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HARVEST RATES OF SHARP-TAILED GROUSE ON MANAGED AREAS IN WISCONSIN

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ABSTRACT

Sharp-tailed grouse (*Tympanuchus phasianellus*) were captured and banded on several management areas during 1983-85 to measure harvest rates and to assess the need for harvest control. Study areas were Wisconsin Department of Natural Resources Wildlife Areas located in northwestern Wisconsin: Namekagon Barrens, Crex Meadows, Douglas County, and Pershing. Sharptail population trends within the study areas were monitored by annual dancing ground counts. Estimates of sharptail hunting pressure and hunter success were obtained from vehicle counts, hunter interviews, and hunter bag checks.

First-season band recovery rates averaged 26% and were considerably higher than those reported for sharptails in Michigan and South Dakota. Recovery rates were adjusted for nonreported bands and crippling loss to calculate hunting kill rates of 56%, 33%, 33%, and 15% on the Namekagon Barrens, Crex Meadows, Douglas County, and Pershing Wildlife Areas, respectively. High kill rates were associated with stable or declining sharptail breeding populations, a lack of regularly used dancing grounds, and greater hunter interest or awareness.

Hunting does not appear to be depressing sharptail populations on all managed sites. However, harvest controls are presently needed at some locations and will likely be required at additional sites in the future. Several potential methods of harvest control are analyzed, and alternative harvest strategies are evaluated.

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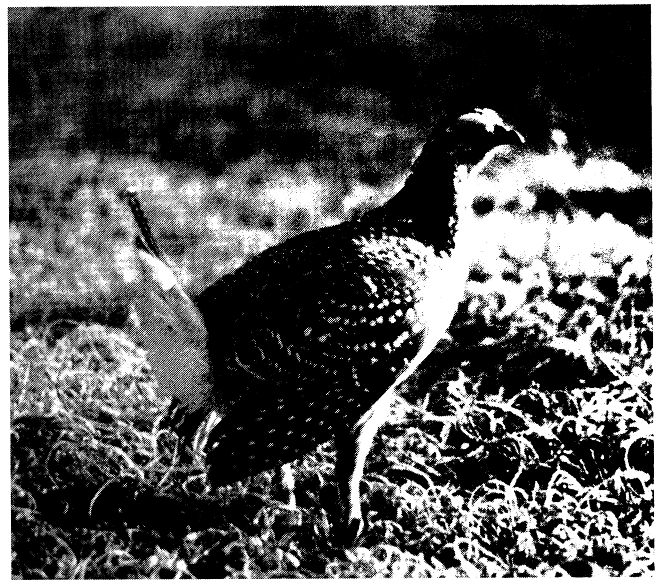
INTRODUCTION

Results of early investigations into the effects of hunting on upland game bird populations consistently demonstrated that hunting had no detrimental effect on populations (Errington and Hamerstrom 1935, Bump et al. 1947, Palmer 1956). The idea of compensatory mortality—whereby hunting mortality substitutes for some of the natural mortality that would otherwise occur—evolved from such studies and became an accepted principle of wildlife management. In a recent paper, however, Bergerud (1985) speculated that "we have built our principles on an unsound foundation." He concluded this after examining data from several grouse studies that indicated hunting mortality was mostly additive to natural mortality.

However, the most rigorous tests of additive vs. compensatory mortality have been conducted on data from studies of waterfowl (e.g., Anderson and Burnham 1976) rather than upland game birds. Those results have generally supported the compensatory mortality hypothesis. Furthermore, some of the examples Bergerud (1985) cites as evidence of additive mortality are, in actuality, examples of overharvest. Hunting can be compensated for by other forms of mortality only to a point, but beyond that threshold, exploitation can adversely affect population levels.

Thus, it may be that our principles are sound but our practices, at least in regard to controlling harvest levels, need to be upgraded. Even if we embrace the compensatory mortality hypothesis and believe that wildlife populations cannot be stockpiled, the relationship between harvest rate and population status is so poorly understood for most species that a conservative management approach is desirable. This is especially true for populations that are isolated or at low density, where even moderate kill rates can easily exceed the threshold.

In Wisconsin, sharp-tailed grouse populations presently fit the pattern of a species that requires such conservative management. A progressive loss of grass-brush habitats over the past 5 decades has left the birds with only small, and often isolated, patches of habitat. In response to habitat deterioration and associated population declines, some modifications have been made over the years in sharptail hunting regulations. These include delayed openings, closure of certain counties or regions, and even a one-year season closure in 1967. However, current season frameworks in areas open to hunting are essentially unchanged from those in place 30 years ago. Such relatively stable regulations in the face of dramatic population declines probably reflect the belief that hunting harvests are relatively unimportant in regulating population size. And it is probably true that hunting mortality has not been a critical factor leading to the decline of sharptails on those areas where their habitat has disappeared.



For many Wisconsin citizens, the sharptail is symbolic of the open, brushy country that was once abundant across the north.

But the situation may be different on those lands managed specifically for sharptails. On such designated management areas, sharptails and sharptail hunters are now concentrated within relatively small blocks of habitat. Because substantial expenditures are being made to insure the continued presence of sharptails on these areas for hunters and nonhunters alike, we must be certain that hunting mortality is not allowed to compromise those efforts.

