STATUS AND MANAGEMENT OF BLACK BEARS IN WISCONSIN

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ABSTRACT

The status of Wisconsin's black bear population was studied from 1972 through 1980 using hunter questionnaires, harvest rates of marked bears, and analysis of the age structure in the harvest. An economical field index to bear populations was also developed and evaluated.

Registered harvests averaged 699 bears annually from 1975 through 1980. Most (80%) of the bears harvested during the 16-day September season were taken by hunters using trained hounds and/or bait.

Three-hundred twelve individual bears were captured a total of 831 times on a 432 mile^2 study area in extreme north central Wisconsin. Most bears were captured in a box trap made with 55-gal barrels that proved very effective, economical, and safe. The population on the study area was estimated as 1 bear/1.5 mile^2, and 20% of the adult marked bears were shot the same year as captured.

Data on 2,699 bears harvested from 1973 through 1979 showed adult males had a significantly higher average annual mortality rate (30%) than adult females (23%), and that bears were harvested most intensively in the eastern portion of their range. Analyses using ages of bears harvested, harvest and reproductive rates of marked bears, and observations reported by hunters indicated a stable or slightly increasing population of at least 4,000 to 4,400 bears.

Major management recommendations include continued monitoring of the bear population, management of regional rather than statewide populations, and harvest strategies for problem areas.

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INTRODUCTION

Black bears are very common throughout much of northern Wisconsin and occur to a lesser extent in the central, forested portion of the state. Their presence has caused considerable controversy, especially in recent years. Public opinion runs the full gamut from those who think all bears should be shot because they represent a threat to personal safety and property, to those who consider them a trophy animal, to those who feel they are endangered and should be completely protected. The secretive, but sometimes vandalistic, nature of black bears contributes to the wide range of emotions among people living in or visiting bear country. Hugie (1979) stated that human attitudes toward bears were one of the main factors controlling bear numbers.

Bears were unprotected in Wisconsin before 1930. Until that time, they could be shot or trapped any time of the year, and there was no bag limit. Since then, there have been considerable changes in legal harvest methods, bag limits, and season lengths and timing. The most prominent changes included:

1. Since 1956, all bears harvested have had to be registered at Wisconsin Department of Natural Resources (DNR) or cooperative stations.
2. Trapping of bears has been prohibited since 1957.
3. The ban on the use of hounds for bear hunting was lifted in 1963.
4. Cubs have been protected since 1965. Since then, hunters have been limited to one adult (yearling or older) bear per year.
5. Since 1974 hunters using firearms have been required to possess a separate big game license to hunt bears. In addition, bears no longer could be taken during the November firearms deer season, and only liquid scents could be used to bait bears.
6. In 1978, hunters were limited to a maximum of 6 hounds while trailing bears, but baiting regulations were relaxed to include apples and pastry products.

Wisconsin consistently produces one of the higher black bear harvests in the United States (Cowan 1972).

TABLE 1. *Registered black bear harvests in Wisconsin, 1956-80.*

	Early Season		November Firearm	Total
Year	Gun	Bow	Deer Season	Harvest
1956	Closed	12	200*	212
1957	Closed	29	314	343
1958	Closed	47	530	577
1959	Closed	47	532	579
1960	Closed	50	625	675
1961	Closed	34	303	337
1962	Closed	58	559	617
1963	6	121	470	597
1964	109	73	329	511
1965	94	56	158	308
1966	125	54	296	475
1967	198	92	251	541
1968	359	72	182	613
1969	476	76	200	752
1970	489	73	110	672
1971	521	77	192	790
1972	541	69	268	878
1973	351	52	203	606
1974	344	46	Closed	390
1975	473	66	Closed	539
1976	486	93	Closed	579
1977	541	89	Closed	630
1978	707	145	Closed	852
1979	602	135	Closed	737
1980	722	133	Closed	855

* Includes 60 bears commercially trapped.

Since mandatory registration began in 1956, annual harvests have ranged from 212 to 878 and have averaged about 600 bears annually (Table 1). Harvests during the special early bear season rose considerably from below 200 bears annually prior to 1967 to over 700 in the last 3 years (1978-80). This great interest in bear hunting, along with the resultant concerns about the status of Wisconsin's bear population, created the impetus for this study.

Works by Knudsen (1961), Erickson et al. (1964), Jonkel and Cowan (1971), Rogers (1977), and many others contributed valuable insight into behavior patterns, food habits, reproductive rates, and the social structure of bear populations. Techniques for obtaining information on the status of regional or statewide populations, however, are severely limited. Spencer (1955) stated, "No wholly satisfactory method has been devised for censusing the black bear." Lawrence (1979) concluded "Methods to estimate (black bear) density on a large scale may be economically prohibitive."

Because of the lack of information and available techniques, this study was designed to evaluate current harvest rates of bears in Wisconsin and to develop an economical field index to their populations.

DESCRIPTION OF STUDY AREA

Field work was conducted on a 432-mile^2 area in the northwestern portion of Iron County (Fig. 1). The area was selected because it was known to have a good bear population that received heavy hunting pressure, and because harvests could be tabulated directly from numbers of bears registered in the Deer Management Unit 28 portion of Iron County.

The study area is sparsely populated compared to most of Wisconsin, with fewer than 6,000 permanent residents, most of whom are located in communities along State Highway 77. Iron ore mining was a major industry in the area prior to 1960, but timber products, agriculture, and tourism now provide the major sources of income. Land ownership south of State Highway 77 is primarily county and industrial forest.

Major geologic features include the high, rugged hills of the Penokee Range in the northern half of the area and the Continental Divide in the southern half. Except for the exposed bedrock of the Penokee Range, soils are predominantly of the Gogebic and Iron River loam and sandy loam series (Hole et al. 1968).

Weather patterns in the area are significantly influenced by Lake Superior. Mean monthly temperatures range from around 15 F in December, January, and February to 65 F in June, July, and August. Precipitation averages 34 inches a year, but average annual snowfall accumulations range from 70 inches in the southern portion to over 100 inches in the northern portion. Hurley averages 160 inches of snowfall a year (Wisconsin Statistical Reporting Service 1967).

Approximately 90% of the area is forested (McCaffery 1973) with most stands originating from extensive logging in the early 1900's. Timber types and logging activities during that period are described in detail by Corrigan (1976) and Huston (1972).

The northern half of the study area consists primarily of large blocks of northern hardwoods (stands comprised primarily of basswood, red maple, sugar maple, or white ash, and

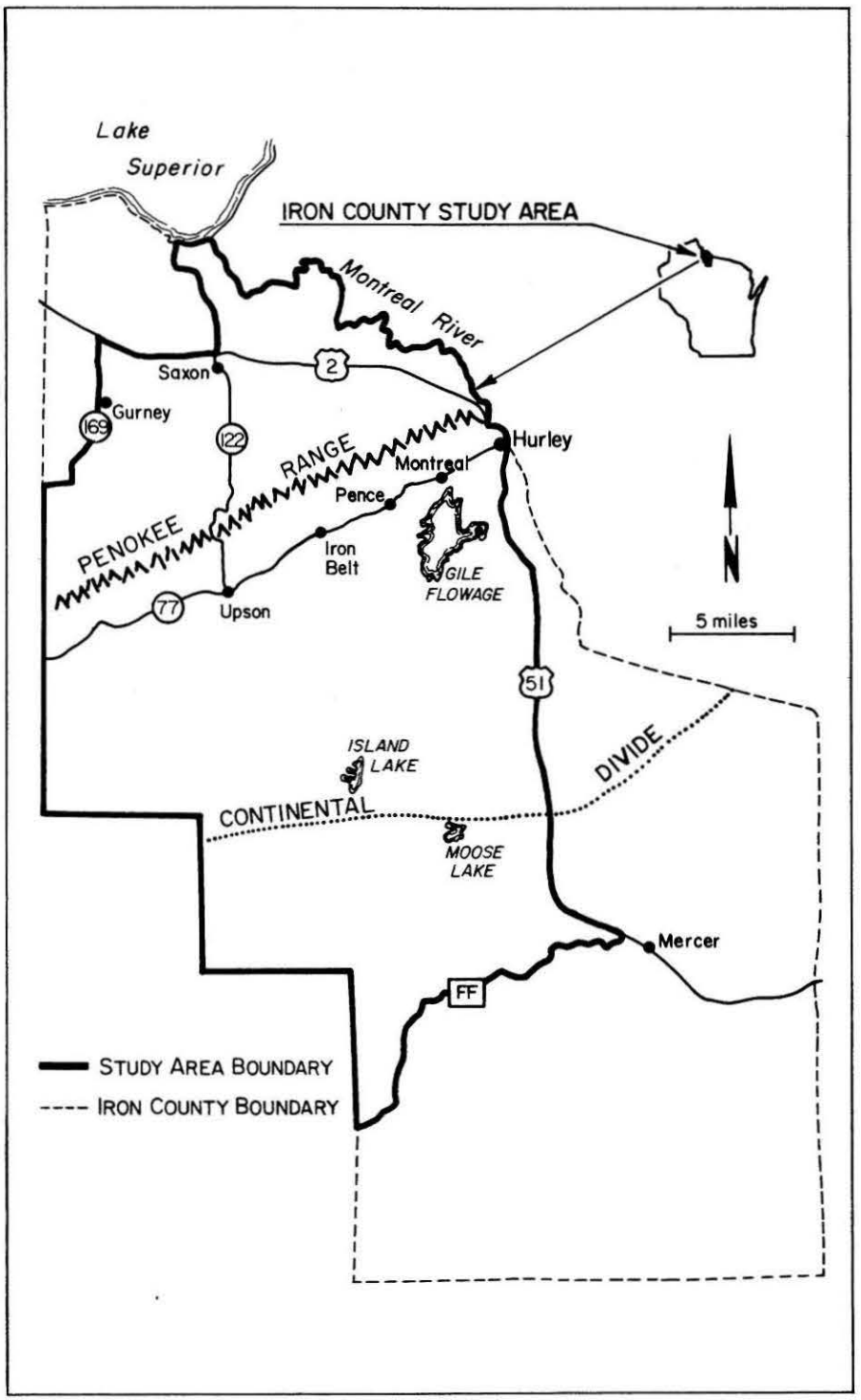
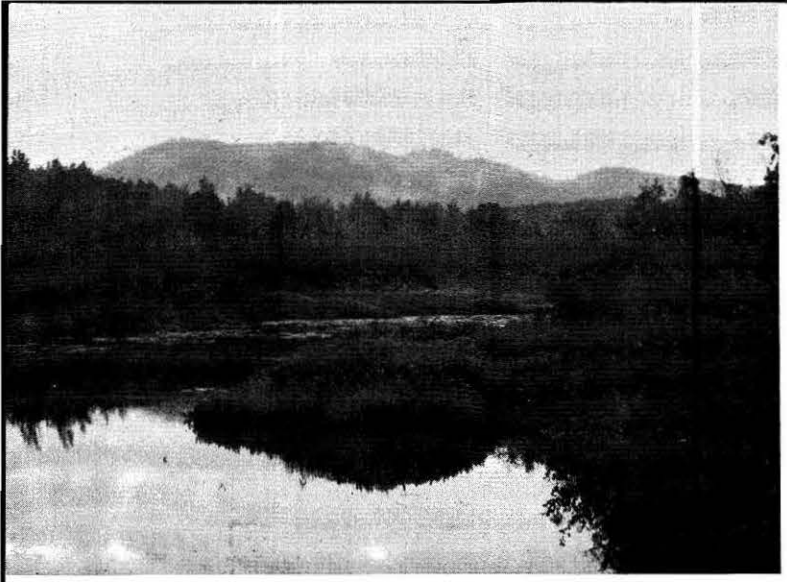
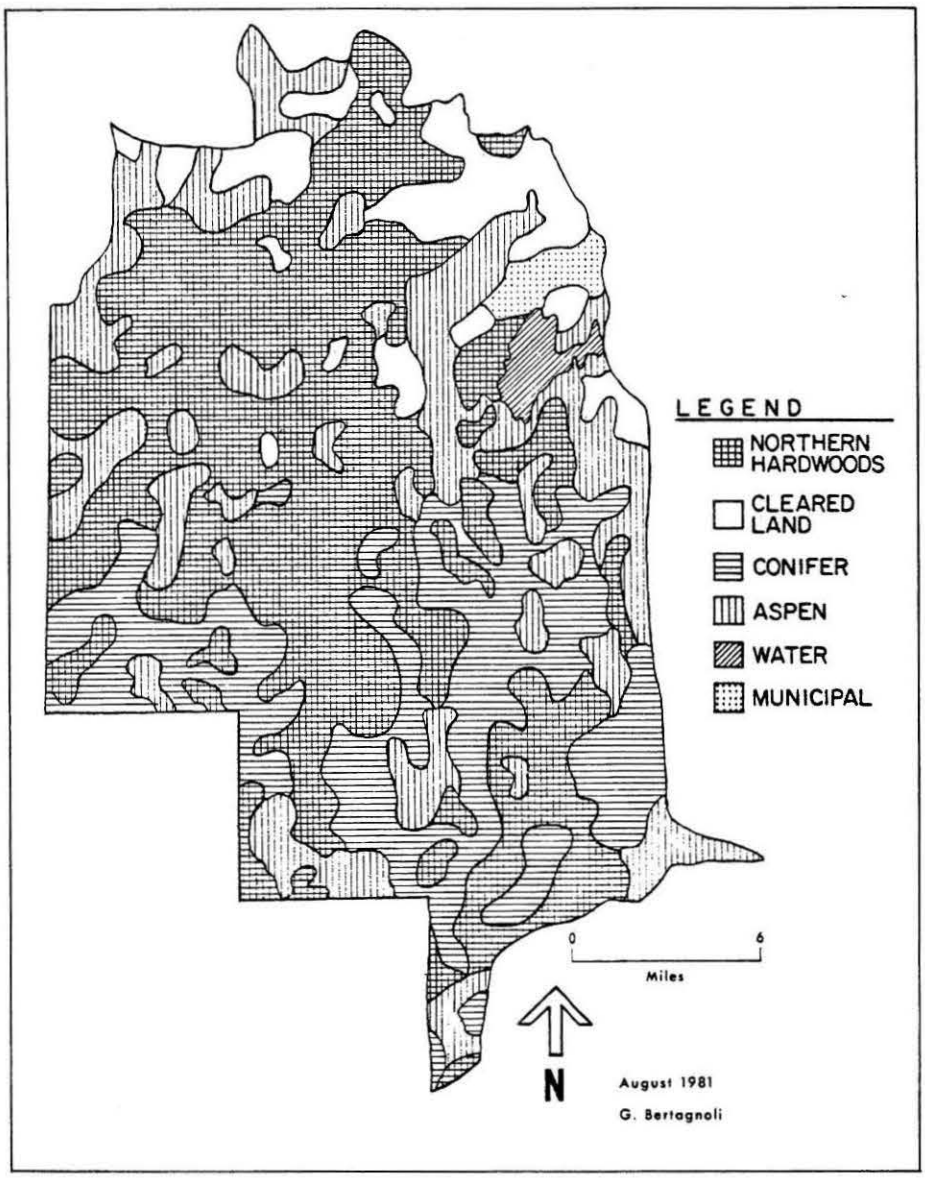


FIGURE 1. *Location and major features of the Iron County Study Area.*



Central portion of the study area looking towards the Penokee Range.

Northern hardwood stands such as this comprise a large portion of the study area.



combinations thereof) interspersed with smaller blocks of aspen (quaking and large-tooth) and open areas resulting from active or abandoned farms (Fig. 2). Both forest types are typically heavily stocked and in the 5- to 11-inch dbh class, but the northern hardwood stands contain very little understory compared to the aspen type. Norton (1982) considered northern hardwoods on the area to be only travel and shelter areas for bears due to their lack of preferred food items.

Forest types are more interspersed in the southern half of the area and include substantial conifer cover. The conifer types are about evenly divided between balsam fir and white spruce on higher sites, and black spruce, white cedar, and tamarack on lower sites.

Other forest types comprising less than 2% of the area include pine (jack, red, and white), paper birch, hemlock-hardwood, and oak (northern pin and red). Relict, sodded openings created primarily by old logging camps and log landings account for less than 1% of the area. There are 12 sanitary landfill sites (dumps) on the area, all of which are used to some extent by bears.

