good cry and repeat the performance"—Aldo Leopold.

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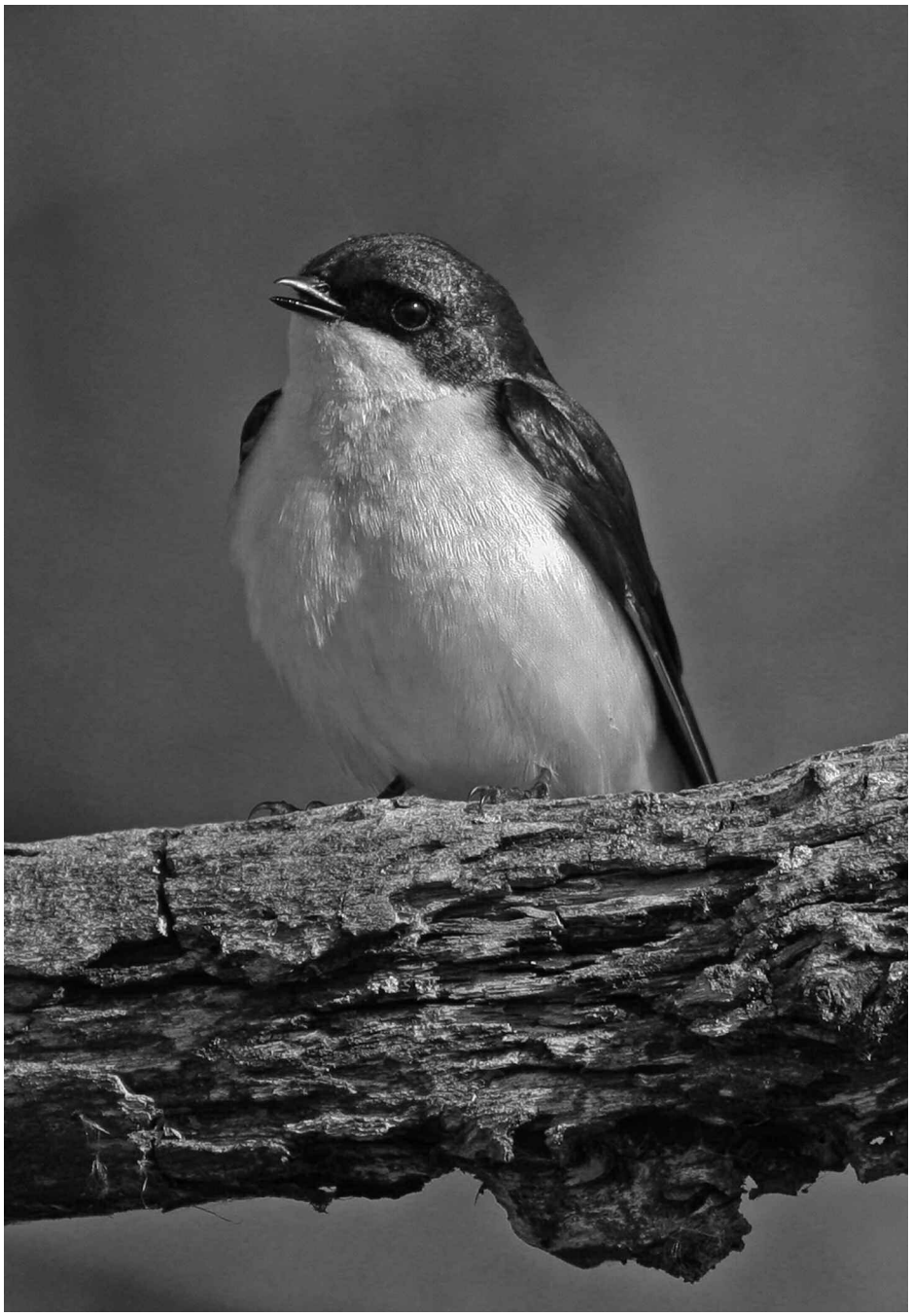
A native of Wisconsin, John E. Toepfer earned his B.S. and M.S. in 1972 and 1976 at UW-Stevens Point where he developed a life-long interest in prairie-chickens and a special friendship with Professor R. K. Anderson and Drs. Frederick and Frances Hamerstrom. As part of his PhD work he made the first attempt to reintroduce prairie-chickens in Wisconsin at Crex Meadows Wildlife Area in northwest Wisconsin. Toepfer earned a PhD in Biological Sciences at Montana State University with his thesis on "The Ecology of the Greater Prairie-Chicken as Related to Reintroductions." As a Professor at Little Hoop Community College at Fort Totten Indian Reservation in North Dakota he developed the first Tribal College Native American Wildlife Program and was instrumental in the development of the Inter-Tribal Bison Cooperative. Since 1996, Toepfer has served as Research Consultant with the Society of Tympanuchus Cupido Pinnatus, Ltd. (STCP). To address their concerns, and at the request of STCP Council members, regarding the future of prairie-chickens in Wisconsin, he developed and carried out STCP's field research project: Prairie Chickens & Grasslands: 2000 and Beyond. Toepfer serves on the Attwater's Prairie-Chicken Recovery Team and on the Board of the North American Grouse Partnership. In 2003, he also received The Hamerstrom Award from the National Prairie Grouse Technical Council for outstanding contributions in the field of prairie grouse biology.

or has it already set?



Tree Swallow seen resting by Scott Franke.