Concern that hunting might, in fact, be having a negative effect on sharptail numbers on some management areas led to the design of this study. In recent years, sharptail populations on managed areas have not responded consistently to habitat improvements. Several factors—including management and size, genetic drift, and hunting—could explain this lack of response. Of these factors, the role of hunting in regulating sharptail populations was chosen for study. Specific objectives were to measure sharptail harvest rates on several designated sharptail management areas, determine the impact of hunting on population levels and, if needed, recommend methods of controlling harvest. Four study areas were selected, on which sharptail harvests would be evaluated over a 3-year period, 1983-85. The study was based on banding of sharptails on these study areas and on subsequent hunting season recoveries of banded birds.

STUDY AREAS

Field work in this study was conducted on several Wisconsin Department of Natural Resources (DNR) Wildlife Areas in northwestern Wisconsin, including Crex Meadows Wildlife Area (CMWA), Namekagon Barrens Wildlife Area (NBWA), Douglas County Wildlife Area (DCWA), and Pershing Wildlife Area (PWA) (Fig. 1). These sites were selected because they were believed to be the only locations with sharptail populations large enough to make trapping feasible. CMWA, NBWA, and DCWA all lie within the state's largest remnant of pine barrens, a region characterized by sandy soils and a history of repeated fires (Curtis 1959). PWA, on the other hand, is dominated by silt-loam and peat soils, and fire has been a less important factor in successional changes that have occurred there. Prior to state ownership, much of the PWA had seen a series of unsuccessful attempts at farming. The 4 study areas are now owned or leased by the DNR, and development and maintenance of sharp-tailed grouse habitat are two of the primary management objectives at each location.

CMWA is slightly more than 30,000 acres in size, and approximately 6,500 acres of that total exist in the grass-brush habitats required by sharptails. Spring dancing ground counts have indicated a sharptail breeding population ranging from 60-100 birds on the area during recent years (Wis. Dep. Nat. Resour., Bur. Res., Park Falls, unpubl. data). Except for a 2,300-acre central refuge, most of CMWA was open to sharptail hunting prior to 1974. The area was closed to sharptail hunting in 1974 to protect a re-introduced flock of prairie chickens from accidental shooting. In 1980, a block of land of about 5,000 acres located in the northeast corner of the area was re-opened to sharptail hunting within normal season frameworks. This parcel remained open during the study period. Sharptail hunting has also traditionally been permitted outside CMWA boundaries. In fact, some hunting does occur near the northwest corner of the area where suitable habitat exists on adjacent private lands.

The NBWA is composed of 3 separate units totaling 5,700 acres. Sharptails are restricted to the northern unit, however, which contains about 3,500 acres of suitable breeding habitat. Annual lek counts indicated that spring sharptail populations have fluctuated between 30 and 50 birds in recent years (Wis. Dep. Nat. Resour., Bur. Res., Park Falls, unpubl. data). No special restrictions on sharptail hunting beyond the normal season framework existed within NBWA during the course of this study.

The 4,000-acre DCWA includes approximately 2,800 acres with the appropriate vegetative structure to support breeding sharptails. Lek surveys have indicated that spring sharptail numbers were in the range

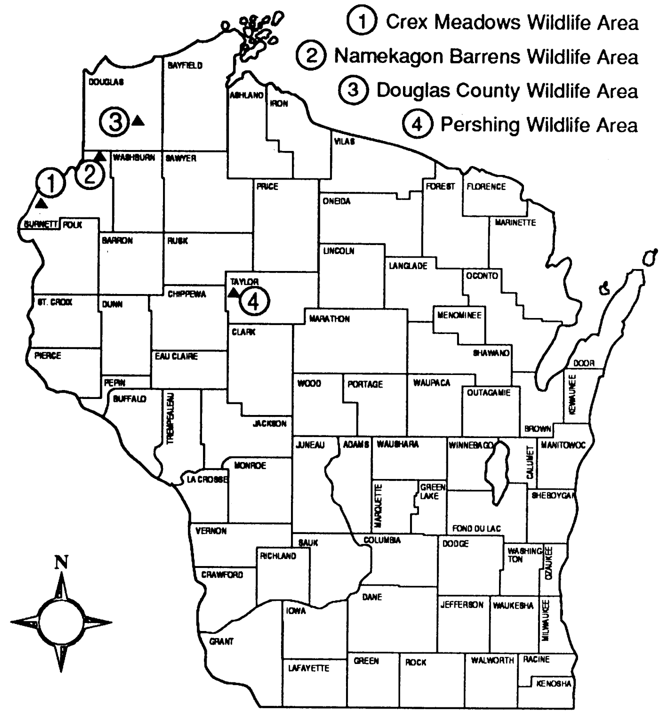
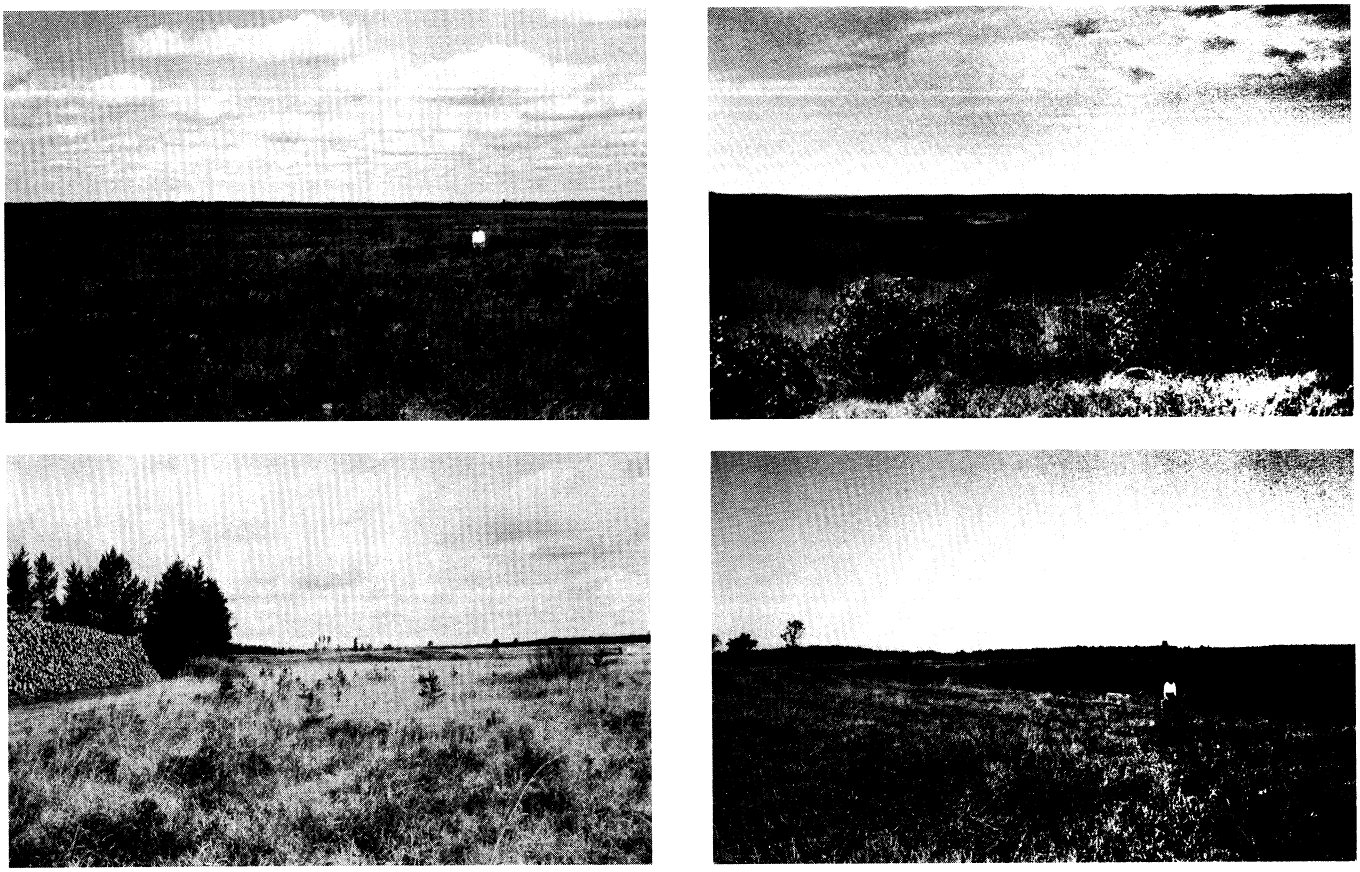