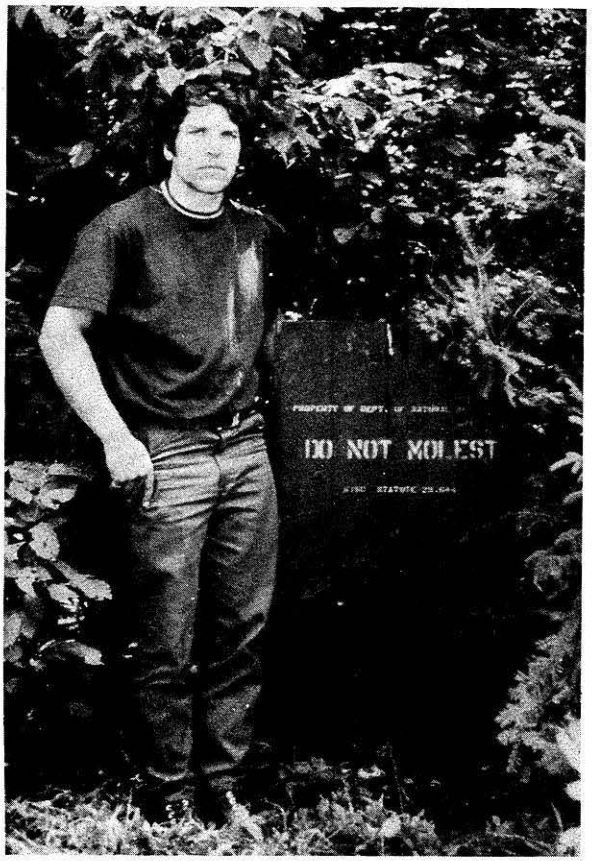
FIGURE 2. *Major cover types on the Iron County Study Area (from Bertagnoli 1982)*

METHODS

BEAR HUNTER QUESTIONNAIRES

Questionnaires were sent to all successful bear hunters from 1972 through 1975. Hunter names and addresses were obtained from registration stubs, and a cover letter and postpaid return envelope accompanied each questionnaire. From 1975 through 1977, questionnaires were sent immediately after the season to hunters selected systematically (every 3rd one) from the copies of resident firearm bear licenses sold the previous year. This questionnaire consisted of a prepaid, self-addressed return postcard separated by perforations from the explanations portion (Append. C).

On both questionnaires, hunters were asked the counties they hunted in, the number of days they hunted, the number of bears they saw, and general information on their hunting practices. Hunter success rates and the number of bears seen/hunter-day were used as indexes to bear population trends, and the number of cubs seen/adult was used as a measure of production. Hunter impressions of bear population trends and hunting regulations also were considered.



Ned Norton standing beside a barrel trap. This type of trap proved to be effective and virtually "injury-free".

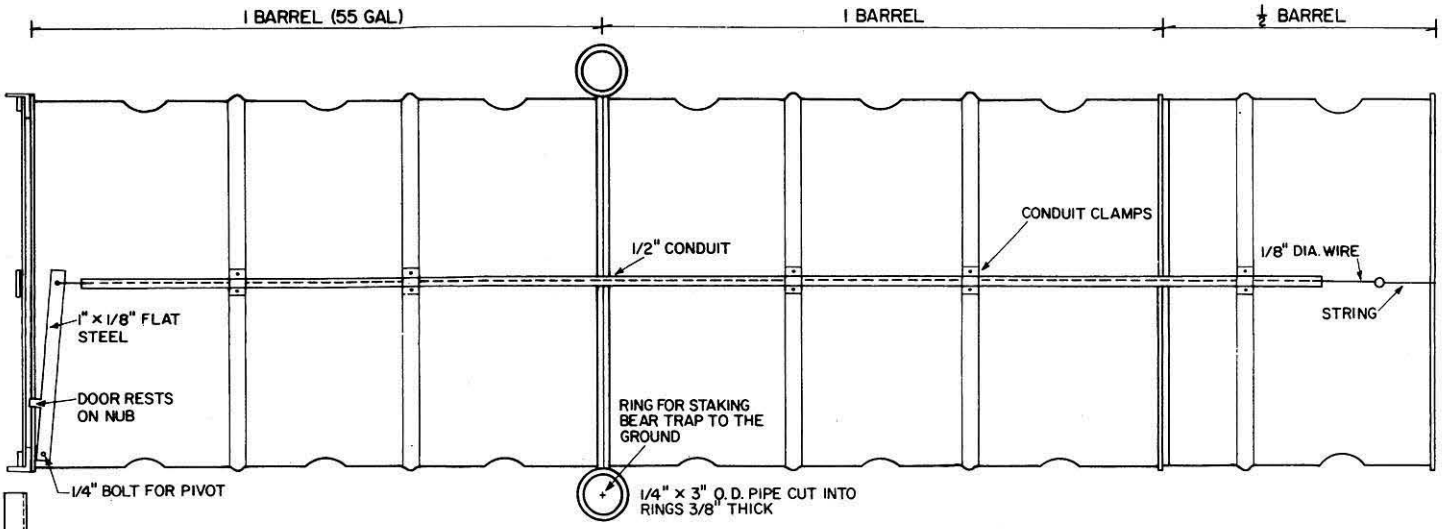
CAPTURE AND TAGGING TECHNIQUES

The Iron County Study Area (ICSA) was trapped intensively from May through August, 1975-79. Traplines were set up along driveable roads to cover approximately one-third of the area at a time, with each third being trapped 5 or 6 weeks per summer. Traplines ranged from 90 to 130 miles in length and usually included 30-33 traps. All traps were checked daily, and activity at each trap site was recorded.

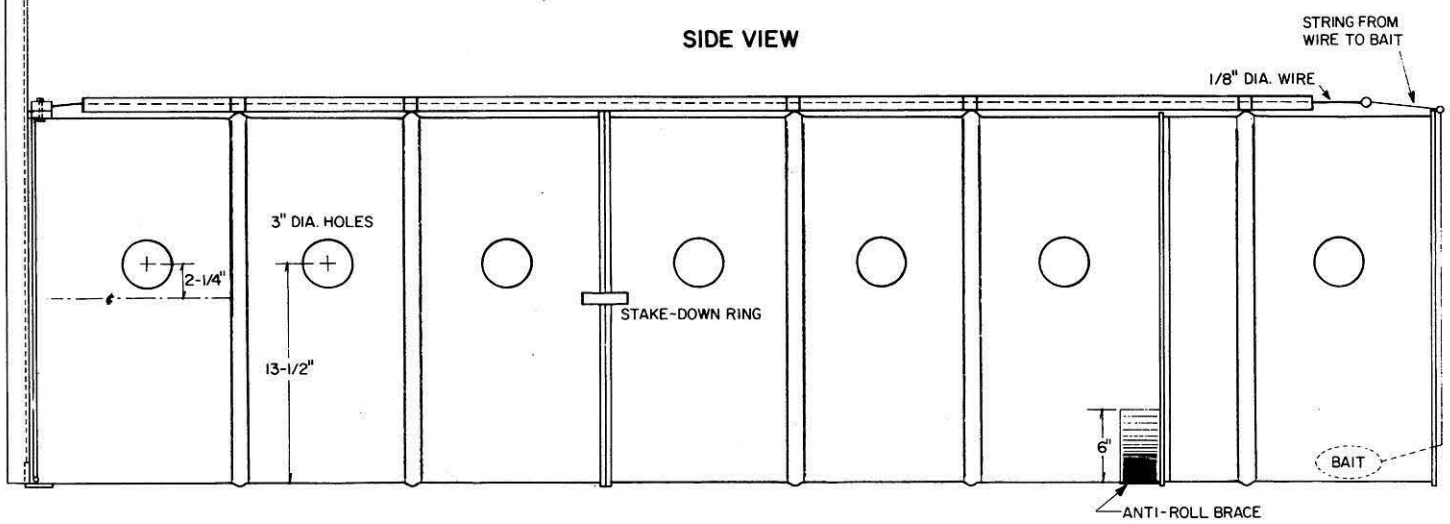
Traps were set at sites known to be productive from previous trapping experience, at sites where bear sign was observed, and at sites which appeared likely places for bears to visit. Usually the traps were located at least 1 mile and less than 5 miles apart, and were moved to new sites if no bears visited

Barrel traps were also quite portable. This allowed us to move the trapline 3 times each summer in order to cover the entire study area.

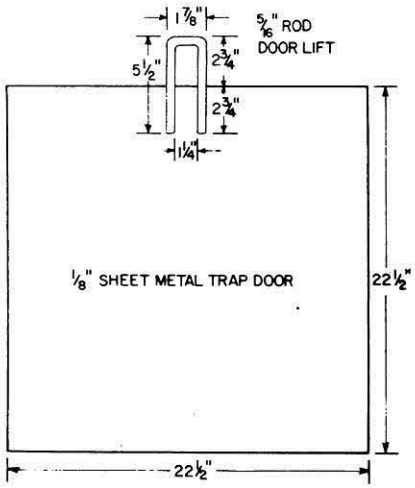
TOP VIEW

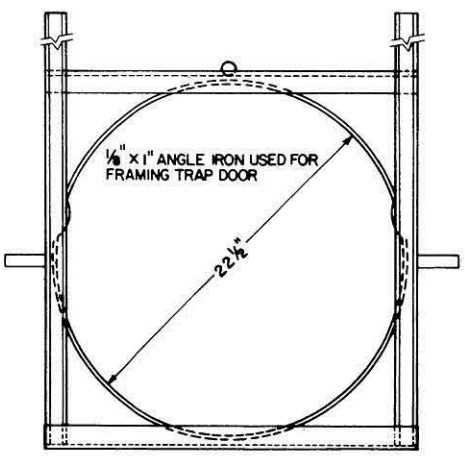


SIDE VIEW

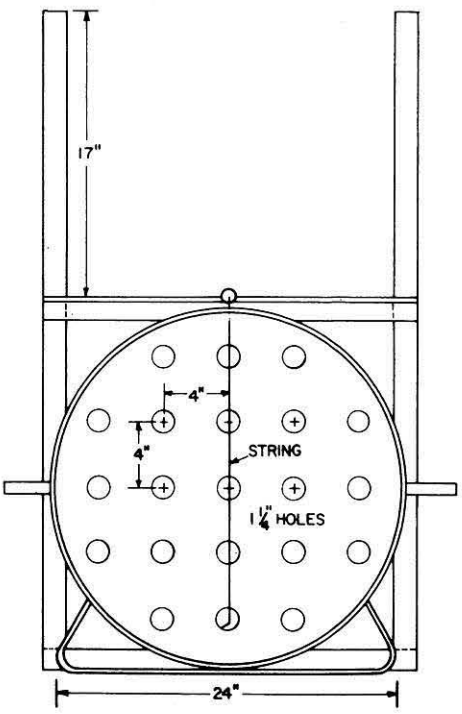


END VIEWS





FRONT VIEW



REAR VIEW

them within 2 weeks or if most of the bears being caught had been previously captured. Special care was taken to place the traps in the shade to prevent bears from becoming overheated.

The traps and immobilization equipment used in this study are described in detail because they may save effort, money, and, perhaps, animals in future projects. The basic barrel trap design and the equipment and procedures for handling bears were given to us by Dr. Lynn Rogers (North Central Forest Range and Experiment Station, St. Paul, pers. comm.). Only the barrel trap trip mechanism and type of pole syringe used were modified in this study.

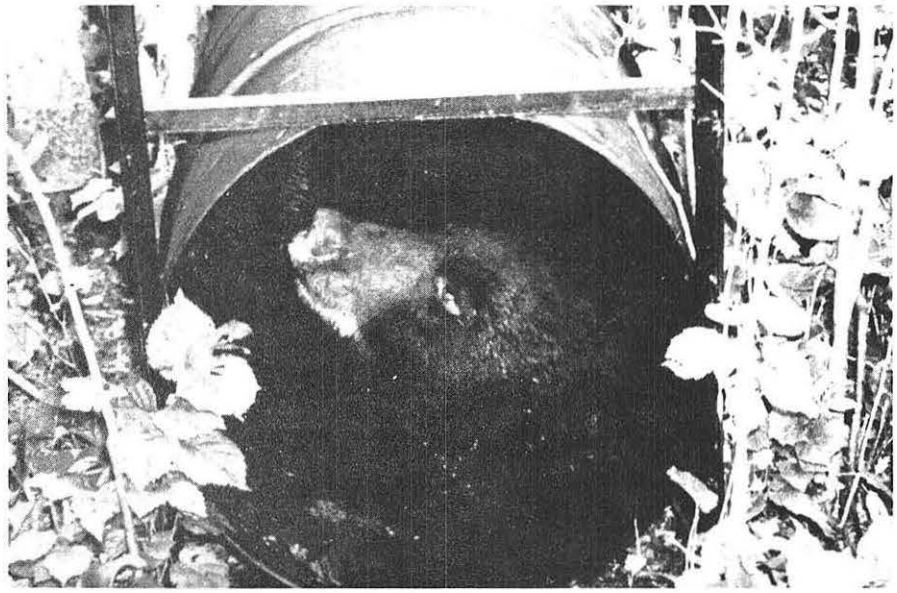
Initially the traps were constructed using two heavy-gauge 55-gal barrels welded end-to-end with a sliding sheetmetal door (Fig. 3). In 1978, a half-barrel was added to 10 of the traps to get the additional length needed to prevent some bears from backing out of the trap after the door had fallen on their backs or legs. Six 3-inch diameter holes were drilled on each side of the traps to allow tranquilization using a pole syringe and the reading of ear tags on recaptured bears, and 21 holes 1.25 inches in diameter were drilled through the rear wall to provide adequate ventilation. The small size of the holes minimized claw and tooth damage.

The trip mechanism was designed to eliminate any metal parts or wire inside the trap which could injure or be destroyed by bears. A solid piece of meat was attached to the trip mechanism by a string running through a hole in the bottom of the trap and then up the back side. An additional 2 lb of meat were scattered around the tied piece to conceal it. Traps were staked into the ground to prevent them from rocking as bears entered, and were covered with brush and trees.

Aldrich foot snares were used when bears repeatedly refused to enter the barrel traps. The snares were usually set along trails made by bears when visiting the barrel traps, but occasionally v-shaped "cubbies" were constructed using logs and brush with the snare set at its entrance. The snares were securely anchored to trees, and meat scraps were trailed in front and behind them. Special efforts were made to check snares before 9:00 a.m. CDT to minimize the length of time bears were restrained.

Attempts were made to find and "tree" cubs of any lactating female captured. The cubs were tranquilized in the tree and caught in a net when they fell or were dropped down.

From 1975 through 1977, bears were tranquilized using a combination of phencyclidine hydrochloride (0.5 mg/lb) and promazine hydrochloride (0.25



In spite of the small size of the barrel traps, this 303-pound male was able to turn around inside of one.

Author with a 485-pound male captured in a barrel trap.

One of the main advantages of the barrel traps was that bears which had been captured before could be released untranquilized.

mg/lb). In 1978 and 1979, ketamine hydrochloride (5 mg/lb) was used. The weights of the animals were estimated and drugs were injected using a pole syringe designed to allow intramuscular penetration by the needle before drug injection (Fig. 4). The use of the syringe container prevented needle loss and plunger breakage when animals moved suddenly during injection. These features saved considerable time and drugs wasted due to incomplete injections with other types of pole syringes. The pole syringe worked well for bears either in barrel traps or snares, and did not create large, bruised areas which normally occur from the impact and instantaneous injection of fluid when using propelled syringes.

Bears were considered safe to handle when their head could be held down easily with a stick and when they exhibited rapid eye movement. All dosages and reactions were recorded each time a bear was tranquilized.

Following tranquilization, a numbered metal stock tag (Nasco Co.) with a $5.00 reward notice was placed in each ear. Hunters returning tags were given a brief summary of the information we had on their bear along with the reward for reporting when and where they shot the bear and its weight.

The bears were then weighed, a lower first premolar was pulled, and the sex, capture location, and physical measurements were recorded (Append. D). After processing, the animals were dragged to a cool, shady spot to recover from the drugs. Recaptured bears were released untranquilized after their ear-tag numbers and capture location had been recorded.

STATEWIDE TOOTH COLLECTIONS

Wisconsin requires that all bears be registered at DNR or cooperative stations before they are removed from the county or adjoining county in which they were killed, and no later than 5:00 p.m. of the day after they were killed. A lower first premolar was collected as the bears were registered, and the sex, estimated or actual weight, and county of kill were recorded for each bear. Registration personnel were provided a sheet of instructions and heavy envelopes for storing the teeth, and given $1.00 for each tooth collected as compensation for their time and effort.

Teeth were sent to the University of Wisconsin-Stevens Point for processing and ages were assigned by counting annuli in the cementum (Willey 1974).

Aldrich foot snares were used to capture bears, such as this 380-pound male, which were too wary to enter the barrel traps.