FIGURE 1. *Locations of the 4 sharptail management areas that were selected as study areas, 1983-85.*

of 20-40 birds in recent years (Wis. Dep. Nat. Resour., Bur. Res., Park Falls, unpubl. data). During the study period, no restrictions on sharptail hunting beyond the normal season framework were in effect on DCWA, although the entire area was historically a sanctuary. In 1948, a 5,440-acre closed area including DCWA and surrounding lands was established; this closure remained in force until the late 1950s.

Slightly more than 7,000 acres split between 2 units make up the PWA. The open grass-brush habitats preferred by sharptails account for less than 3,000 acres on Pershing, but some additional habitat also exists on adjacent private lands. Spring dancing ground counts have indicated a breeding population ranging from 40-70 sharptails, with higher counts in the past few years signifying an expanding flock (Wis. Dep. Nat. Resour., Bur. Res., Park Falls, unpubl. data). During the study period, the normal season framework permitted sharptail hunting on most of the PWA, except for a 545-acre closed area on the northern unit. This closed area was created to aid in the expansion of a breeding flock of Canada geese and to provide a resting area for migrant ducks and geese. Although established for waterfowl, the closed area may also benefit sharptails since it includes one of the primary dancing grounds and receives a considerable amount of fall use by the birds.



Sharptail habitat at the 4 study areas: Crex Meadows Wildlife Area (upper left), Namekagon Barrens Wildlife Area (upper right), Douglas County Wildlife Area (lower left), and Pershing Wildlife Area (lower right).

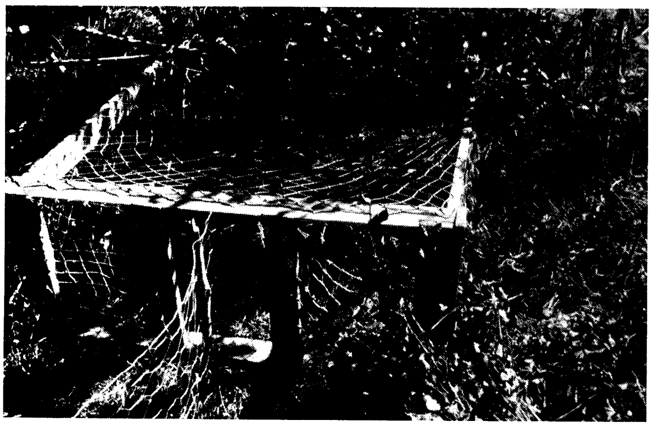
METHODS

A large variety of techniques have been employed in past studies to capture sharptails. These methods include mist nets used in conjunction with taped chick distress calls (Artmann 1971), bow nets (Anderson and Hamerstrom 1967), cannon nets (Rippin 1970), and baited walk-in traps (Robel et al. 1972, Sisson 1976). Most of these capture efforts occurred during the spring when the birds were frequenting the dancing grounds or during the winter when they would respond to bait.

In the present study, however, we had to capture and mark birds during the late summer or fall. This was necessary to limit the effect of natural mortality on estimated harvest rates and to insure that juvenile birds would be included in the banded sample. No proven capture method was available for trapping sharptails during this period prior to the hunting season. One exception was reported by Gratson (1983), who used lily pad traps to capture broods in late summer. He apparently did not experience great success with the technique, however, since only a few of the 57 birds he captured during his investigation were taken in that manner. Despite the uncertain effectiveness of lily pad traps for capturing sharptails, they were selected for use in the present study. We did so because they had been successfully employed in Wisconsin on ruffed grouse (Kubisiak 1985) and woodcock (Gregg 1984), and because the traps used in those studies were readily available.

During the course of the study, various modifications in the basic lily trap were made in an effort to find a safe yet effective trap. We began with wire traps (used in 1983), added traps made from wood and cloth netting in 1984, then went back in 1985 to only wire traps.

Trap site locations were chosen within and along the edges of openings that contained dancing grounds, adjacent to food patches, or in sites where broods had been observed earlier in the summer. Brood observations were obtained from DNR personnel who reported sharptails seen during routine field work. Observations were also obtained from brood searches we conducted with the aid of bird dogs. After trap sites were selected, a brush mower was used to clear a strip where the trap and lead could be set. An effort was made to place the ends of each trap in sites that afforded some overhead



Examples of the 2 types of lily pad traps used: one made of chicken wire with a cloth netting top (top) and the other made of cloth netting stretched between wood frames (bottom).

cover, such as in clumps of scrub oak or hazel. Chicken-wire leads connecting the ends of the traps were up to 450 ft long, averaging about 200 ft.

Live trapping commenced in late August or early September each year of the study period and continued through mid-October. Traps were checked twice daily, at midday and dusk. The second check was purposefully conducted late in the day to insure that no birds were left in the traps overnight. Periodic searches were also conducted around the more productive trap sites to check for carcasses of sharptails that might have been killed by predators after release.

All captured birds were marked with 2 numbered leg bands (3 in 1983), including 1 plastic color-coded band (2 in 1983) and 1 metal band inscribed with the address of the Grantsburg DNR office and a $5 reward notice. Trapped birds were weighed and classified by sex and age based on size, primary molt, and plumage characteristics (Ammann 1944, Henderson et al. 1967). At the onset of trapping each year, some young birds still exhibited juvenile plumage when captured, and those birds could not be sexed. All birds were released near the capture site.

Reports of banded sharptails were obtained from a variety of sources, including hunting season recoveries, birds found dead, and sight records. Of these, only recoveries of birds shot during the first season were used to estimate fall harvest rates. Most recoveries were obtained from hunters voluntarily reporting the band. Some additional banded birds were encountered during hunter checks made on CMWA, NBWA, and DCWA. Overall recoveries were also calculated and included band recoveries obtained from subsequent hunting seasons. These recoveries were used to provide information on sharptail movements and the value of closed areas.

Sharptail hunter checks were conducted by DNR Wildlife Management personnel on CMWA and NBWA during the 1983-85 hunting seasons and on DCWA during 1983-84.* The purpose of these checks was to estimate hunting pressure and hunter success. Hunter checks were generally restricted to opening weekend and sometimes the second weekend of the season. Occasional weekday inspections were also made, but these checks revealed very few hunters. Hunter checks were not attempted on PWA. Observations made there in previous hunting seasons indicated that hunter numbers were too low to justify efforts to contact hunters in that locale.

The hunter checks involved vehicle counts, hunter interviews, and bag checks. Postcards placed on vehicles or postseason mail questionnaires were used to obtain data from hunters who were missed during interview sessions. Age and sex of sharptails examined in hunters' bags was determined by molt and plumage characteristics (Ammann 1944, Henderson et al. 1967).

In addition to data from band recoveries, further information on sharptail populations on each area was obtained through incidental observations made during the study period. These observations—by Research and Wildlife Management personnel—included general assessments of reproductive success, appraisals of dancing ground stability (e.g., whether leks were permanent or transient), annual counts of birds using these dancing grounds, and occasional identifications of banded birds. These latter observations were made from blinds on dancing grounds, but only a small proportion of banded birds could be identified due to faded band numbers and vegetation that reduced band visibility.

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* The sharptail season framework remained unchanged during the study; it consisted of a 23-day season that opened in mid-October and allowed a daily bag limit of 3 birds.

RESULTS AND DISCUSSION

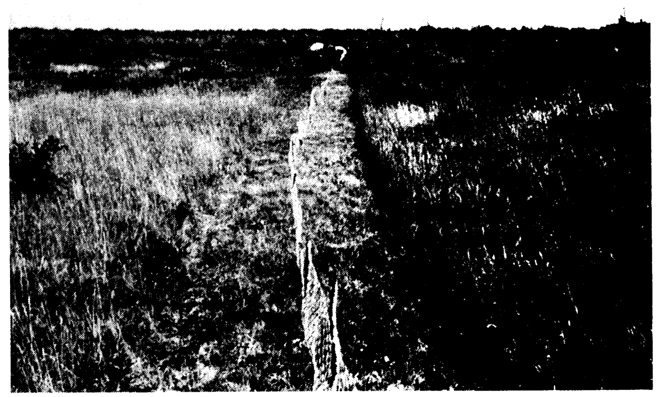
Trapping Success

During late summer and fall 1983-85, we captured 342 sharptails in 3,359 trapdays of effort (Table 1). Capture success was highest in the initial year of trapping, when trapping effort was confined to CMWA and only wire traps were employed. Declining success on all 4 study areas in subsequent years may have been the result of lower sharptail reproductive success, since broods were difficult to locate in both 1984 and 1985. However, our inclusion of trapping areas supporting lower sharptail populations than at Crex Meadows, as well as our changes in trap design, may also have contributed to the later variations in capture success.