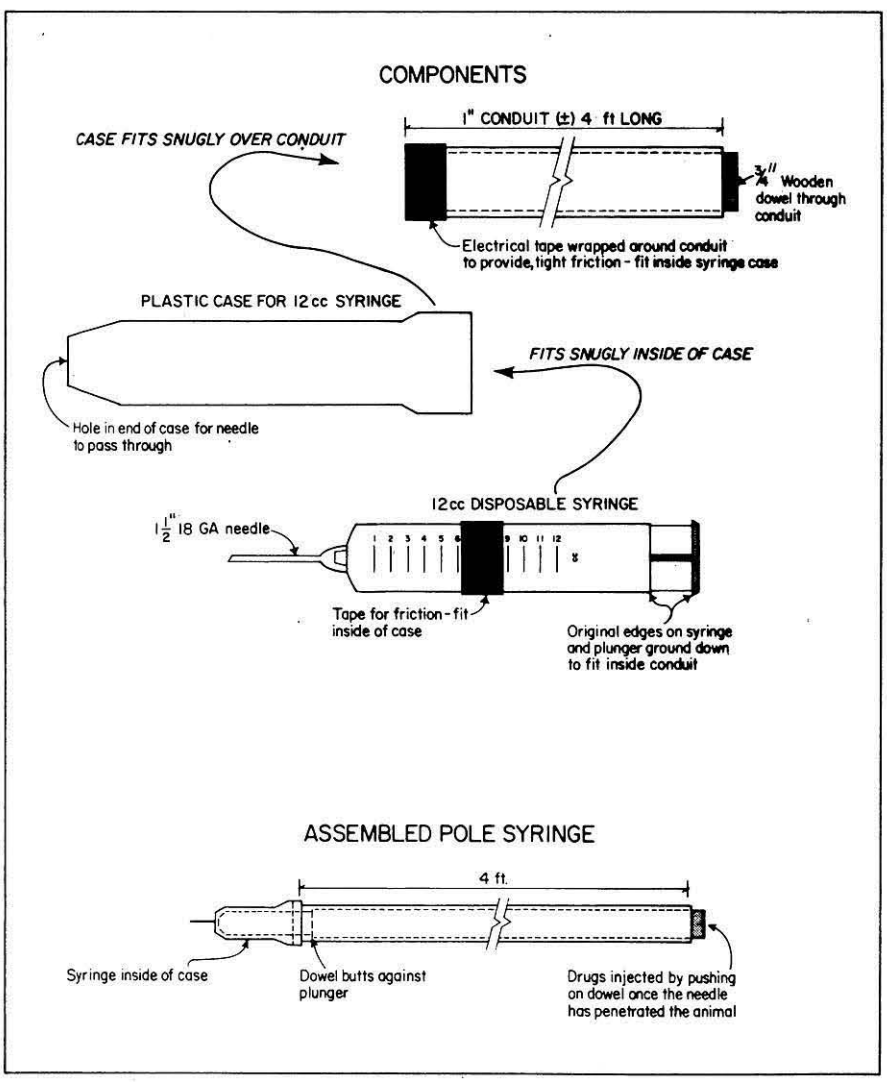


FIGURE 4. *An effective pole syringe designed during the study.*

Bear ages were tabulated by year class, sex, and county of kill, and analyzed following life-table procedures described by Allee et al. (1949) and Caughley (1966).

BAIT STATION SURVEYS

Bait station surveys were evaluated as an index to bear populations beginning in 1977 on the ICSA and by wildlife management personnel in 7 additional areas starting in 1979. The surveys were run between 15 June and 15 July each year and consisted of 50 bait stations placed at 1/2-mile intervals along driveable roads running primarily through public lands. A plastic mesh ham-overwrap bag filled with approximately 2 lb of fresh meat was securely wired to a tree about 7 ft from the ground at each bait station. The bait stations were located on the easterly or northeasterly side of the road far enough back in the woods to be concealed from passersby. Usually, the bags of meat were wired to small aspen, birch, or balsam trees because any marks made by bears showed up well on these species.

The bait stations were checked for bear visitations after 7 nights. A station was considered to have been visited by bears if the bag of meat was gone and the wire securing it had been broken, and by marks present on the trees and/or trails leading to the station. No attempts were made to determine if a station had been visited by more than 1 bear. If the observer could not locate a station or if the bait had been taken by animals other than bears, the station was considered "inoperable" and not included in the calculations. All bags and wire remaining at the stations were removed at the time they were checked. Instructions and the data sheet used for the survey are shown in Appendix E.

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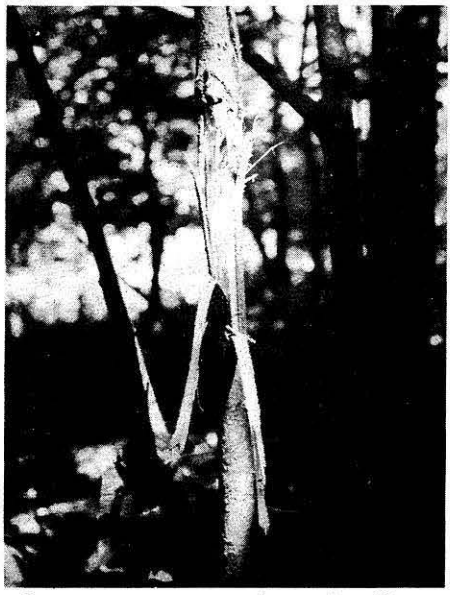

It was very easy to determine if a bear had visited a bait station during the 7-day interval.

RESULTS AND DISCUSSION

BEAR HUNTING AND THE HUNTER

Most bears harvested in Wisconsin before 1967 were taken during the November firearm deer season. Since then, bear hunting has evolved into a specialized sport involving primarily those people hunting specifically for bears. In 1979, 5,791 resident and nonresident firearms bear licenses were sold. In addition, archers accounted for 18% of the bears harvested that year, but the number of archers who hunted bear could not be determined because they were not required to buy a special bear license.

Wisconsin harvests averaged 699 bears annually from 1975 through 1980, or 4.4 bears/100 miles^2 of forested land in the major bear range. Average harvests/100 miles^2 ranged from 8.5 bears in Iron County down to 2.2 in Langlade County (Fig. 5), and were generally highest in the northwestern counties. Harvests in counties other than those depicted in Figure 5 averaged less than 5 bears annually.

Bears were harvested primarily by hunters using trained hounds or hunting over baited areas (Table 2). A much smaller proportion was taken by hunters using other methods — for example, sitting in natural travel or feeding areas, or, in the case of archers, taking a bear incidental to deer hunting.

The percentage of bears taken by hunters using hounds remained fairly constant during the study period, but the proportions reported as taken using bait or other methods fluctuated greatly. Prior to 1974, baiters could use all types of attractants, including meat, and accounted for over 50% of the bears harvested each year. But from 1974 through 1977, baiters were limited to liquid scents and only 12-23% of the bears were reported as taken at bait stations. Conversely, the proportion of bears taken by other methods jumped from less than 10% up to 30-40%. When baiting regulations were relaxed in 1978 to include apples and pastry products in addition to liquid scents, baiters again started taking around 50% of the bears each year and those harvested by other methods fell back to about 10%.

The severe baiting restrictions from 1974 through 1977 reduced the harvest somewhat, but the actual change in hunting methods was probably not as

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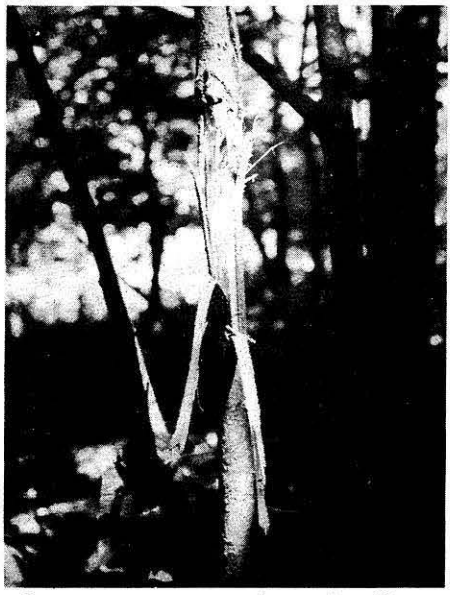

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TABLE 2. *Hunting methods used to harvest black bears in Wisconsin, 1970-80.*

	Bears Taken (Percent)*		
Year	Dogs	Bait	Other
1970	42	55	3
1971	40	57	3
1972**	—	—	—
1973	39	51	10
1974	43	20	37
1975	46	12	42
1976	52	21	27
1977	50	23	27
1978	37	46	17
1979	37	53	10
1980	41	50	9
Avg.	42	40	18

* Includes only those bears where method of kill was recorded on registration form, and does not include bears taken during the November seasons of 1970-73.
** Data not available for 1972.

TABLE 3. *Bears seen/hunter-day and number of hunter-days as reported on questionnaires, 1972-77.*

	Bears Seen/Hunter-Day						
Administrative	Successful	Hunter	Questionnaires		General	Hunter	Questionnaires
District*	1972	1973	1974	1975	1975	1976	1977
Northwest	0.84	0.50	0.85	0.73	0.40	0.43	0.47
	(1,156)**	(834)	(842)	(1,330)	(654)	(856)	(1,025)
North Central	0.67	0.44	0.52	0.56	0.35	0.27	0.32
	(479)	(337)	(338)	(417)	(180)	(385)	(305)
Lake Michigan	0.60	0.28	0.60	0.58	0.32	0.22	0.30
	(281)	(159)	(180)	(224)	(139)	(220)	(226)
State Total	0.76	0.46	0.73	0.67	0.37	0.35	0.41
	(1,916)	(1,332)	(1,360)	(1,989)	(973)	(1,461)	(1,556)

* See Figure 7 for district boundaries.
** Number of hunter-days in parentheses.

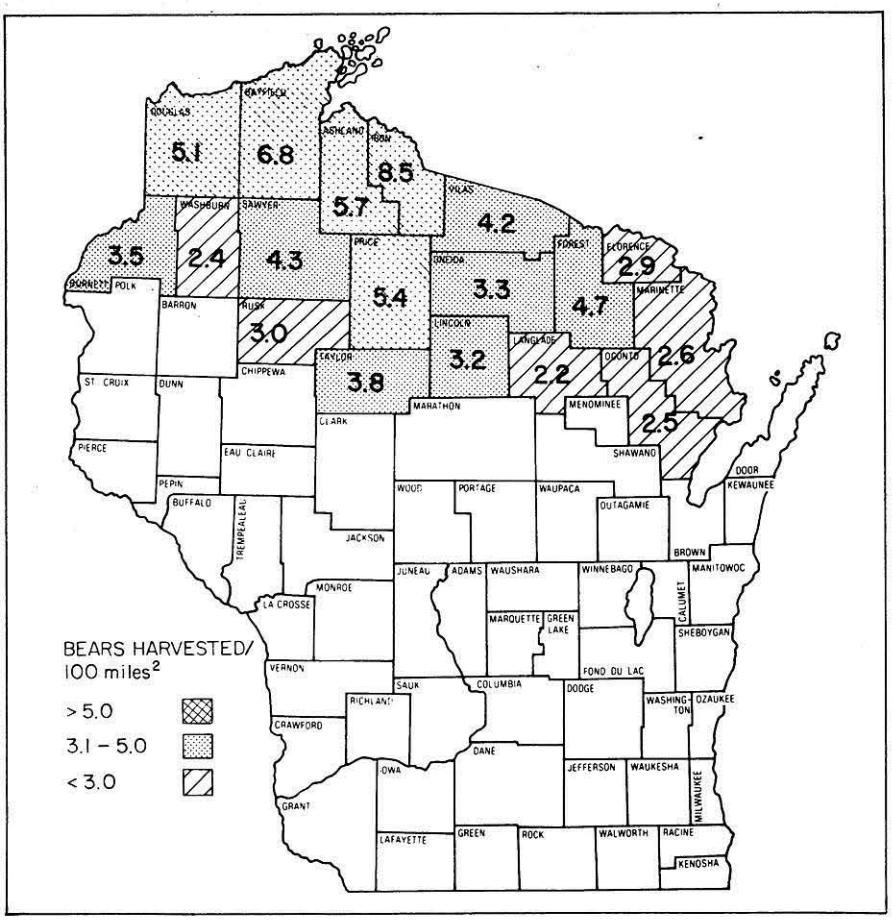


FIGURE 5. *Average numbers of bears harvested/100 miles² in Wisconsin, 1975-80.*

dramatic as reported by hunters. Undoubtedly, some bears were shot at bait stations but reported as being taken by "other" methods because hunters did not consider liquid scents to be bait or they were using illegal bait. Bears were attracted to some liquid scents, but did not return to the site consistently enough for hunters to be very effective.

Additional information on hunting pressure, methods, and general practices was obtained from the returns of 2,493 hunter questionnaires. Return rates averaged 64% for questionnaires sent to successful hunters in 1972-75 and 45% for those mailed to a random sample of all bear hunters in 1975-77. Questionnaires were discontinued after 1977 due to internal problems in obtaining mailing lists.

Bear hunter densities are low over most of the bear range in Wisconsin, averaging less than 1 hunter/2.5 miles². Questionnaires showed that Iron, Ashland, and Vilas counties received the highest hunting pressure, with an average of 200 or more man-days of effort/100 miles² expended during the 1975-77 seasons (Fig. 6). Although there was some general agreement between hunting pressure and harvest, pressures reported in many eastern counties were disproportionately high in relation to numbers of bears harvested.

Average numbers of bears seen/hunter-day in each county (Fig. 7) agreed more closely with harvest intensities shown in Figure 5. Reported observation rates were generally higher in western counties than in eastern ones,

and ranged from 0.60 bears/day in Iron County to 0.17/day in Forest County.

Annual observation rates showed no major trends from 1972 through 1977 (Table 3). Observation rates reported on the General Hunter Questionnaires from 1975 through 1977 were lower than those reported previously, because they included unsuccessful hunters. The low observation rate in 1973 was possibly due to a superabundance of natural foods which made bears less vulnerable to hunters, especially those sitting at bait stations. This also possibly accounted for the lowered harvest that year (Table 1).

Other information obtained from the questionnaires showed hunters hunted an average of 5.1 days/season. Sixty percent hunted in a party averaging 8 hunters, and 18% hired guides. Hunters using hounds averaged 4.6 dogs/pack and saw 56% of the bears they "started".

Twenty-three percent of the hunters reported passing up at least 1 adult bear they could have shot. The most common reasons for doing so were that the bears were too small or were accompanied by cubs. Finally, 91% of the successful and 72% of the unsuccessful hunters felt the bear population was stable or increasing.

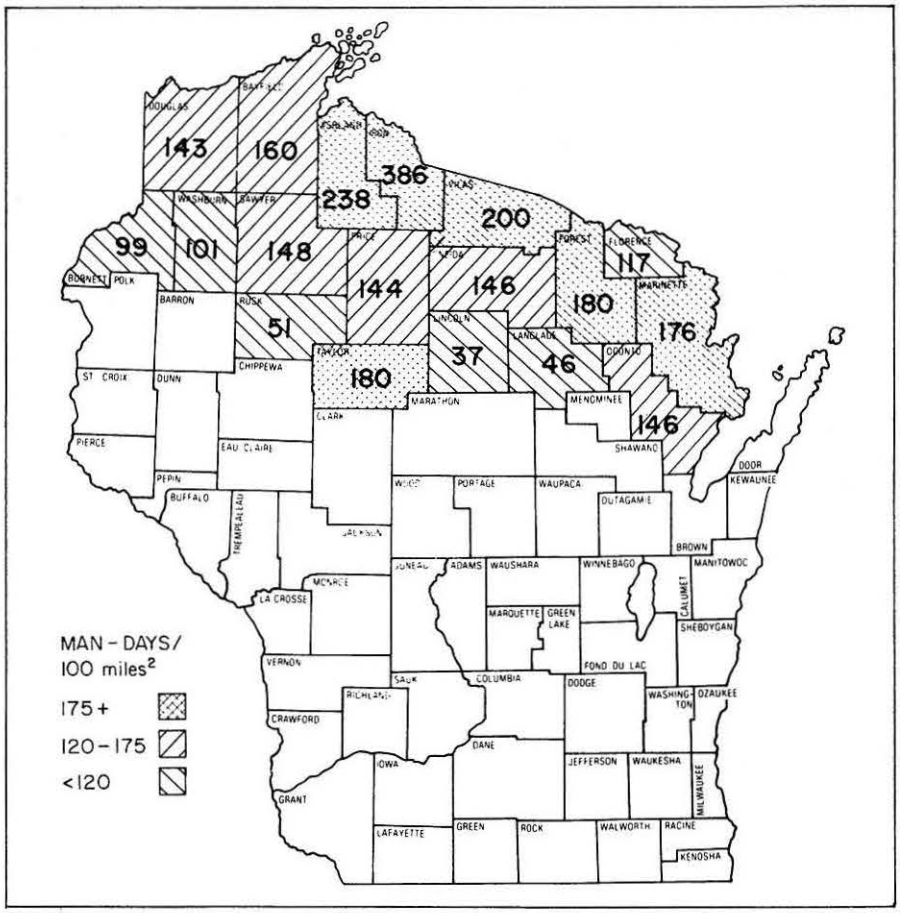


FIGURE 6. *Average total season man-days of effort/100 miles² as determined from hunter questionnaires, 1975-77.*

TRAPPING AND HANDLING EFFICIENCY

Bears were captured 831 times in 9,263 trap-nights on the ICSA (Table 4). Although Aldrich foot snares proved to be more effective (18.6 captures/100 trap-nights), barrel traps (8.6 captures/100 trap-nights) were used almost exclusively because there was virtually no chance of bears injuring themselves while in the trap, and bears that had been captured previously could be released untranquilized. Also, the apparent effectiveness of Aldrich foot snares as shown in Table 4 was inflated because they were set only when bears had visited a site repeatedly but would not enter a barrel trap. Only 16 cubs and 2 yearlings were captured while in trees.

Trapping success dropped steadily from 12.1 captures/100 trap-nights in 1975 to 5.8 in 1979. This was believed due to bears becoming more wary and adept at escaping capture as the study progressed rather than to a population decline. Numbers of times bears evaded capture in barrel traps (by letting the door fall on their back or legs and then backing out, by taking the bait without tripping the trap, or by rolling, throwing, or destroying the trap) increased from 162 instances in 1975 to 326 in 1979.