One feature of our trapping technique had unexpected benefits. The strip mowed so that chicken-wire leads could be easily erected appeared to attract grasshoppers. Sharptail broods were in turn attracted to these strips to feed.

In comparison to ruffed grouse or woodcock, sharptails tended to react more adversely to traps, and scalping and wing bruising occurred frequently. Thus we faced the same double problem that plagued Hamerstrom and Truax (1938:180) many years earlier: "how to catch them, and how to catch them without injury." They abandoned wire traps in favor of softer materials and were able to design several traps that safely caught birds during the winter. Our attempts to design a "soft" lily pad trap for summer use were disappointing. The catch rate for the traps we constructed of wood and cloth netting was well below that for wire traps (18 vs. 7 trapdays/capture, respectively). This decline in catch rate may have been a result of the visibility of the wood frames, which may have made birds reluctant to enter the traps.

Efforts made by sharptails to escape from traps exposed them not only to injuries from abrasion but also to attack by predators. Eight birds were killed by predators while in a trap. Of these birds, badgers killed 6 and raptors—probably harriers—accounted for 2 more. Nine additional birds died from capture stress or trap-related injuries. Harriers were abundant in most study areas and may have contributed to trap injuries by their habit of perching near the traps. Sharptails appeared to be vulnerable to predation only while in the trap. Carcass searches conducted periodically revealed little evidence of predation on released birds.



A typical trap location, showing the mowed strip and long chicken-wire lead.

Provided their frantic behavior in the traps did not attract a predator, most sharptails evidently survived the trapping ordeal in good fashion, since many of them were subsequently recaptured (Table 1). In addition to recaptures, observations of banded birds on dancing grounds and hunting season recoveries also provided evidence that most birds survived capture and handling. For example, more than one half of the 1983 banded cohort on CMWA was eventually recaptured, sighted, or reported shot.

Recoveries of Banded Grouse

The recovery rate, defined as the proportion of banded birds that are recovered and reported, averaged 26% for sharptails that were banded on areas open to hunting and recovered during the first hunting season (Table 2). Recovery rates varied between years and declined during the course of the study. The addition of the relatively lightly hunted PWA as a

TABLE 1. *Sharptail trapping success, by year, on 4 northwestern Wisconsin study areas, 1983-85.*

			Grouse Captures				
			No. Recaptured				
Year	No. Trapdays	No. Banded	From Prior Year	In Same Year	No. Trapping Casualties	Total No. Captured	Average No. Trapdays Per Capture
1983	564	66	-	25	-	91	6
1984	1,525	106	8	33	7	154	10
1985	1,270	61	7	19	10	97	13
Totals	3,359	233	15	77	17	342	10

TABLE 2. *Hunting season recoveries, by year, for sharptails banded in refuge and hunted portions of 4 northwestern Wisconsin study areas, 1983-85.*

	No. Banded		Recovery Rates							
			First Season				Overall			
Year	Refuge	Hunted	Refuge	(No.)	Hunted	(No.)	Refuge	(No.)	Hunted	(No.)
1983*	54	12	0.00	(0)	0.33	(4)	0.04	(2)	0.42	(5)
1984	61	45	0.02	(1)	0.27	(12)	0.07	(4)	0.33	(15)
1985	25	36	0.00	(0)	0.22	(8)	0.04	(1)	0.28	(10)
Totals	140	93		(1)		(24)		(7)		(30)
Averages			0.01		0.26		0.05		0.32	

* Banding effort confined to CMWA.

TABLE 3. *Opening day sharptail hunting pressure and hunter success, by study area, for hunted portions of 3 northwestern Wisconsin study areas, 1983-85.*

	Opening Day Hunting Pressure						Opening Day Hunter Success								
	No. Vehicles			No. Hunters			No. Hunters Checked			No. Birds Bagged			No. Birds/Hunter Checked		
Study Area	1983	1984	1985	1983	1984	1985	1983	1984	1985	1983	1984	1985	1983	1984	1985
Crex Meadows	23	16	8	44	35	19	19	25	12	5	11	2	0.3	0.4	0.2
Namekagon Barrens	21	25	20	40	70	37	38	52	23	3	15	6	0.1	0.3	0.3
Douglas County	7	7	-	17	16	-	11	10	-	11	1	-	1.0	0.1	-

TABLE 4. *Hunting season recoveries, by study area, for sharptails banded in refuge and hunted portions of 4 northwestern Wisconsin study areas, 1983-85.*

		No. Banded		Recovery Rates			
				First Season		Overall	
Study Area	Banding Years	Refuge	Hunted	Refuge	Hunted	Refuge	Hunted
Crex Meadows	1983-85	125	32	0.00	0.25	0.04	0.30
Namekagon Barrens	1984-85	-	26	-	0.42	-	0.46
Douglas County	1984-85	-	8	-	0.25	-	0.50
Pershing	1984-85	15	27	0.07	0.11	0.07	0.15
Totals		140	93				
Averages				0.01	0.26	0.05	0.32

banding site in 1984 may have contributed to some of this decline. However, this additional site was not the exclusive cause, since 1985 recovery rates declined from 1984 levels on both CMWA and NBWA. Declining recovery rates probably mirrored a decline in hunter effort, evidenced by opening day hunter checks from 1983-85. These checks revealed a progressive decline in hunter numbers on CMWA and a sharp reduction on NBWA in 1985 (Table 3). However, previous studies (Ammann 1957, Sisson 1976) have indicated that hunting effort is primarily a function of grouse density. Thus, declining sharptail populations may have been the ultimate cause of declining recovery rates.

First-season recovery rates varied not only between years but also between study areas, ranging from a low of 11% on PWA to a high of 42% on NBWA (Table 4). The recovery rate for sharptails on NBWA matched that reported for ruffed grouse banded on the DNR Sandhill Wildlife Area in central Wisconsin. This rate caused Kubisiak (1985) to conclude that hunting mortality was a major factor depressing grouse populations on that area. Recovery rates for sharptails banded on CMWA, DCWA, and PWA were well below those on NBWA, but were still substantially higher than those reported in earlier banding studies. Birds banded in those studies were trapped during the winter, however, so resultant recovery rates could be expected to be lower because natural mortality would reduce the size of the marked cohort prior to the hunting season. Nevertheless, a comparison of recovery rates in this study with the 3% recovery rate in Michigan (Ammann 1957), 3% in Nebraska (Sisson 1976), and 4-11% in South Dakota (Robel et al. 1972) provides some cause for concern about the impact of hunting on Wisconsin sharptails.

Recovery rates varied between years and between study areas, but were similar for adult and juvenile birds. Although evidence of greater vulnerability of juveniles to hunting has been found for some birds (Wagner et al. 1965), our banded samples were too small to demonstrate any age-related difference in vulnerability of sharptails to the gun. Examinations of changes in sharptail age ratios during the hunting season in Michigan (Ammann 1957) and Nebraska (Sisson 1976) also failed to support the existence of differential vulnerability.

Harvest Rates and Total Hunting Kill

The harvest rate has traditionally been defined as the proportion of a population that is harvested, and hunting kill rate as the proportion that dies as a result of hunting. Band recovery rates must be adjusted for nonreported bands to calculate the harvest rates. The harvest rate can then be increased by including a measure of crippling loss to determine the hunting kill rate.

In the present study, the proportion of recovered bands that were reported was determined by comparing band numbers encountered during hunter bag checks with a list of bands eventually returned to us. Two of the 13 numbered bands observed during hunter checks were never received, indicating a band reporting rate of 85%. Our reporting rate was well below the 96% that DeStefano and Rusch (1986) determined for reward-banded ruffed grouse, but the reason for the lower rate was unknown. Perhaps a concern for redundancy caused the failure of a few sharptail hunters to report bands that they knew had been recorded during hunter checks. Regardless of the cause for the low reporting rate, it was the best estimate available and was used to adjust the 26% average recovery rate to arrive at an average harvest rate of 30%.

Scattered reports of unretrieved birds were obtained during hunter interviews, but no specific attempt was made in this study to document crippling loss because too few hunters were interviewed. Therefore, we were forced to rely on the literature for such information. Published estimates were scarce, however, and most were based on little more than guesswork. For example, Grange (1948) arbitrarily adjusted his kill estimate for all game birds by 20% to correct for unrecovered birds and for errors in the check. Likewise, Ammann (1957) provided no support for the 10% crippling loss adjustment he applied to his sharptail kill figures from Drummond Island, Michigan. Instead he provided data from hunter interviews conducted on another study area, Beaver Island, which indicated a crippling loss of 25%. Sisson (1976) has evidently conducted the most reliable appraisal of crippling loss of prairie grouse, since his estimate was based on information obtained from more than 4,000 hunters over a period of 8 years. We chose to use his crippling loss estimate of 11%, and we applied that adjustment to our 30% harvest rates to produce an average kill rate of 33%.

Adjustments for nonreported bands and crippling loss resulted in an estimated hunting kill rate that was nearly 1.3 times the recovery rate. The kill rate estimate was minimal, however, since it did not include any adjustment for mortality or egress of banded birds. Our trapping efforts failed to generate enough capture-recapture data to estimate preseason mortality of banded birds. But results of recent ruffed grouse studies (Kubisiak 1985, DeStefano and Rusch 1986) have indicated that such mortality can be significant. In those studies, 26% of the banded cohorts on both of their Wisconsin study areas were lost to preseason mortality. When adjustments were made for this preseason mortality, ruffed grouse kill rates on those areas were about 1.6 times the band recovery rates.

In our sharptail study, estimated hunting kill rates ranged from 15% on PWA to 56% on NBWA. The kill rate on both other study areas was 33%. Of these figures, the kill rate on PWA was similar to hunting mortality estimates obtained in other sharptail studies, but the NBWA rate was higher than any reported in the literature. Sisson (1976) estimated that an average of 12% of the total preseason population on his Nebraska study area was killed by hunters each fall, based on summer transect censuses. Band return data were used by Robel et al. (1972) to determine that hunters annually harvested a minimum of 20-25% of the sharptails on their South Dakota study sites. In Wisconsin, Grange (1948:64) estimated that hunting removed 24% of the theoretical fall population, a harvest level that he considered "substantial and even dangerous." Grange obtained his fall population estimate by applying a 55% expansion from his spring counts. This expansion rate was undoubtedly conservative, because other investigators have found a 100-300% increase between spring and fall.