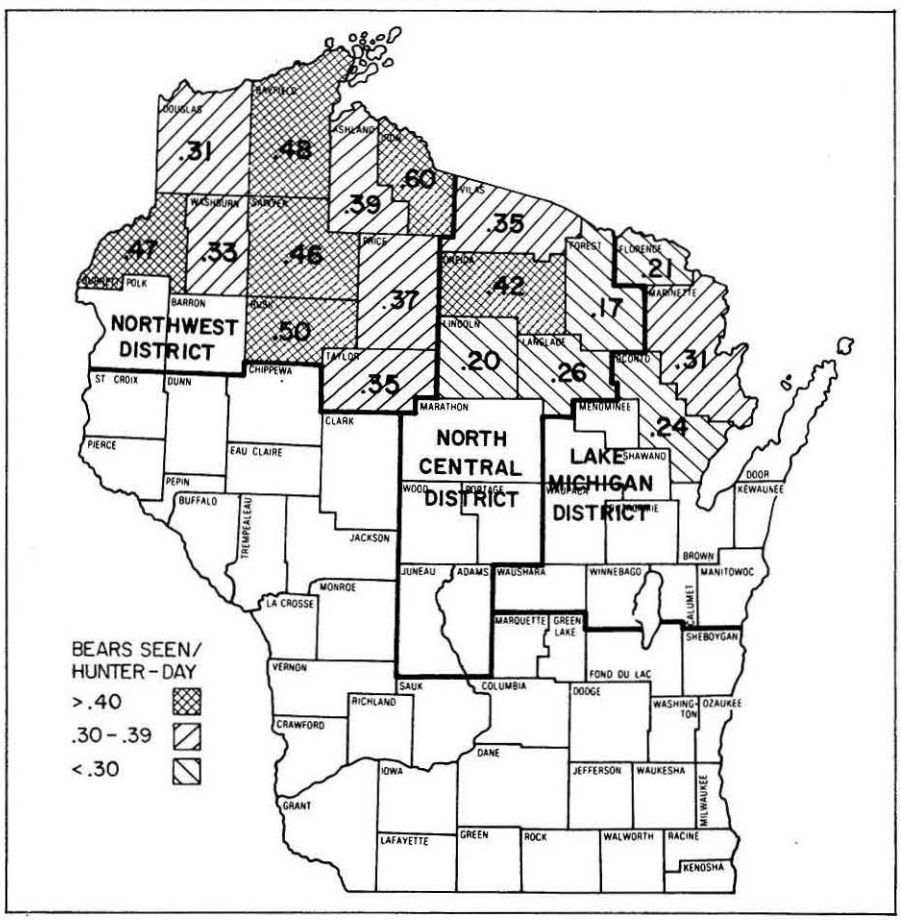
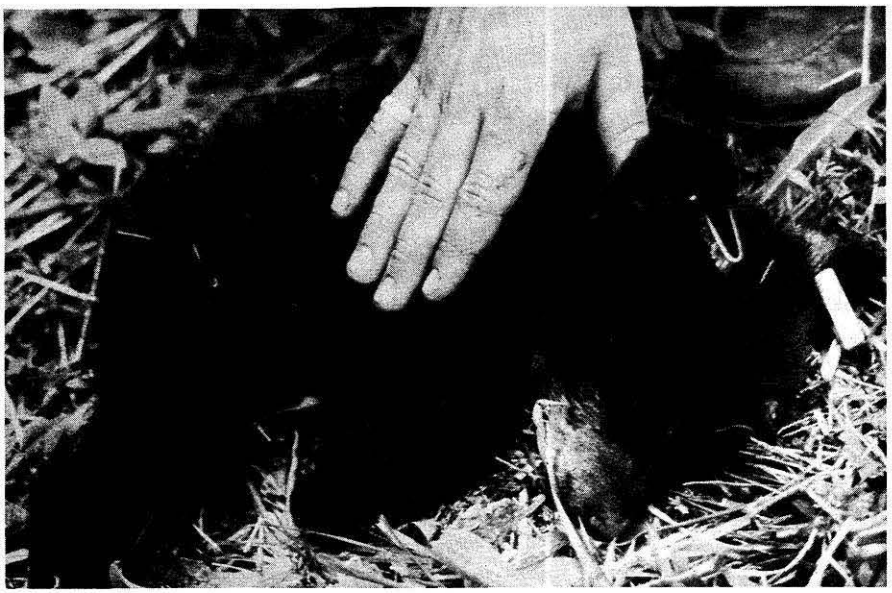


FIGURE 7. *Average numbers of bears seen/hunter-day as reported on hunter questionnaires, 1975-77.*



A 3-pound male captured which was from a litter of 4. He survived in spite of his small size, and was recaptured the following year.

TABLE 4. *Trapping effort and efficiency on the Iron County Study Area, 1975-79.*

	Year					
Trapping Method	1975	1976	1977	1978	1979	Total
Barrel traps						
No. trap-nights*	1,161	1,855	2,058	2,024	2,020	9,118
No. captures	141	182	181	167	115	786
Captures/100 trap-nights	12.1	9.8	8.8	8.3	5.7	8.6
Aldrich foot snares						
No. trap-nights	65	10	4	13	53	145
No. captures	7	7	0	7	6	27
Captures/100 trap-nights	10.8	70.0	--	53.8	11.3	18.6
Free-roaming (in trees)						
No. captures	4	7	0	3	4	18
All methods						
No. trap-nights	1,226	1,865	2,062	2,037	2,073	9,263
No. captures	152	196	181	177	125	831
Captures/100 trap-nights**	12.1	10.1	8.8	8.5	5.8	8.8

* One trap-night = 1 trap set 1 night excluding nights when animals other than bears were caught or the trap malfunctioned

** Excludes free-roaming captures

NOTE: Other animals captured in barrel traps included 89 skunks, 26 dogs, 14 fisher, 9 raccoons, 3 ravens, and 1 porcupine.

TABLE 5. *Numbers and sex of black bears captured on the Iron County Study Area, 1975-79.*

	New Bears		Bears Recaptured From Previous Years		
Year	Males	Females	Males	Females	Annual Totals
1975	45	30	—	—	75
1976	55	24	15	13	107
1977	43	15	16	24	98
1978	46	17	21	20	104
1979	28	9	24	13	74
Study Total	217	95			

The addition of a half barrel to 10 traps in 1978 greatly reduced the problem of bears escaping by letting the door fall on their backs or legs. This occurred only 4 times with the lengthened traps in 1978 and about 10 times in 1979, but remained a serious problem with the 23 shorter traps. Therefore, it is strongly recommended that this type of trap be constructed from 2 1/2 55-gal barrels.

The 831 captures involved 312 individual bears including 1 male captured 20 times in 5 summers and 1 male captured 17 times in just 80 days. Numbers of bears captured ranged from 74 in 1979 to 107 in 1976 (Table 5). The preponderance of males captured was probably due to males being less wary than females and, therefore, more prone to enter a barrel trap (Erickson and Petrides 1964), and male bears being more likely to encounter our traps because of their greater daily movements (Rogers 1977).

Although Erickson and Petrides (1964) and Rogers (1977) found that dumps were frequented more often by males than females, it did not appear to be the case in this study. Males comprised 73% of the bears captured in dumps and 66% of the bears caught in other cover types. These sex ratios could not be shown to be different (Chi square = 1.28, $P > 0.05$).

No major problems were encountered using either the phencyclidine hydrochloride-promazine hydrochloride combination or ketamine hydrochloride by itself to immobilize bears. In approximately 500 immobilizations, no bears died and only 5 bears (3 of which were cubs) went into minor convulsions. All but one of these 5 were seen or shot later.

Ketamine hydrochloride proved to be the most satisfactory for our use. It was readily available from veterinarians, and the bears were immobilized significantly ($P < 0.01$) more quickly with ketamine hydrochloride (4.8 min avg.) than with phencyclidine hydrochloride (12.9 min avg.). And if a bear's dosage weight was underestimated or it did not get a complete injection, additional dosages of ketamine hydrochloride could be given after just 7 min compared to 20 min with phencyclidine hydrochloride.

Although not documented in this study, it was very apparent that bears recovered from ketamine hydrochloride much sooner than they did from phencylidine hydrochloride. Hugie et al. (1979) reported recovery periods often lasting 5 hours or longer with phencyclidine hydrochloride whereas 72% of the bears immobilized with ketamine hydrochloride recovered within less than 80 minutes. The quicker recovery period is desirable because immobilized bears are in poten-

tial danger from humans, other bears, or possibly other animals.

The fact that traps were not set randomly but only at likely looking sites and that the bait used may have attracted bears from considerable distances precluded meaningful analysis of capture rates as an indicator of habitat use. Bears were captured at 102 (76%) of the 135 sites selected, which was probably higher than would be expected with random trap placement.

Nuisance complaint situations and dumps were the most productive trap sites (Table 6). Trapping sites in aspen appeared slightly more productive than in northern hardwoods, and least productive in agricultural areas. Poor capture rates in agricultural areas probably occurred because trapping terminated before these areas received their heaviest use in September and October.

Fifty-four percent of the trap sites selected in aspen and 43% of those in northern hardwoods were adjacent to sodded openings or creeks. The fact that most sites were originally selected because of the presence of bear sign, and openings and creeks comprised only about 1% of the study area but made up a high percentage of trap sites selected, suggests their heavy use by bears. Data collected by Erickson et al. (1964), Young (1976), Rogers (1976), and Norton (1982) provide much more sophisticated evaluations of bear use of habitat types of the region and the reasons for this use.

TABLE 6. *Trapping success in various trap site locations, 1975-79.*

Trap Site Classification	No. Sites	No. Captures	No. Trap-nights	Captures/100 Trap-nights
Nuisance complaints	4	5	19	26.3
Dumps	12	354	2,661	13.3
Aspen	46	212	2,809	7.5
Northern hardwoods	56	237	3,321	7.1
Agriculture/ orchards	17	23	453	5.1
All classifications	135	831	9,263	9.0*

* Differs from value shown in Table 4 because it includes free-roaming captures.

TABLE 7. *Harvest rates of ear-tagged bears, 1975-79.*

	No. Males*		No. Females*		All Adults	
Year	Handled	Shot (%)	Handled	Shot (%)	Handled	Shot (%)
1975	44	13 (30)	27	4 (15)	71	17 (24)
1976	60**	16 (27)	35	7 (20)	95	23 (24)
1977	51	11 (22)	37	7 (19)	88	18 (21)
1978	59**	6 (10)	35*	9 (26)	94	15 (16)
1979	48**	6 (13)	22	3 (14)	70	9 (13)
All Years	262	52 (20)	156	30 (19)	418	82 (20)

* Excludes cubs.

** One bear handled in 1976, 2 handled in 1978, and 1 handled in 1979 were not included because they were either killed or known to have lost both ear tags prior to the hunting season.

RECOVERY RATES OF EAR-TAGGED BEARS

In an analysis of recovery rates, tag losses must be considered. In this study, the calculated likelihood of bears losing both ear-tags (the square of the single ear-tag loss rate) was only 0.02% the same year as handled and 1.4% after 1 year; it increased rapidly after that, reaching 83% after 4 years. Thirteen bears lost both tags during the study and could not be identified. Because of this problem, recovery rates were analyzed only for bears captured and shot in the same year.

Hunting accounted for 94 of the 100 known mortalities of ear-tagged bears. Three other bears were shot on nuisance complaints, 2 were killed by vehicles, and 1 was shot on an Indian reservation where hunting was allowed all year. Although other ear-tagged bears undoubtedly died and were unaccounted for, hunting was the major cause of mortality of marked bears on the ICSA.

Recovery rates for yearling and older bears tagged in a given year ranged from 13% in the 1979 hunting season to 24% in 1975 and 1976, and averaged 20% for the 5 hunting seasons reported (Table 7). Recovery rates of males and females were not correlated and appeared to be much lower for females than males in 1975 and 1976. There was a highly significant ($P < 0.01$) decrease in rates for all bears and for males separately as the study progressed, but this was not significant for females ($P > 0.05$). The overall recovery rate between sexes was not different despite yearly variation. Since cubs were protected during this study and comprised at least 20% of the total bear population (see section on reproduction), the reported harvest represented approximately 16% of the entire bear population.

Erickson and Petrides (1964) suggested that bears frequenting dumps were more vulnerable to hunting than "wild" bears. However, in this study, recovery rates involving 82 bears were almost identical for bears captured only in dumps (21%), for those caught both in dumps and "wild" sets (18%), and for those captured only in "wild" sets (19%).

Overall mortality rates (hunting plus natural causes) calculated from the ages of 267 yearling and older ear-tagged bears averaged 27% annually. The close agreement between mortality rates calculated from hunter returns of ear-tagged bears and those from their ages suggested that failure to report taking marked bears was not a serious problem in the calculation of harvest rates.

Data collected by George Knudsen (DNR files) from 1958 through 1962 were retabulated for comparison with this study. At that time, bears were harvested during the regular archery and firearms deer seasons, and cubs were not protected. A questionnaire distributed to successful hunters during that period showed 45% of the bears taken during the firearms season were either shot in their dens or as they were coming out, and 75% of these consisted of sows with cubs (Dahlen 1959).

TABLE 8. *Bear population estimates for the Iron County Study Area, 1975-79, based on three methods of calculation.*

Year	Same Year Recovery Rates*	Marked:Unmarked Ratios**	Jolly Method[1]
1975	99	No estimate	No estimate
1976	181	222	364
1977	226	280	297
1978	375	252	302
1979	359	266	No estimate
Average	285[2]	255	321

* Population = Number of bears harvested on area÷percentage of adult bears handled and shot that year÷0.80 (assumes cubs comprise 20% of the population).

** Population = (Number of bears captured x maximum number of surviving marked bears from previous year) ÷number of bears captured that were handled the previous year.

[1] Population calculated as described by Davis and Winstead (1980).

[2] Excluding 1975 estimate.

Under these regulations and conditions, 28 (17%) of the 168 bears marked and released by Knudsen were shot the same year as captured. This was nearly identical to harvest rates (16%) calculated in this study. Apparently, bear harvest rates have not changed significantly in Wisconsin despite the interest created by the September bear season initiated in 1963. Bears are now merely being taken at a different time of year by people specifically hunting for bears. Also, 16 (21%) out of the 75 of Knudsen's bears recovered were shot as nuisances, compared to only 3% in this study.

POPULATION ESTIMATES FOR THE STUDY AREA

Population estimates for the study area (Table 8) were calculated using: (1) harvest rates for adult bears captured and shot in the same year, (2) marked:unmarked ratios of bears captured in consecutive years, and (3) the Jolly Method (Davis and Winstead 1980). Except for the Jolly Method, these methods minimized the length of time bears had to die from natural causes or lose their ear-tags, and thus, not be available for harvest or recapture.

Other assumptions made in using these methods to estimate the population included: (1) There was no difference in mortality rates between marked and unmarked bears. This assumption was probably valid because there was no significant difference ($P > 0.05$) between mortality rates calculated from the ages of marked bears and those calculated from all bears harvested on the ICSA. (2) There was no difference in catchability between marked and unmarked bears. This assumption could not be validated, but if unmarked bears were indeed less vulnerable to our traps, the population on the ICSA would actually be higher than calculated. And (3), there was no difference in rates of immigration and emigration between marked and unmarked bears. This assumption also could not be validated, but there was no reason to believe that they differed.

The single population estimate for 1975 was of low precision due to the small number of animals harvested on the study area (19), and the lack of previously marked animals to calculate a population using marked:unmarked ratios. The 1975 estimate should be disregarded, because if it were actually valid it would mean that all but 24 of the bears on the area were captured that year, and that the population almost doubled the next year. Both possibilities were extremely unlikely. Subsequent harvests on the ICSA were 35 (1976), 37 (1977), 48 (1978), and 37 (1979).

Although annual population estimates calculated using the 3 methods were quite diverse, their average estimates differed by a maximum of only 66 bears, and there were no significant differences ($P > 0.05$) between any of the estimates. But, estimates calculated from marked:unmarked ratios of bears captured each summer were considered the most precise because: (1) a larger sample of animals was involved than in estimates from first-year recovery rates, and failures to report the shooting of marked bears would not affect the estimates as much, and (2) ear-tag retention would not be as significant a problem as it could be with the Jolly Method. These marked:unmarked estimates ranged from 222 to 280 bears on the ICSA and showed no major trend in population size.

The average estimate of 255 bears calculated from marked:unmarked ratios represented an average density of 1 bear/1.5 miles^2 of forested land on the ICSA. The average annual harvest of 39 bears on the ICSA during this period (1976-79) would represent a 15% harvest rate from a population of 255 bears, compared to a 16% harvest rate calculated from returns of the ear-tagged bears. This close agreement gave further credibility to the marked:unmarked population estimate.

PHYSICAL CHARACTERISTICS

Only 1 bear captured during the study, a chocolate-brown, 3.5-year-old male, had a coat color other than black. The only other evidence we found of brown-phase bears on the ICSA was where 1 had rubbed against a tree. Seventy-three (23%) of the individuals captured had some white on their chests ranging from small dots to large blazes. No adults changed coat coloration as described by Rogers (1980).