Of the range of hunting kill rates we found, higher rates appeared associated with those sites having greater notoriety, a longer tradition of sharptail hunting, and greater hunter interest. Namekagon Barrens, for example, was recognized by Hamerstrom et al. (1952:27) as "one of the two or three best wild-land sharptail areas—if not *the* best—in northern Wisconsin." Furthermore, recent hunter checks in that area have revealed the presence of several second generation sharptail hunters (Wis. Dep. Nat. Resour., Bur. Res., Park Falls, unpubl. data). PWA, on the other hand, is a more difficult area to hunt and has received less acclaim as a sharptail area. Both factors have probably contributed to the lower hunting kill rate found on that area.

Impact of Hunting on Sharptail Populations

Even though most previous investigations have failed to provide any hard evidence that fall harvests have a detrimental effect on grouse populations, Grange was not alone in his concern about the potential impact of hunting. Ammann (1957), for example, believed that sharptails existing in large areas of good habitat were unaffected by hunting, while populations residing in isolated or sub-optimum habitats could be depressed or depleted by fall harvests. Likewise, Sisson (1976) concluded that special regulations might be necessary to prevent overharvest of prairie grouse on the Nebraska National Forest, where a 4-fold increase in hunting pressure was observed in just 6 years.

There is little doubt that a kill rate in excess of 50% is sufficient cause for concern about the impact of hunting on NBWA. And even though estimated kill rates were higher on NBWA than on the remaining study areas, information from spring dancing ground surveys has provided some evidence that hunting may also be impacting populations on those sites. On CMWA, for example, a substantial reduction in sharptail courtship activity has been recorded in the hunted portion since the re-opening of hunting in 1980. In 1981, courtship activity was observed within the hunted zone at 4 different locations, including 1 regularly used lek that contained at least 12 cocks (Wis. Dep. Nat. Resour., Glacial Lakes Grantsburg files, unpubl. data). Approximately one half of the 50-55 male sharptails observed on Crex Meadows that year resided within the hunted zone. By 1985, however, only 3-4 cocks, representing about 10% of the total on Crex Meadows, were found within the hunted zone. No regularly used dancing ground was found within the zone, and the birds observed there displayed in only a transient manner during the survey period.

Previous investigators have observed transient courtship displays, and Sisson (1976) speculated that males exhibiting such behavior were surplus birds that failed to establish territories. Ammann (1957), too, found birds dancing in odd areas during periods of population expansion, but he also stated that male courtship behavior became more unsettled in response to habitat deterioration. Although the presence of transient dancing grounds may provide little indication of the status of a sharptail population, previous Wisconsin research (Gregg 1987) did reveal that a lack of permanent dancing grounds is evidence that a population is in trouble.

If dancing ground instability is indeed symptomatic of population instability, then we need to be concerned not only about those birds within the hunted portion of CMWA, but also about the birds on NBWA and DCWA. Dancing ground surveys conducted on these areas in

Sharptail numbers and the need to regulate harvests have changed dramatically in Wisconsin since this 1940s photograph of hunters in Oconto County.

recent years have revealed a scarcity of regularly used leks. Despite some evidence of a tendency to occupy traditional sites from year to year, during any particular spring the birds are often here today and gone tomorrow. A variety of factors, including weather and habitat changes, could influence the regularity of use a dancing ground might receive.

Within our management areas, however, habitat deterioration is an unlikely cause of dancing ground instability. Not only has sharptail habitat on these areas not deteriorated, it has generally been improved. Because these are designated sharptail management areas, continual efforts are being made to make habitat more attractive for sharptails. The fact that sharptail courtship activity on these areas is highly variable and transient suggests that fall hunting removal, not habitat conditions, is affecting the birds.

But how could fall harvests affect sharptail populations when such a small number of hunters pursue the species? Even on NBWA, for example, which generally attracted the largest cadre of sharptail hunters, an average of only about 50 hunters, or 9/mile^2, were present on opening day during the 1983-85 seasons (see Table 3). Hunting pressure of that magnitude does not seem excessive in comparison to the maximum daily hunting pressure of 23 hunters/mile^2 that Kubisiak (1984) permitted for ruffed grouse hunters on the Sandhill Wildlife Area. However, the hunting pressure on NBWA could be high in comparison to sharptail hunter densities found within more extensive prairie habitats. For example, Sisson (1976) estimated that cumulative hunting pressure for the entire 1962 season amounted to only 5 hunter-days/mile^2 in his Nebraska study area and averaged only 9 hunter-days/mile^2 during the 1962-69 seasons.

In Wisconsin, only limited information is available on seasonal hunting pressure, since hunter checks were normally confined to the first one or two weekends. During the 1975 sharptail season, however, daily hunter checks were conducted on DCWA. These revealed that 42% of the entire season effort was expended on opening day (Don Bublitz, Wis. Dep. Nat. Resour., pers. comm.). If the same proportion is applied to our NBWA data for 1984, the year of our highest hunting intensity, total seasonal hunting pressure would have amounted to 30 hunter-days/mile^2. That level of hunter effort resulted in a sharptail kill rate exceeding 50%, and yet it was less than one half the average of 65 hunter-days/mile^2 expended for ruffed grouse hunting statewide (Wis. Dep. Nat. Resour. 1979). Furthermore, our high kill rate was achieved with only a fraction of the hunter effort (111-158 cumulative hunter days/mile^2) that Kubisiak (1984) determined would be required to result in a 50% harvest rate for ruffed grouse. From these comparisons, it appears that sharptail populations occupying small blocks of habitat can evidently tolerate only low levels of hunting pressure. It is therefore imperative to establish a harvest regime that will prevent overharvest.

Based on the low hunter efforts yet high hunting kills, harvest controls are presently needed on NBWA, CMWA, and DCWA, and they may also be needed on some other managed sharptail areas in Wisconsin in the future. This is especially important because of increasing hunter awareness of the few remaining spots where sharptails can be found.