Live weights of bears captured, excluding cubs, averaged 162 lb for males and 125 lb for females. The largest male captured weighed 485 lb and the largest female 263 lb. Weights of yearling and older Wisconsin bears captured from 1958 through 1962 by Knudsen (DNR Files) were almost identical, with males averaging 166 lb and females 118 lb. Although this comparison is subjective, the similarity in weights suggests that the age structure of the population during the 2 study periods was also similar since any marked change in the age structure would be expected to greatly change the weight averages, especially for males.

On the average, females achieved their maximum weight at 6-7 years whereas males continued to grow until they were 8-9 years old (Fig. 8). Average weights of females 4.5 years old and older did not change significantly from May through July, but increased rapidly in August and September (Fig. 9). Males 4.5 years old and older lost weight during the breeding season (June and early July), but then gained weight throughout the summer. One male weighing 396 lb in May had lost

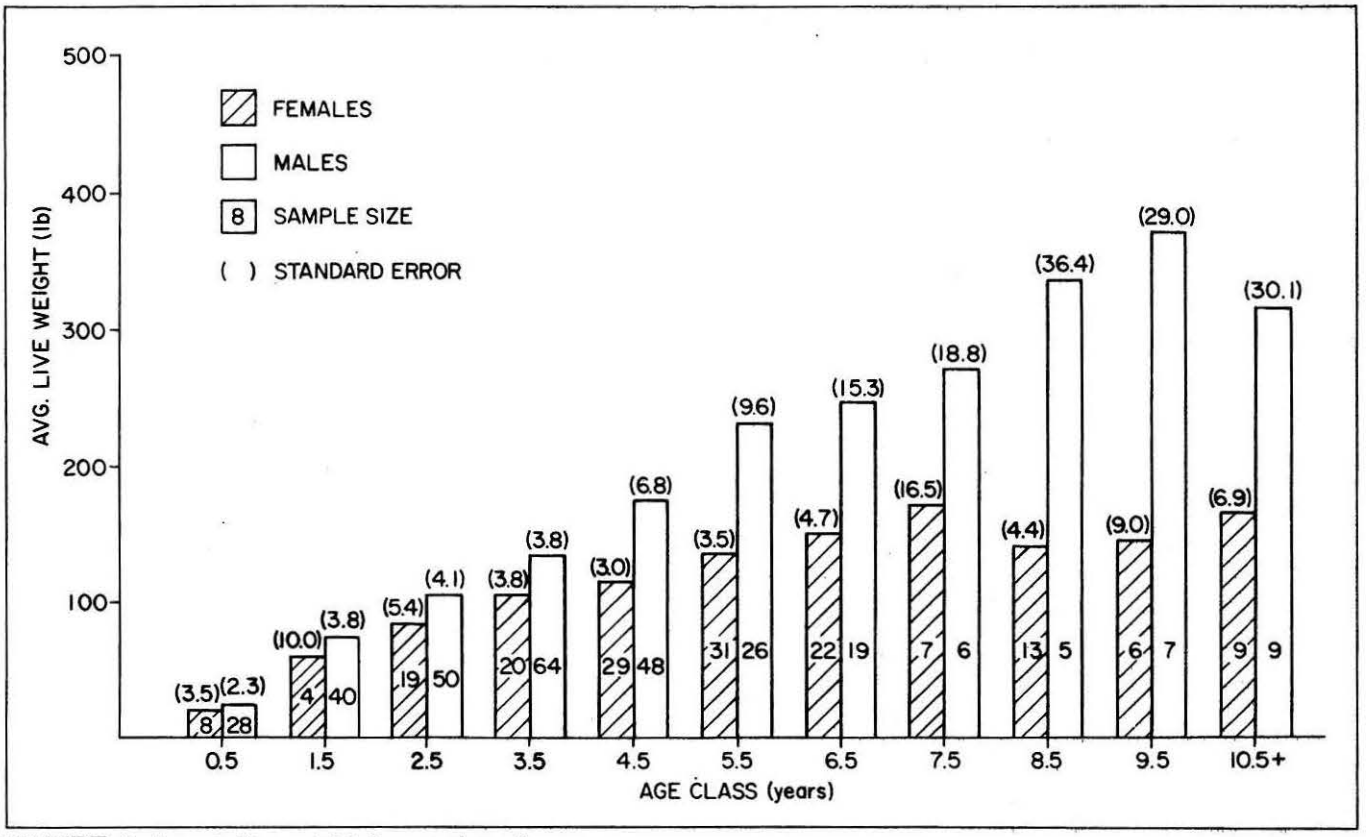


FIGURE 8. *Average live weights by age class of bears captured on the Iron County Study Area.*

23% of his body weight when recaptured in July. May to September weight gains averaged 78% for females and 36% for males. Jonkel and Cowen (1971) reported similar weight patterns for bears in Montana. Testing for differences among groups was not done since the data include repeat weights of the same individuals.

Chest girth (LeCount 1977, Payne 1976) and composite foot measurements (Piekielek and Burton 1975) were evaluated as estimators of live weight for Wisconsin bears (Figs. 10 and 11). Both showed a strong relationship to weight of bears, but variation was too great for either to usefully estimate an individual bear's actual weight. Some of the variation, especially with composite foot measurements, was undoubtedly due to the use of bear weights obtained throughout the summer. Such estimators might be much more precise if based on the live weight of bears taken during a specific, short period of time (e.g., hunting season).

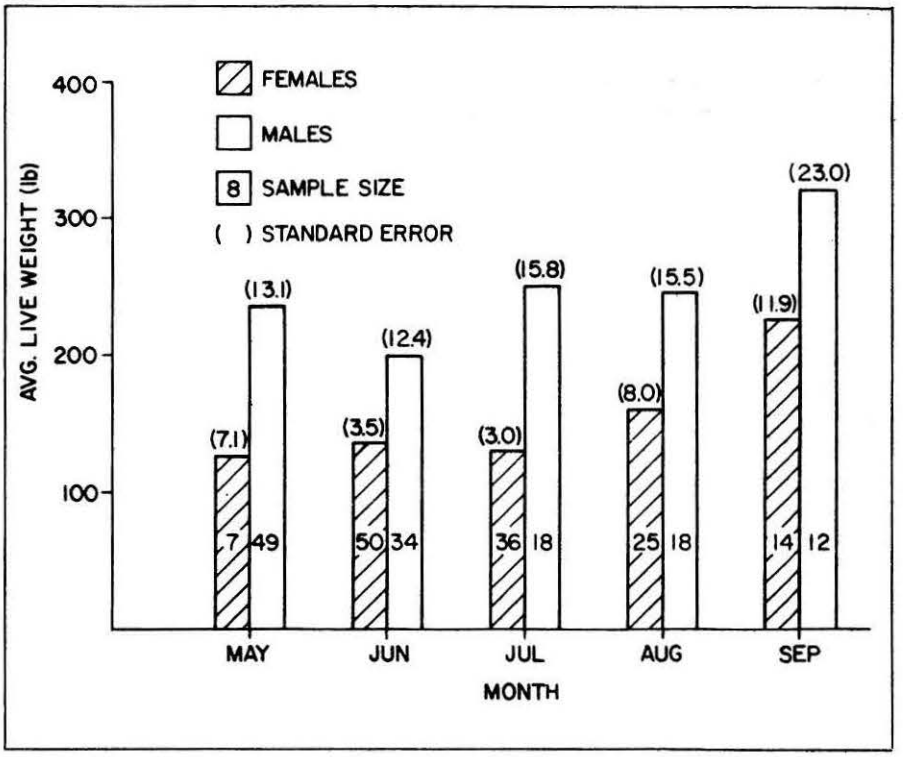


FIGURE 9. *Average monthly live weights of adult bears captured on the Iron County Study Area.*

MOVEMENTS AND HOME RANGES

Males were much more mobile than females. Maximum straightline distances between points of capture and/

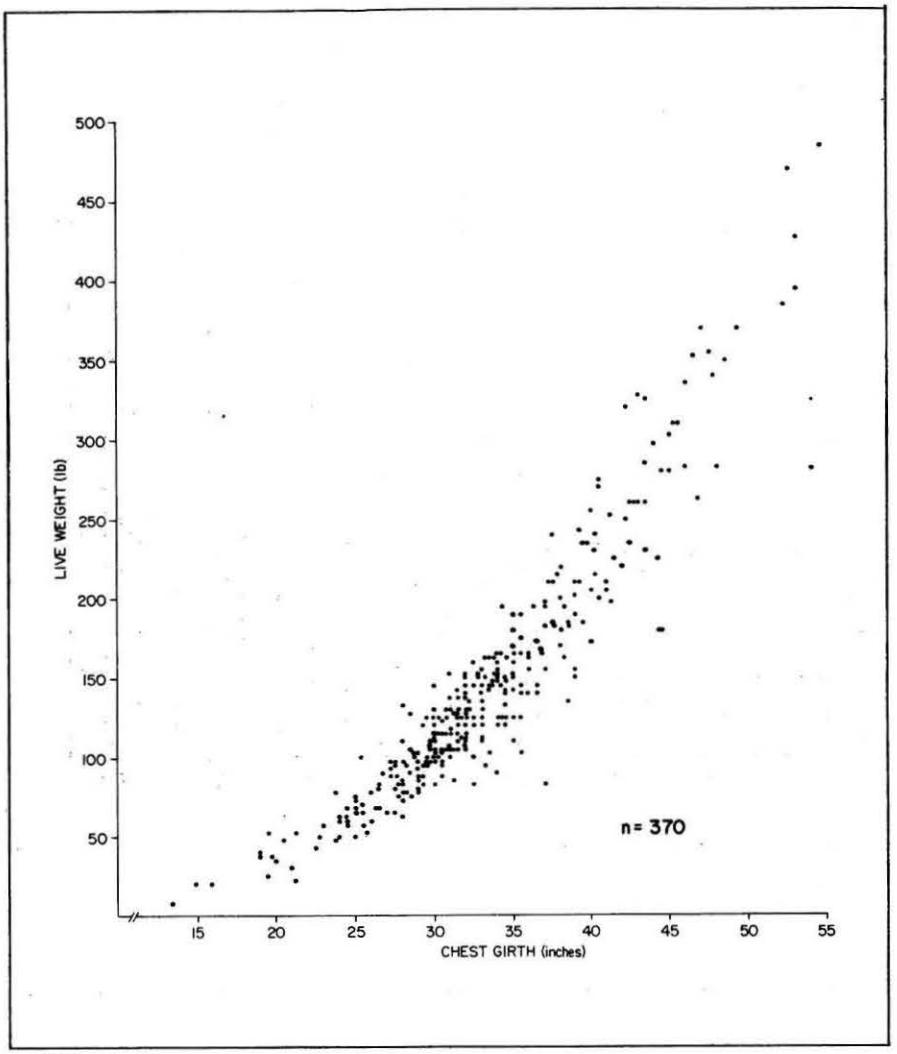


FIGURE 10. *Relationship between chest girth and live weight of bears captured on the Iron County Study Area.*

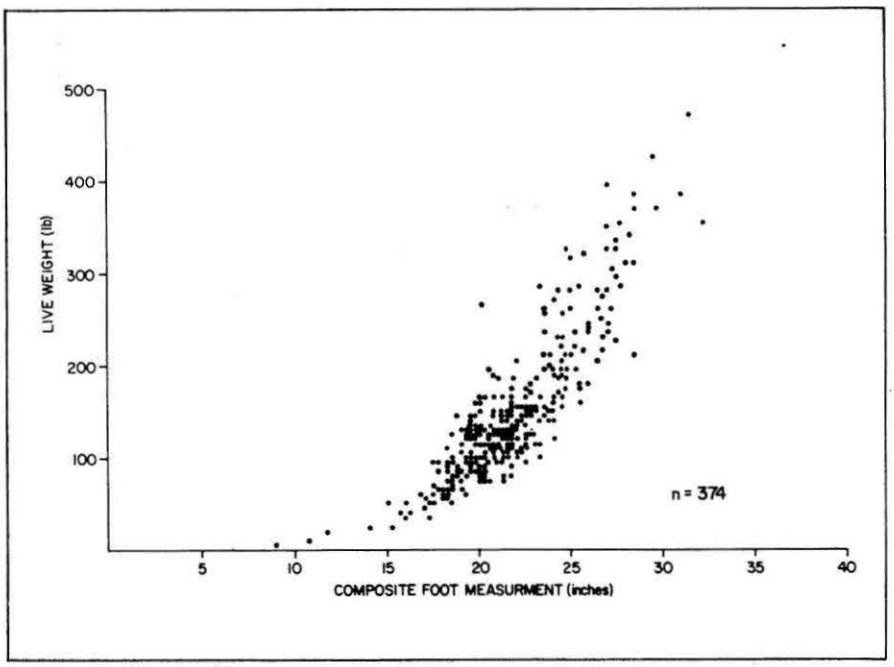


FIGURE 11. *Relationship between composite foot measurements and live weight of bears captured on the Iron County Study Area.*

or kill sites of bears at least 2.5 years old averaged 10.2 miles for 89 males and 4.0 miles for 58 females. The longest movement recorded during the study was 83.3 miles by a 2.5-year-old male, and 5 other males and 1 female traveled more than 25 miles. Knudsen (1961) reported slightly greater movements of his tagged bears with averages of 13.0 miles for males and 4.9 miles for females.

Minimum home ranges were calculated for 21 bears (13 males and 8 females) captured and/or shot in at least 4 different locations. The size of each home range was determined by measuring the area within a polygon formed by connecting the outermost locations. These were considered minimal estimates because they were restricted by trap placement and small numbers of captures. Males again showed greater mobility with an average home range of 27.5 miles^2, compared to 5.3 miles^2 for females. Rogers (1977) reported similar sizes in home ranges of bears in Minnesota, and found that males covered areas that included at least parts of territories of 7-15 females.

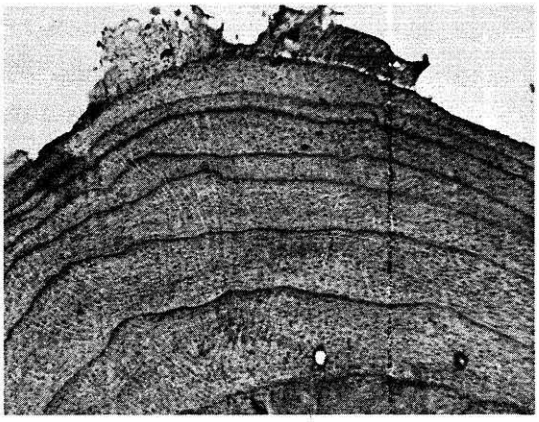
POPULATION DYNAMICS

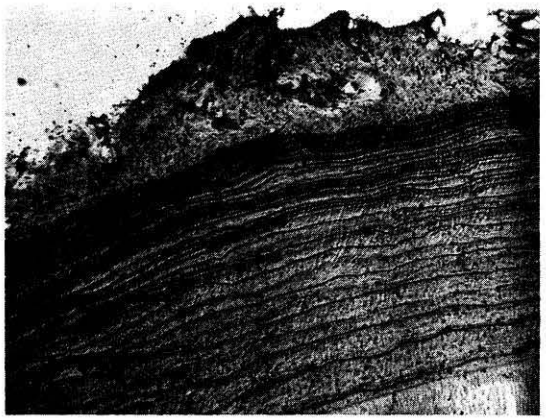
Sex and Age Ratios

The sex ratio of 3,489 bears harvested in Wisconsin from 1975 through 1980 was 133 males:100 females. Erickson (1964), Willey (1978), and Poelker and Hartwell (1973) reported similar sex ratios for bears harvested in Michigan, Vermont, and Washington, respectively, but thought they were distorted because males were more vulnerable to hunting. Rogers (1977) found that the sex ratio for cubs live-trapped on his study area in Minnesota was 118 males:100 females, but that it dropped quite rapidly thereafter due to higher male mortality rates. The sex ratio on his study area was 51 males:100 females for bears 4 or more years old and averaged 82 males:100 females for all bears.

Although males outnumbered females in the harvest and in our age samples (Tables 9 and 10), the sex ratio dropped to 92 males:100 females for bears 4 or more years old. Because of this and the known biases in using harvest figures to determine sex ratios due to greater vulnerability of males to hunting, females probably comprised at least half of the bear population in Wisconsin.

Ages were determined for 2,699 bears harvested from 1973 through 1979 (Tables 9 and 10). Except for 1973, when teeth were collected at only a few registration stations, samples in-





Seven and one-half year old bear was aged by cementum annuli (left).

A bear estimated to be around 30 years old by cementum annuli (right).

cluded approximately 70% of the bears shot each year.

The average age of males harvested during the period (4.1 years) was significantly lower ($P < 0.01$) than the average age of females (5.1 years). Six bears (5 males and 1 female) were over 20 years old, including 1 male estimated to be 36 years old. Raybourne (1976) and Willey (1971) reported similar ages for bears in Virginia and Vermont, respectively.

Yearlings of both sexes and to some extent 2-year-old females were underrepresented in the harvested sample. This was probably due to hunters either being reluctant to shoot small bears they thought might be cubs, or passing up smaller bears in hopes of eventually taking a larger one.

The average age of males harvested was relatively stable from 1973 through 1979. However, the average age of females appeared to fluctuate more than males and showed a downward trend the last 4 years, perhaps due to an increasing proportion of 2-year-olds in the harvest. Gill (1953) showed that changes in the age structure of the female segment of polygamous populations were caused primarily by changes in natality rather than mortality. Since there was no decrease in numbers of females 10 or more years old in the harvest and the average age of males harvested did not decrease, the decline in the average age of females harvested most likely resulted from increased production rather than increased mortality. The increase in production reported by hunters in 1976 and 1977 (Table 12) also supported this conclusion. These bears reached 2 years of age in 1978 and 1979, respectively.

Life-table analyses (Allee et al. 1949, Caughley 1966) showed a significantly higher ($P < 0.01$) average annual adult mortality rate for males 1.5 years old and older (30%) than for females (23%) in the same age classes. Much of this difference undoubtedly was due to males being more vulnerable to hunting, but it also reflected hunter selection. Twenty-three per-

TABLE 9. *Age classes of male bears harvested in Wisconsin, 1973-79.*

Age Class In Years	Percent in Age Class							All Years
	1973	1974	1975	1976	1977	1978	1979	
1	15.9	16.7	4.9	2.9	4.0	13.5	28.7	12.0
2	20.3	23.2	33.3	27.8	43.4	33.1	27.6	31.3
3	26.1	24.4	20.7	33.6	22.8	31.3	14.3	24.6
4	18.8	14.3	20.7	17.3	13.2	7.8	7.5	13.4
5	1.4	7.1	8.9	7.2	3.7	6.0	6.5	6.4
6	—	4.2	4.5	4.7	3.3	2.5	5.5	3.9
7	2.9	5.4	2.8	2.2	2.2	2.8	2.0	2.7
8	—	1.8	2.0	1.4	1.8	0.4	3.4	1.7
9	1.4	0.6	1.2	0.7	1.5	0.7	0.7	0.9
10	1.4	1.2	0.8	0.4	1.1	0.7	0.3	0.7
11	4.3	0.6	—	0.7	0.7	—	0.7	0.6
12	1.4	—	—	0.4	0.4	0.7	—	0.3
13	1.4	—	—	0.4	0.4	0.4	0.3	0.3
14	1.4	—	—	—	0.4	—	0.3	0.2
15 and over	2.9	0.6	—	0.4	1.1	—	2.0	0.8
No. aged*	69	168	246	277	272	281	293	1,606
Avg. age	5.0	4.1	4.2	4.3	4.2	3.7	4.0	4.1
Avg. mortality (%)	24.1	29.6	29.0	28.4	29.0	33.2	31.0	29.8

* Includes only those bears recorded by sex.

TABLE 10. *Age classes of female bears harvested in Wisconsin, 1973-79.*

Age Class In Years	Percent in Age Class							All Years
	1973	1974	1975	1976	1977	1978	1979	
1	14.3	14.5	1.4	2.6	1.9	3.0	17.4	6.8
2	28.6	23.4	18.6	17.1	20.8	25.1	26.8	22.8
3	20.0	15.3	16.4	26.3	17.0	21.0	11.6	18.3
4	11.4	23.4	18.6	14.5	14.5	13.7	15.3	15.8
5	8.6	5.6	15.0	6.6	15.1	12.2	10.5	11.0
6	—	8.9	13.7	7.9	9.4	7.0	4.2	7.8
7	2.9	0.8	7.1	4.6	8.8	7.4	2.1	5.3
8	—	1.6	5.0	5.9	1.9	4.1	2.6	3.5
9	2.9	1.6	1.4	2.0	1.9	2.2	1.1	1.8
10	—	1.6	—	2.6	2.5	1.8	1.6	1.7
11	2.9	0.8	2.1	2.6	1.9	1.1	1.1	1.6
12	2.9	0.8	0.7	2.0	1.3	1.5	2.1	1.3
13	2.9	0.8	—	2.0	1.3	—	0.5	0.7
14	—	0.8	—	1.3	0.6	—	1.1	0.6
15 and over	2.9	—	—	2.0	1.3	—	2.1	1.0
No. aged*	35	124	140	152	159	271	190	1,071
Avg. age	4.9	4.5	5.3	5.8	5.6	5.0	4.7	5.1
Avg. mortality (%)	24.4	26.8	22.1	19.8	20.8	23.5	25.3	23.1

* Includes only those bears recorded by sex.

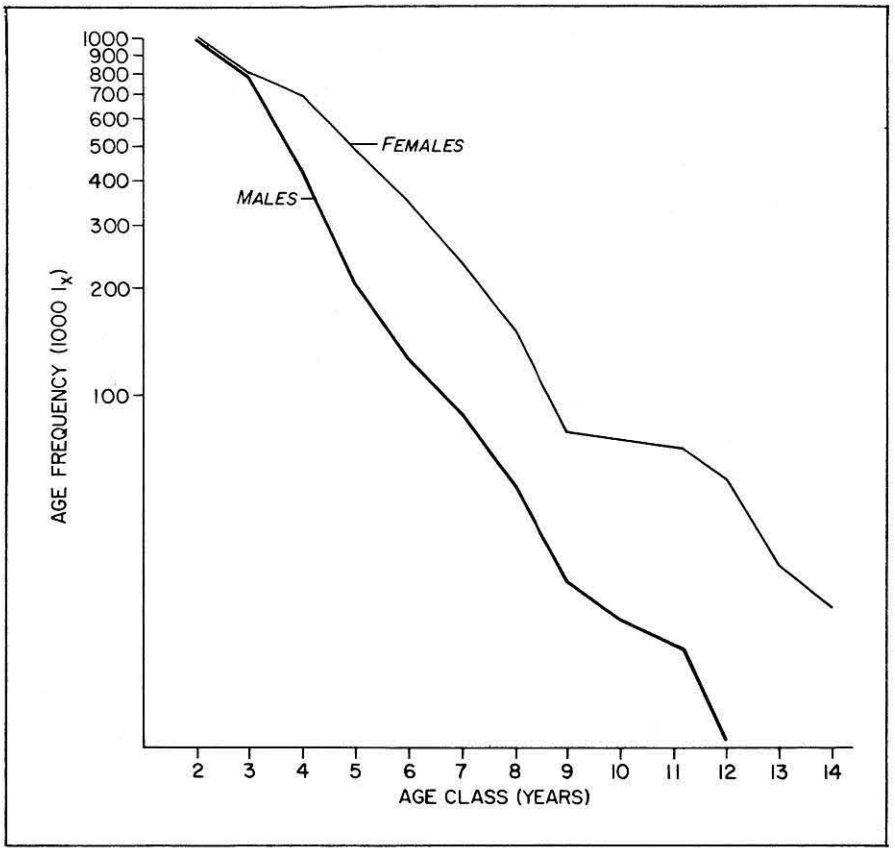


FIGURE 12. *Survivorship curves determined from ages of bears harvested in Wisconsin, 1973-79.*

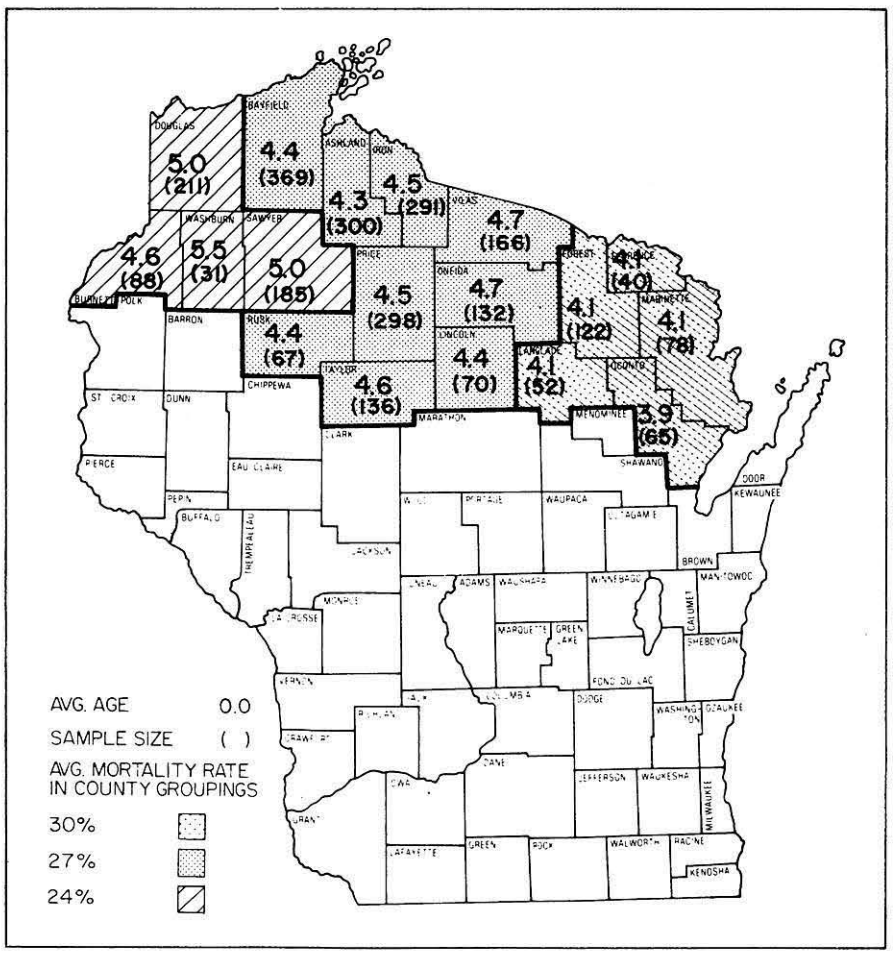


FIGURE 13. *Average ages and calculated annual mortality rates of bears harvested in Wisconsin, 1973-79.*

cent of the hunters returning questionnaires reported passing up adult bears they could have shot primarily because they wanted to shoot a larger bear or because they would not shoot females accompanied by cubs. Both of these factors put additional pressure on males.

Assuming a 50:50 sex ratio in the population, the overall annual adult mortality rate would be 26%, which is quite close to that calculated from hunter harvest of our ear-tagged bears (20%). If there actually were more adult females than males in the population as Rogers (1977) found in Minnesota and as could be expected here due to higher mortality rates for males, mortality rates calculated by the 2 methods would have agreed even more closely. This agreement showed that hunting was the major cause of mortality for adult bears, and that unreported kills of marked bears was probably not a significant problem.

Survivorship curves could not be calculated for cubs and yearlings from ages of bears harvested due to cubs being protected and hunter selection. Average annual mortality rates for bears 2 years old and older were 36% for males and 24% for females. Survival rates were quite comparable at 3 years of age but were considerably lower for males than females after that (Fig. 12). This again must reflect differential vulnerability and, to some extent, hunter selection.

Bears harvested in the eastern portion of the bear range were significantly ($P < 0.01$) younger and their calculated mortality rates significantly higher than those from the western portion (Fig. 13). The eastern portion had a much greater human population living in or near it, and because of this, bears may have received proportionately greater hunting pressure and/or were more often shot but not reported by persons considering them a threat or nuisance. Hunter questionnaires showed average or above average hunting pressure in this area, whereas the number of bears observed/day was generally below the statewide average (Figs. 5 and 6). Future monitoring will be required to adequately explain these differences and their possible impact on the bear population.

Reproduction

Females on the ICSA reached sexual maturity at 3.5 years based on the ages of bears lactating or displaying vulval swelling when captured. One female successfully bred when 2.5 years old and produced 2 cubs the next year. Rogers (1977) reported similar results for well-nourished females, but found

TABLE 11. *Lactation rates for adult female bears captured on the Iron County Study Area, 1975-79.*

Year	No. Captured	No. Lactating	Percent Lactating
1975	22	3	14
1976	29	11	38
1977	21	3	14
1978	27	7	26
1979	16	3	19
All Years	115	27	24

TABLE 12. *Age ratios of bears reported on hunter questionnaires, 1972-77.*

Year	No. Observed Cubs	Adults	Total	Percent Cubs
1972	168	590	758	22
1973	86	524	610	14
1974	235	838	1,073	22
1975	272	1,091	1,363	20
1976	195	448	643	30
1977	205	567	772	27
All years	1,161	4,058	5,219	22

that undernourished females remained barren past 7 years of age. We were not able to determine if this occurred on the ICSA, but the availability of high quality food items such as cherries, apples, and agricultural products appeared greater and more consistent there than reported on Rogers' study area.

The peak of the breeding season occurred from 19 June through 9 July. All adult, nonlactating females captured during that period appeared to be in estrus. No females captured were in breeding condition before 4 June or after 22 July. Similar breeding dates have been reported for Michigan (Erickson and Nellor 1964) and Minnesota (Rogers 1977).

On the average, 24% of the adult females captured each year were lactating (Table 11). We felt that lactation rates calculated from our trapped sample were conservative because: (1) Females with cubs were more sedentary than other classes of bears (Rogers 1977, Kemp 1972), and thus less likely to encounter our traps. (2) Females with cubs also appeared more wary than those without. Many females captured while in breeding condition were not recaptured the following year when they may have produced cubs, but were recaptured 2 summers later when they again were in estrus. And (3), lactation rates for individual females captured in *consecutive* years averaged 43% each year.

Although lactation rates of bears captured on the ICSA suggested reproductive synchrony (Free and McCaffery 1972) with 1975, 1977, and 1979 being low cub years and 1976 and 1978 high cub years, the observed rates could not be shown to be significantly different ($P > 0.05$). Most females on the ICSA met the assumptions for synchronous breeding by attaining sexual maturity at 3.5 years and having litters every other year. But, 8 (31%) of the 26 adult females captured 2 or more consecutive years did not breed for 2 years in a row and 2 (8%) skipped at least 3 years. One female captured on 15 June 1978 was lactating and appeared to be in estrus at the same time. However, we did not observe her cubs so she may have lost them earlier. These deviations could have upset the occurence or our detection of breeding synchrony. Hunter observations (Table 12) and ages of bears harvested in Wisconsin from 1973 through 1979 (Tables 9 and 10) also did not suggest breeding synchrony.

Complete counts were obtained for only 14 litters during the study. These consisted of 10 litters with 2 cubs, 3 with 3 cubs, and 1 with 4, and averaged 2.4 (±0.45) cubs/litter. Although our sample was small, the average litter size compared closely to those reported previously for Wisconsin (Schorger 1949, Knudsen - DNR files), Michigan (Erickson et al. 1964), and Minnesota (Rogers 1976), and was higher than Jonkel and Cowan (1971) reported for western states.

Of 5,219 bears observed by hunters, 1,161 (22%) were cubs (Table 12). The proportions of cubs observed each year did not suggest synchronous breeding but were substantially higher during the last 2 years data were collected. This possible increase in production was also suggested by ages of female bears harvested in subsequent years.

Hunters were not asked to record numbers of cubs they saw in each litter because it was unlikely they would observe all cubs in every litter. But assuming an even sex ratio with 52% of the adult females 4.5 years old or older (Table 9) and 43% of these breeding each year as calculated from females captured in consecutive years on the ICSA, an average litter size of 2.5 cubs would produce the proportion observed by hunters. This agrees quite well with the average litter size observed on the ICSA.

Implications

Data gathered on the ICSA and from ages of bears harvested over the entire bear range were combined to assess the current status of Wisconsin's bear population. We assumed an even sex ratio in the population and that the age structure of the harvest represented the true age structure in the population.

Both assumptions made the following model conservative because if there actually were more adult females than adult males in the population, as Rogers (1977) found and our data suggested, the number of cubs produced would actually be higher than calculated. And average annual mortality rates calculated from ages of bears harvested may have been higher than for all bears in the population due to certain behavior patterns or the area in which they lived.

We used a theoretical population of 100 male and 100 female bears 1.5 years old and older in our model. Of these, 52 of the females were 4.5 years old or older (Table 9) and capable of having cubs. If 43% (22) of these had bred the previous year and averaged 2.4 cubs/litter (see "Reproduction"), 54 cubs would be produced. This would be sufficient to replace the 53 yearling and older bears dying that year as calculated from the age samples.

Although the model is admittedly simple, it agreed with the observations reported by hunters (Table 11). On the average, 22% of the bears hunters observed were cubs. In order for this to occur, 28 cubs would have had to be produced per 100 adults, compared to 27 cubs calculated in the model.

Therefore, both the model and hunter observations suggested that the present statewide bear population is stable or perhaps increasing slightly. DNR wildlife management personnel, especially those in the northwestern portion of the state, have expressed

TABLE 13. *Bear visitations at experimental bait stations along transects on the Iron County Study Area 1977-79.*

Date Conducted	No. Operable Stations	No. Stations Visited (%)
18 Jun 77	42	18 (43)
20 Jul 77	44	16 (36)
25 Aug 77	52	26 (50)
1977 Total	138	60 (43)
15 Jul 78	48	35 (73)
28 Jul 78	48	24 (50)
2 Aug 78	49	20 (41)
1978 Total	145	79 (54)
18 Jul 79	50	39 (78)
25 Jul 79	50	45 (90)
1979 Total	100	84 (84)

TABLE 14. *Bear visitations at bait stations on wildlife management surveys in northern Wisconsin, 1979-80.*

	1979		1980	
County	No. Operable Stations	No. Stations Visited (%)	No. Operable Stations	No. Stations Visited (%)
Bayfield	48	14 (29)	48	16 (33)
Forest	43	15 (35)	50	18 (36)
Iron (Study Area) *	100	84 (84)	50	31 (62)
Lincoln	47	9 (19)	38	12 (32)
Marinette	48	10 (21)	49	14 (29)
Oneida*	46	6 (13)	42	17 (40)
Taylor	48	20 (42)	49	15 (31)
Washburn	48	23 (48)	49	26 (53)
Average	428	181 (42)	375	149 (40)

* Visitation rates significantly different ($P < 0.05$) between years.