MANAGEMENT RECOMMENDATIONS AND CONCLUSIONS

Results of this study suggest that hunting can have detrimental effects on sharptail populations, but fail to demonstrate that fall harvests are impacting populations on *all* sites. Estimated hunting kill rates varied considerably between study areas, with the highest rates found on those sites with greater hunter interest or awareness. The lowest kill rate was found on the study area that was least accessible and least well known for its sharptail hunting.

However, there is no guarantee that hunter effort will remain low on any managed sharptail area. Effort will more likely increase on all such sites, due to the continued loss of habitat on unmanaged lands. Thus, it is important that an effective means of controlling harvest levels on sharptail management areas be implemented.

Several approaches to regulating the harvest are available, with each offering a different degree of control. Possible actions include: (1) reducing season length, bag limits, or both; (2) establishing closed areas within each managed area; (3) restricting kill through issuance of permits; or (4) closing the season.

Because season length and daily bag limits have been fairly liberal in the past, they presumably had little impact on the size of the kill. Hunter checks have indicated that very little hunting occurs after the first one or two weekends of the season, and very few hunters attain their limit of grouse. Since the average hunter hunts for only a few days and bags less than 1 bird per day, severe restrictions on season length and bag limit would have to be imposed to significantly reduce the kill. And without some means of controlling hunter numbers, it is conceivable that even a 1- or 2-day season and a 1-bird daily bag limit could still result in overharvest. This would occur if a large number of hunters were present on any individual management area.

Recoveries of sharptails banded on CMWA suggest that a closed area might be an effective means of controlling harvest. None of the 125 birds banded in the unhunted portion of Crex were shot the first fall after banding, and only 5 birds were shot in subsequent years. Despite this evidence from our study, establishing a closed area has several disadvantages that diminish its value as a possible harvest control technique. Although the presence of a closed area insures that a portion of the sharptail population in an area is protected from hunting, it also concentrates hunter effort in that portion open to hunting and may increase the risk of overharvest there. Furthermore, if through overharvest or some other reason, sharptail numbers in the hunted portion of an area are at a low level, repopulation with nearby birds may not occur. The same limited mobility of sharptails that makes a closed area effective also makes it unlikely that birds will quickly move out of the closed area and refill vacant habitats.

The third option for harvest control involves hunting permits. This approach has had historical support for both sharptails and prairie chickens. Grange (1948:268) believed that prairie "grouse production tracts should be under special hunting controls" and suggested a managed hunt wherein a quota would be set for each tract and the tract would be closed when the quota was reached. Hamerstrom et al. (1957) also pointed out the potential value in establishing a quota or issuing permits to control the prairie chicken harvest in Wisconsin. Although such a system did not become a reality at that time, we have gained considerable experience in issuing permits for Canada geese, turkeys, bear, and anterless deer during the 40-year interim since the prairie grouse permit received its first endorsement. As a result, we should now be better prepared to implement such a program.

Several disadvantages are still inherent with this permit method of harvest control. It would be cumbersome to administer. Secondly, sharptail hunting would not be possible every year on every site, and only a small number of birds could be harvested. Despite this, a permit system would be a more reliable method of harvest control than restricting season regulations, since participation in the hunt would be limited by the number of permits.

A prairie grouse permit fee or stamp could even provide benefits in addition to harvest control. Such benefits might include focusing public attention on the plight of prairie grouse in Wisconsin and, if revenues were dedicated for these species, providing funds needed for habitat management. For example, a permit fee could be required to reserve a seat in a blind for viewing sharptail or prairie chicken courtship displays, or for participating in a field trial where dogs can work prairie grouse. Substantial opportunities exist for increasing nonconsumptive use of prairie grouse on all managed areas. We should strive to broaden support for our management program by making the public aware of those opportunities.

If sharptail hunting is to have any future on our managed areas, I believe the harvest option with the most promise and fewest drawbacks is a permit system. If we are unable to institute a permit hunt on managed sharptail areas, then the season should be closed on such sites. In making a decision, we should recognize that closed seasons are sometimes difficult to re-open. Prairie chicken numbers in Wisconsin, for example, were as high or higher in 1981 than they had been in 1951 (Hamerstrom and Hamerstrom 1973), and yet the season has remained closed.

But sharptail hunting offers a unique and uplifting experience, a chance to escape the dense woods and spend some time in one of those scarce fragments of "big sky country" that still remain in northern Wisconsin. A decision must be made, however, on what is best for the sharptail. I have my own viewpoint, but perhaps the decision would best be made by someone whose reasoning has not been affected by October days spent on the barrens, by the smell of sweet fern, and by the glimpse of the dog on a distant knoll.

EPILOGUE

During the 4-year interval between the completion of this study and the publication of this report, a holding cage lined with fiberglass netting was described by Parrish and Saunders (1989) as a means of reducing self-inflicted injury in confined birds. If incorporated into a trap design, this netting material may have promise for summer trapping of sharptails.

In addition, some of the management recommendations made in this report have been implemented. A closed, 1-mile^2 area was established on NBWA in 1987. The entire DCWA was closed to sharptail hunting in 1989. Sharptail hunting was also prohibited on 2 additional managed areas, Kimberly-Clark Wildlife Area in Price County and Moquah Barrens Wildlife Management Area in Bayfield County in 1985 and 1988, respectively. Furthermore, the statewide daily bag limit for sharptails was reduced in 1989 to 1 bird. However, a permit system should still be implemented if potential overharvest on the remaining sites is to be avoided or if re-opening the hunting season in closed areas is to be considered.

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