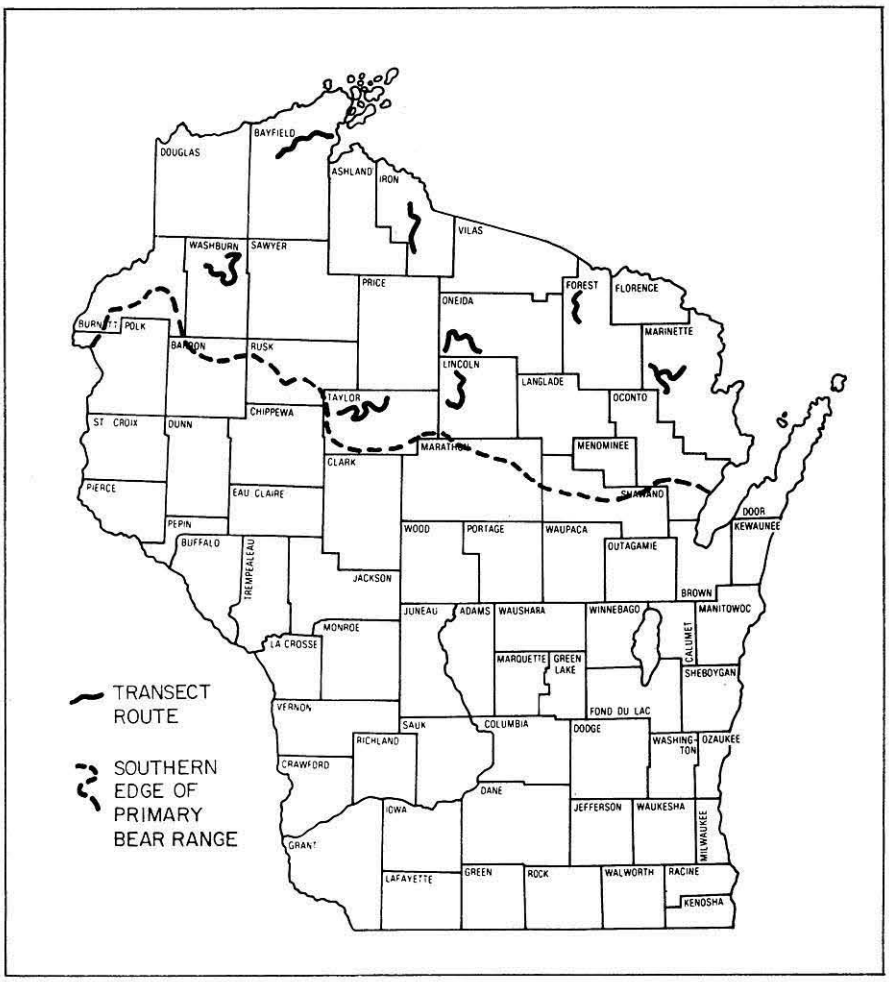


FIGURE 14. *Location of wildlife management bear bait station transects.*

similar opinions based on numbers of bear sightings and nuisance complaints reported in recent years.

Survey Methods

Estimating densities and population trends for animals such as bears which occur in relatively low numbers has always been a problem for researchers and managers. Techniques used to estimate black bear numbers or trends have included analysis of harvests, questionnaires (Pelton 1972), track and scat counts (Spencer 1955), direct counts (Jonkel and Cowen 1971), capture-recapture programs (Kemp 1972, Erickson and Petrides 1964), and the use of radioisotopes (Pelton and Marcum 1977).

Lindzey et al. (1977) modified the scent station technique for indexing coyotes (Linhart and Knowlton 1975) to make it more selective for black bears. Although they felt the technique could be used to index bear abundance, they found substantial day-to-day variation and were limited to only 1 year's data.

The analysis of bear harvest trends, hunter questionnaires, and age data were the methods used initially to survey Wisconsin's bear population. All provided considerable information, as discussed previously, but it was felt that a field index to evaluate population trends and densities would be valuable. Therefore, the scent station technique was tested on the ICSA beginning in 1975.

Initially the fermented egg attractant and procedures used on the coyote survey and by Lindzey et al. (1977) were followed but visitation rates were too low to be useful as an index. Anise oil, molasses, "Liquid

Smoke" (E. H. Wright Company), and bacon grease were tested as attractants in 1976, but also produced inadequate visitation rates. In 1977, we used meat scraps as the attractant and found they provided high visitation rates. Timing and procedures for the bait station survey were then developed later that summer on the ICSA.

The 3 bait station surveys run on the ICSA in 1977 produced visitation rates ranging from 26 to 50% which was adequate and consistent enough to be useful as an index to the relative abundance of bears (Table 13). Results were more variable in 1978, primarily because the first survey was conducted shortly after we had completed trapping bears along the transect and they probably were concentrated somewhat by all the previous baiting. This was also true to some extent in 1979, and further complicated by the fact that the surveys were conducted in consecutive weeks.

After the initial testing, we decided to run the surveys between 15 June and 15 July, because at that time of year bears were in their established territories (Rogers 1977), and there was little annual variation in food abundance. The 7-day period between setting out and checking bait stations provided higher visitation rates and made it less likely that weather conditions during the surveys would have a significant impact on the results. Finally, securely wiring the bags of meat to trees prevented most animals other than bears from stealing the bait, and bear visitations could be detected easily even if it had rained hard enough during the period to obliterate tracks. All of these advantages made this survey superior to the scent-station technique (Linhart and Knowlton 1975) for our purposes.

Wildlife management personnel began running bait station surveys in 7 additional counties in 1979 (Fig. 14). Usually, 2 workers were involved in setting up and checking the bait stations and, depending on the travel distance to the survey routes, 3-4 mandays of effort were expended on each survey. Since survey routes were relatively short, not randomly selected, and were restricted to areas primarily in public ownership, they did not adequately sample all bear range in each county.

Bear visitation rates on bait station surveys run by wildlife management personnel ranged from 13 to 84% in 1979 and from 29 to 62% in 1980 (Table 14). Visitation rates were significantly different ($P < 0.05$) between years in only 2 (Iron and Oneida) out of the 8 counties, and average annual rates for all counties were almost identical (42% in 1979 vs. 40% in 1980). Chi-square analysis detected no significant difference ($P < 0.01$ in statewide trends.

The big change in visitation rates in Iron County was probably due to the concentration of bears resulting from baiting and trapping them along the transect in 1979 but not in 1980. No explanation can be given for the significant increase in Oneida County, but the Lincoln County transect, which is quite close to the one in Oneida County, also showed a similar increase.

Although results of this technique must still be considered preliminary, I feel the bait station technique has potential as an economical, reliable field index to relative bear populations. But at present, only statewide average visitation rates should be considered when determining bear population trends. The small number of bait stations per county and the fact that transects did not adequately sample all of that county's bear range make it unwise to use individual county results. When future data are collected, it may be possible to use average county visitation rates to document relative densities and trends on a more local basis.

MANAGEMENT AND RESEARCH CONSIDERATIONS

PRESENT POPULATION STATUS

There appears to be no immediate threat to Wisconsin's bear population. Reproductive and mortality data gathered during this study suggest a stable or slightly increasing statewide population.

Although background information and techniques are now available to measure future bear population trends, we still cannot determine the exact number of bears we have in the state. If the average annual harvest since 1975 (699) represents 16% of the population as found on the ICSA, there are approximately 4,400 bears statewide. However, the ICSA was in the most heavily hunted portion of the state and the proportion of the population harvested statewide may be substantially less. If true, this would project to a higher population estimate.

A reconstructed population estimate for 1972, using annual harvests and bear ages through 1980, showed 3,660 bears known to be alive that year. This estimate should also be considered minimal since additional animals from that cohort undoubtedly will be harvested in future hunts. Also, some bears died of natural causes and thus were not available for the harvest and could not be included in the calculations.

Based on these two population estimates, there are a minimum of 4,000-4,400 bears in Wisconsin or an average density of 1 bear/3.6-4.0 miles^2 of forested land in the primary bear range. And since harvests approached or exceeded 700 bears in 6 of the 11 hunting seasons since 1970 (Table 1) without any measurable impact on subsequent populations, it is evident that the current population can withstand annual harvests of at least 700 animals.

We are at a point in time, however, when we may have to start managing bears on a regional basis. Mortality rates calculated for bears in Florence, Forest, Langlade, Marinette, and Oconto Counties were significantly higher than in the rest of the state and at the maximum allowable level. If mortality rates in these counties increase further, restrictive regulations will have to be applied in the area to prevent the bear population from decreasing.

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CURRENT HUNTING REGULATIONS AND CONSIDERATIONS

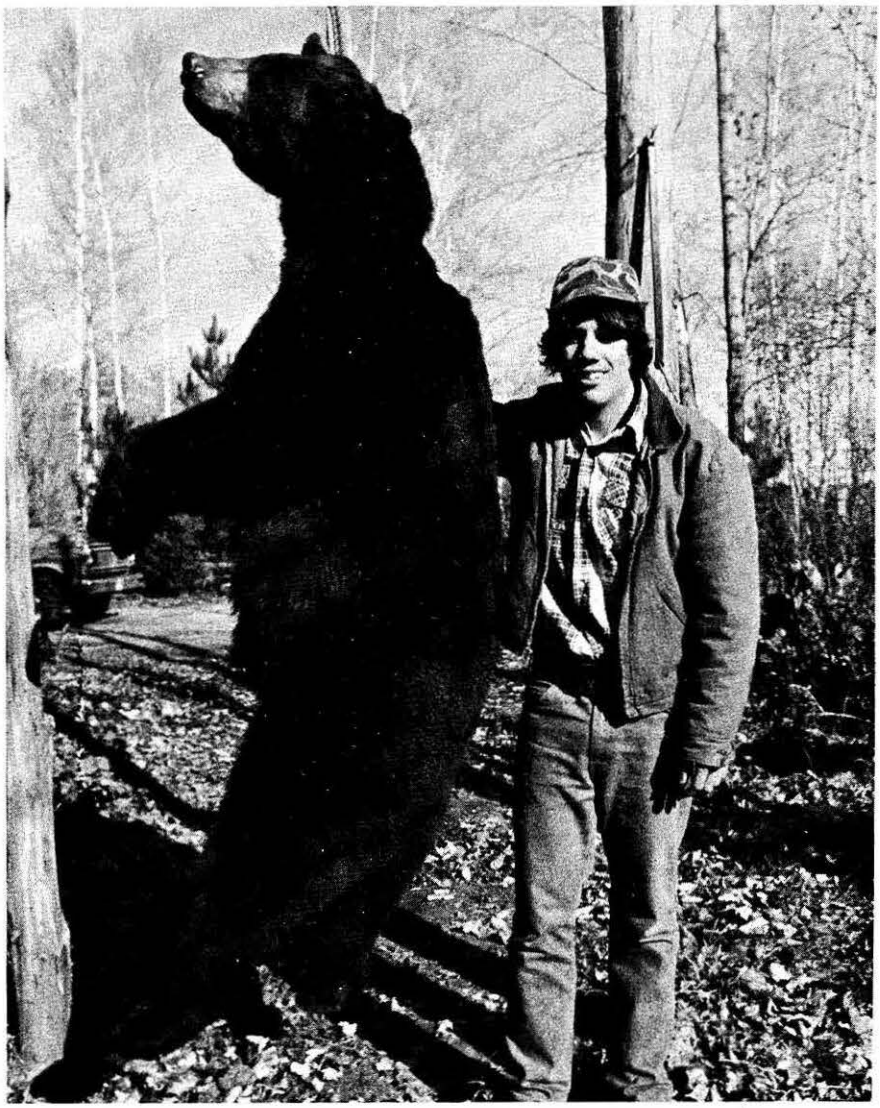
Since bears are relatively scarce and normally very secretive, people other than bear hunters seldom if ever see one in the wild. This leads some persons to believe that bears are endangered and should be completely protected. And methods most commonly used to hunt bears (trained hounds or sitting at bait stations) appear unsporting to those who do not realize the tremendous amount of time, money, and effort required to be effective even with these methods. Therefore, harvest regulations should be designed to allow hunters to hunt bears effectively without endangering the population, yet cause minimal conflict between bear hunters and other persons. Regulations that are too restrictive tend to discourage ethical hunters from hunting at all, and encourage unethical hunters to use any means possible to get a bear.

Wisconsin's current bear hunting regulations seem to be working quite well. They provide adequate protection to the bear resource, give hunters a fair chance to harvest a bear legally, and most are relatively easy to enforce. And, the majority of hunters have learned from past experience to avoid tactics that inflame the nonhunting public.

The effectiveness of cub laws has been disputed, especially in eastern states with high hunting pressure (Alt and Lindzey 1980). They found such laws difficult to enforce and thought many cubs were shot anyway and left in the woods. However, the cub law appears to be effective here and provides additional protection to yearling and smaller 2-year-old bears.

Reinstating the November bear season (concurrent with the deer firearm season) does not seem advisable at this time. Harvests during the last 5 November seasons (1969-73) ranged from 110 to 268 and averaged 195 bears annually. It seems doubtful that the current population could withstand this additional harvest unless more restrictive regulations were imposed during the September season.

Two factors would also add to the impact of a November season harvest. Deer hunting pressure is generally much higher in marginal counties (southern and eastern) of the bear range than in the prime counties (Wisconsin DNR 1978). Therefore, the November bear harvest could be concentrated in areas less able to withstand additional pressure. And, proportionately more females are taken during November than in September. Females comprised 48% of the harvest in previous November seasons, compared to 43% in the current September seasons. This would place an added drain on reproduction and thus, the population as a whole.



Larry M. Johnson, Tomahawk, Wisconsin with a 355-pound (field-dressed) black bear he shot with a bow and arrow during the 1980 season.

FUTURE MONITORING OF THE BEAR POPULATION

Although there presently is a good balance between the bear population and hunters, it is very likely this will change in the future. Bear hunting is still in an evolutionary stage in Wisconsin, and annual license sales have increased steadily from around 3,500 in 1974 to over 6,500 in 1980. A limit on hunter numbers or more severe restrictions may have to be considered if this trend continues, especially in counties where bears appear to be harvested at the maximum allowable rate.

The quantity and quality of our bear range could also decrease substantially, making fewer bears available to hunters. Increased human development in the bear range will reduce the amount of available habitat, make bears more accessible to hunters, and perhaps increase the number of bears shot as nuisances and left in the woods. Although critical habitat types were not adequately defined in this study, the major food items used by bears on the study area (Norton 1982) occur most commonly in shade-intolerant types. The loss of sodded openings and conversion of aspen and oak types to hardwoods and pine may reduce the range's carrying capacity for bears. Our current openings and aspen maintenance programs benefit many species of wildlife in addition to bears, and should be continued.

Because of the many factors that may affect the status of future bear populations, it is imperative that Wisconsin continues to monitor popula-

tion trends and mortality rates in order to keep hunting regulations consistent with the resource. Registration of each bear harvested must be continued because it allows documentation of harvest trends in relatively small areas. Annual harvests do fluctuate dramatically between years and areas due to changes in abundance of natural foods, hunting pressure, and regulations. But barring any major changes in hunting pressure or regulations, major changes in the bear population should become evident in longer term (3- to 4-year) harvest trends.

Registration also provides an economical means of obtaining teeth and pertinent information from bears harvested. Ages have been obtained for approximately 70% of the bears shot each year since 1975 at an average annual cost of approximately $500 to registration stations for pulling the teeth, and $1,000 for processing and aging. It would not be absolutely necessary to age bears every year, but it should be continued unless costs become prohibitive. It does provide valuable information at a reasonable cost, and periodic collections may result in inadequate samples because of confusion among registration station operators.

Bait station surveys look promising as a field index to bear populations and should be continued and evaluated further. The small number of transects (8) currently being run is probably adequate to measure statewide population trends, but in the future 1 transect should be run in each of the 16 counties comprising the major portion of the bear range. This would require an additional 24-32 man-days of effort statewide but provide a better index to regional population trends.

Questionnaires to DNR personnel and hunters can provide additional sources of information concerning the status of future bear populations. Currently, all DNR personnel are requested to report the number of bears in addition to several other species of wildlife seen each year (Thompson and Rusch 1980). Recording the number of bears observed each year may be adequate to assess future trends if this survey is continued. If and when considered necessary, hunter questionnaires could again be distributed for comparison with the original data collected from 1972 through 1977.

Finally, DNR wildlife management personnel in the Northwest District have been trained to tranquilize and ear-tag any nuisance bears they capture and release. Although numbers of bears marked annually may be inadequate, pooled data from several years should indicate any major changes in bear harvest rates.

Sodded, forest openings received heavy bear use and provided a wide variety of preferred foods.

HARVEST MANAGEMENT STRATEGIES

It seems inevitable that substantial changes in future hunting regulations will become necessary as numbers of bear hunters increase, as more human development occurs in the bear range, and as major changes in forest composition take place. These changes will occur at different rates in the various portions of the bear range, and accordingly, bears should be managed regionally based on county harvest trends, age structures, and results of bait station surveys.

The use of trained hounds and/or baiting to hunt bears are legitimate harvest management tools. Elimination of these hunting methods would not provide an adequate level of harvest and would deny most ethical hunters the opportunity to harvest a bear. Several alternative restrictions could be imposed to reduce harvests in overexploited areas. These include limiting hunter numbers, shortening seasons or, in extreme cases, complete season closure. A season starting later in September or in early October would also reduce harvests because bears are less attracted to bait as fall progresses. However, a later season may cause considerable conflict between bear hunters and small game hunters.

Prohibiting hunters from shooting sows accompanied by cubs would reduce the impact of the harvest on the population but would probably be unenforceable. But encouraging hunters to do so could have an impact. Many hunters mentioned in the questionnaires that they would not shoot sows with cubs, and the Wisconsin Bear Hunters Association voted to support this concept at their annual meeting in 1980. Therefore, the protection of sows with cubs could be promoted as a "hunter code of ethics" in areas that appear to be overharvested.

Conversely, harvests could be increased in areas with a high incidence of nuisance complaints by attracting more hunters through a longer September season. If this did not bring harvests up to necessary levels, hunters could again be allowed to shoot bears during the November deer season in these areas.

In conclusion, a sustained effort is needed to keep harvests and regulations consistent with the bear population. Bears are long-lived, do not normally reach population levels that destroy their environment, and are not normally subject to large losses caused by adverse weather conditions. Therefore, management goals should be directed at maintaining the bear population at a viable, acceptable level rather than attempting to promote maximum use of the resource.

FUTURE BEAR RESEARCH IN WISCONSIN

Continued monitoring of the population and evaluation of current and newly developed indexes should constitute the most important facet of future bear research in Wisconsin. As time progresses and pressures on the population become greater, the need for regional bear management will also

increase. Much additional information will be needed to do so effectively.

The frequency at which adult females bred was not adequately documented in this study and was one of the weakest inputs in the population model. This could be determined through radio-telemetry, but costs would be prohibitive at this time unless done in cooperation with the University of Wisconsin. Rogers (1975) described procedures for determining reproductive success through examination of dental annuli. Stained sections of teeth from past and future collections should be analyzed using this technique to fill a major gap in our knowledge of bear productivity.

Numbers of nuisance bear complaints have risen dramatically in recent years, especially in the Northwest District, resulting in considerable expenditures of manpower and money to translocate the animals involved (Cliff Wiita, DNR, pers. comm.). Alt et al. (1977), Erickson and Petrides (1964), Harger (1967), and McArthur (1981) evaluated translocations of nuisance black bears but reported varying degrees of success. Generally, their success was related to distances bears were moved, major topographic features, and ages of the bears involved.

The translocation of nuisance bears is currently being evaluated in the Northwest District of DNR by UW-Stevens Point personnel. They hope to determine the practicality of translocating bears and the major factors affecting success in Wisconsin. If translocation is found to be impractical and ineffective, guidelines will have to be established defining the situations when nuisance bears should be destroyed.

Two other methods to help alleviate nuisance bear problems should be explored. Alt (1980) described a technique that reduced bear damage in apiaries by using suet or bacon rind attached to an electric fence. This may be applicable in certain situations in Wisconsin. Bear-human conflicts will increase as more people, especially urbanites, move into bear habitat. It would be very beneficial to develop an aggressive informational program to increase the public's understanding of bears and how to reduce potential conflicts.

SUMMARY

The status of Wisconsin's bear population was evaluated using harvest data and trends since 1956, comparisons with research previously conducted in the state, hunter questionnaires distributed from 1972 through 1977, a 5-year trapping and marking effort on the Iron County Study Area (ICSA), and analyses of the age composition of bears harvested annually since 1973. In addition, a field index to bear populations was developed and evaluated.

Annual harvests have ranged from 212 to 878 bears since mandatory registration began in 1956. Prior to 1967, most bears were harvested in conjunction with the November deer season. That season was closed in 1975, and since then, most bears have been taken during September by hunters either using trained hounds or sitting at bait stations. Harvests have averaged 699 bears annually since 1975 and have generally been highest in the northwestern portion of the bear range.

Bear hunter densities were low, averaging less than 1 hunter/2.5 miles^2. Hunters responding to questionnaires reported 5,219 bear observations. There was no apparent trend in numbers of bears seen/hunter day from 1972 through 1977. Observation rates were also generally higher in the northwestern portion, but reported hunter effort was disproportionately high in relation to numbers of bears observed and harvested in the eastern portion.

Trapping on the ICSA produced 831 captures of 312 individual bears in 9,263 trap-nights. Although Aldrich foot snares proved more effective than barrel traps, the latter were preferred because there was virtually no chance of injury to the bears and recaptured bears could be released untranquilized. Ketamine hydrochloride proved to be a very safe and effective drug for tranquilizing bears.

Annual harvest rates of ear-tagged bears, excluding cubs, averaged 20% with no significant differences between years, sexes, or "dump" and "wild" bears. Harvest rates during the period (1975-79) were similar to those experienced by bears trapped and marked from 1958 through 1962. The bear density on the 432-mile^2 ICSA was estimated to be 1/1.5 miles^2. Live weights of yearling and older bears captured on the ICSA averaged 162 lb for males and 125 lb for females. Females continued to gain weight until they were 6-7 years old and males until they were 8-9 years old. Males lost weight through the breeding season, but then gained weight rapidly through late summer and fall.

Males were more mobile than females. Maximum distances between relocations averaged 10.2 miles for males and 4.0 miles for females and home ranges averaged 27.5 miles^2 and 5.3 miles^2 for males and females, respectively. Movement data reported were considered minimal because they were restricted by trap placement and small numbers of relocations.

Ages were determined for 2,699 bears harvested from 1973 through 1979. The average age of males harvested (4.1 years) was significantly lower than that of females (5.1 years), and their average annual mortality rate significantly higher (30% vs. 23%), reflecting differences in vulnerability and hunter selection. Regional bear ages indicated that a significantly higher proportion of the bears in the eastern portion of the range were being harvested than in the western portion. This reflected the disproportionately high hunting pressure in the area as determined from hunter questionnaires.

The average age of males was relatively stable during the period but that of females fluctuated more and showed a downward trend the last 4 years. This was attributed, at least in part, to increased production rather than increased mortality, and reflected changes in reproductive rates similar to those suggested by hunter observations of cubs.

Females reached sexual maturity at 3.5 years, and the peak of breeding season occurred between 19 June and 9 July. The average litter size calculated from bears captured on the ICSA was 2.4, compared to 2.5 cubs/litter calculated from hunter observations. Synchronous breeding patterns as described by Free and McCaffery (1972) were not detected.

A conservative population model

increase. Much additional information will be needed to do so effectively.

The frequency at which adult females bred was not adequately documented in this study and was one of the weakest inputs in the population model. This could be determined through radio-telemetry, but costs would be prohibitive at this time unless done in cooperation with the University of Wisconsin. Rogers (1975) described procedures for determining reproductive success through examination of dental annuli. Stained sections of teeth from past and future collections should be analyzed using this technique to fill a major gap in our knowledge of bear productivity.

Numbers of nuisance bear complaints have risen dramatically in recent years, especially in the Northwest District, resulting in considerable expenditures of manpower and money to translocate the animals involved (Cliff Wiita, DNR, pers. comm.). Alt et al. (1977), Erickson and Petrides (1964), Harger (1967), and McArthur (1981) evaluated translocations of nuisance black bears but reported varying degrees of success. Generally, their success was related to distances bears were moved, major topographic features, and ages of the bears involved.

The translocation of nuisance bears is currently being evaluated in the Northwest District of DNR by UW-Stevens Point personnel. They hope to determine the practicality of translocating bears and the major factors affecting success in Wisconsin. If translocation is found to be impractical and ineffective, guidelines will have to be established defining the situations when nuisance bears should be destroyed.

Two other methods to help alleviate nuisance bear problems should be explored. Alt (1980) described a technique that reduced bear damage in apiaries by using suet or bacon rind attached to an electric fence. This may be applicable in certain situations in Wisconsin. Bear-human conflicts will increase as more people, especially urbanites, move into bear habitat. It would be very beneficial to develop an aggressive informational program to increase the public's understanding of bears and how to reduce potential conflicts.

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Initial testing of a bear bait station survey was encouraging. The survey, which consisted of placing bags of meat at 0.5-mile intervals and checking them after 7 days for bear visitations, required only 3-4 man-days of effort per transect and produced visitation rates adequate and consistent enough to be useful as a field index. However, it was recommended that transect results be combined and used as an index to statewide, rather than regional, population trends until further testing is completed. Visitation rates averaged 42% in 1979 and 40% in 1980.

None of the information gathered suggests any immediate threat to Wisconsin's bear population. The population appears stable or slightly increasing with the possible exception of 5 northeastern counties. The statewide bear population is conservatively estimated at between 4,000 and 4,400 animals, and is considered capable of withstanding harvests of at least 700 animals annually.

Current hunting regulations appear to be working quite well and continuance of the cub law is recommended. Reinstating the November bear season presently appears inadvisable.

Management recommendations include: (1) continued monitoring of the bear population through registration, age analyses, bait station surveys, and questionnaires; (2) management of regional, rather than statewide, populations based on county harvest trends, age structures, and bait station survey results; (3) continued acceptance of trained hounds and/or baiting as legal methods of hunting bears; (4) establishing hunter number limitations, shorter seasons, or complete closure in areas with threatened bear populations, or starting the season later in September or early October to reduce the statewide harvest; (5) having a longer September season and reinstating the November season in underharvested areas; and (6) managing for a viable, acceptable population level rather than promoting maximum use of the resource.

Future research should emphasize continued monitoring of the population and evaluation of survey techniques. More accurate determination of breeding rates and analysis of procedures for handling bear nuisance complaints were other research needs mentioned.

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APPENDIX A: Scientific Names of Plants and Animals Used in Text

Scientific names of animals from Jackson (1961) and Peterson (1964), and of plants from Fernald (1950).

Animals

Black bear, *Ursus americanus*
Deer, *Odocoileus virginianus*
Dogs or hounds, *Canis familiaris*
Fisher, *Martes pennanti*
Raccoon, *Procyon lotor*
Raven, *Corvus corax*
Skunk, *Mephitis mephitis*
Porcupine, *Erethizon dorsatum*

Plants

Apples, *Pyrus* sp.
Aspen,
- Large-tooth, *Populus grandidentata*
- Quaking, *Populus tremuloides*

Balsam fir, *Abies balsamea*
Basswood, *Tilia americana*
Hemlock, *Tsuga canadensis*
Maple,
- Red, *Acer rubrum*
- Sugar, *Acer saccharum*

Oak,
- Northern pin, *Quercus ellipsoidalis*
- Red, *Quercus rubra*

Paper birch, *Betula papyrifera*
Pine,
- Jack, *Pinus banksiana*
- Red, *Pinus resinosa*
- White, *Pinus strobus*

Spruce,
- Black, *Picea mariana*
- White, *Picea glauca*

Tamarack, *Larix laricina*
White ash, *Fraxinus americana*
White cedar, *Thuja occidentalis*

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APPENDIX A: Scientific Names of Plants and Animals Used in Text

Scientific names of animals from Jackson (1961) and Peterson (1964), and of plants from Fernald (1950).

Animals

Black bear, *Ursus americanus*
Deer, *Odocoileus virginianus*
Dogs or hounds, *Canis familiaris*
Fisher, *Martes pennanti*
Raccoon, *Procyon lotor*
Raven, *Corvus corax*
Skunk, *Mephitis mephitis*
Porcupine, *Erethizon dorsatum*

Plants

Apples, *Pyrus* sp.
Aspen,
- Large-tooth, *Populus grandidentata*
- Quaking, *Populus tremuloides*

Balsam fir, *Abies balsamea*
Basswood, *Tilia americana*
Hemlock, *Tsuga canadensis*
Maple,
- Red, *Acer rubrum*
- Sugar, *Acer saccharum*

Oak,
- Northern pin, *Quercus ellipsoidalis*
- Red, *Quercus rubra*

Paper birch, *Betula papyrifera*
Pine,
- Jack, *Pinus banksiana*
- Red, *Pinus resinosa*
- White, *Pinus strobus*

Spruce,
- Black, *Picea mariana*
- White, *Picea glauca*

Tamarack, *Larix laricina*
White ash, *Fraxinus americana*
White cedar, *Thuja occidentalis*

APPENDIX B: Wisconsin Bear Hunting Regulations, 1980

GUN SEASON

North of State Highway 29: September 13-28.

BOW AND ARROW SEASON

North of State Highway 29: September 13-November 16. Statewide: September 20-November 16.
Dogs may be used for hunting bear ONLY in the Zone A portion of the open season area, and ONLY from September 13-September 28 in both gun and bow seasons.

BAG LIMIT

One adult bear per person per year. (An adult bear is any bear except a cub of the year.)

BEAR HUNTING LICENSES

Resident:

Bear License: Bear with firearms only, valid only September 13-28, license must be purchased prior to September 13 ($11.00).

Archer License: All game with a bow ($9.50).

Nonresident:

General License: All small game with a bow, all game with firearms, not valid for bear hunting if purchased after September 12 ($125.50).

Bear License: Bear with firearms only, valid only September 13-28, license must be purchased prior to September 13 ($100.50).

Archer License: All game with bow and arrow ($60.50).

SPECIAL REGULATIONS

Definitions for the Purposes of Hunting Bears:

"Hunter" means any person shooting, shooting at, taking, catching, killing, or pursuing a bear and any person who aids, assists, abets, or acts in concert with such a person in the pursuit of the bear whether or not such a person possesses a weapon or other means capable of reducing a bear to possession.
"Pursuit" means the activity by a person or persons in concert designed to overtake and reduce a bear to possession.
"Bait" means honey and any solid or nonliquid material attractive to wildlife.
"Liquid Scent" means any nonsolid material except honey.

Bear-Dog Permit Requirement

Hunters using dogs for bear hunting must obtain a Bear-Dog Permit from the DNR.

Bear Registration

Each bear harvested must be registered before it is removed from the county or adjoining county in which it was killed no later than 5:00 p.m. of the day after it was killed.

You May Not:

- Hunt deer or bear with dogs, except bear may be hunted with dogs in the area shown as Zone A on the bear zone map, and only from September 13 through September 28 during both gun and bow seasons.
- Train dogs by pursuing bear except during the period from July 10 through August 20.
- Hunt or pursue bear with any dog unless such dog is tattooed or wears a collar bearing the owner's name and address.
- Hunt bear with any dog without being in possession of a Bear-Dog Permit and valid state bear hunting license.
- Hunt bear with the aid of more than 6 dogs in a single pack, regardless of the ownership of the dogs.
- Replace a dog engaged in the pursuit of a bear with another dog. However, until the maximum of 6 dogs are released in pursuit of a bear, dogs may be added to the pack.
- Place or hunt any species of wildlife over any bait other than apples, pastry, or liquid scent.
- Use any bait material for attracting game (as a hunting aid) other than apples, pastry or liquid scent. Such apples and pastry must be confined to a hole in the ground measuring no more than 2 feet square.
- Place or hunt over bait or liquid scent used for attracting game within 50 yards of any trail, road, or campsite used by the public.
- Hunt bear in any dump or sanitary land fill.
- Put out bait containing poison where it might cause the destruction of wild animals or birds or possess poison while hunting or trapping.
- Place, use, or hunt over bait contained within paper, plastic, glass, metal, wood, or other nondegradable materials.

APPENDIX C: Questionnaire Sent to Bear Hunters from 1975 through 1977

1. DID YOU HUNT BEAR IN 1977? (IF NO, DISREGARD REST OF QUESTIONNAIRE, BUT PLEASE RETURN IT.)
   ☐ YES ☐ NO
2. DID YOU REGISTER A BEAR IN 1977?
   ☐ YES ☐ NO
3. WHAT HUNTING METHOD DID YOU USE?
   ☐ BAIT ☐ DOGS ☐ OTHER
4. WHERE DID YOU HUNT?

County	Number Days	Number of Bears Seen

5. WHAT WAS THE OWNERSHIP OF THE LAND WHERE YOU DID MOST OF YOUR HUNTING?
   ☐ INDUSTRIAL ☐ PUBLIC ☐ PRIVATE ☐ UNKNOWN
6. OF THE BEARS SEEN HOW MANY WERE:
   ____ CUBS ____ ADULTS
7. DID YOU PASS UP ANY ADULT BEARS YOU COULD HAVE SHOT?
   ☐ YES ☐ NO
   REASON: _____
8. DO YOU FEEL THE BEAR POPULATION WAS:
   ☐ INCREASED ☐ REMAINED STABLE
   ☐ DECREASED DURING THE PAST 5 YEARS
9. THE FOLLOWING QUESTIONS APPLY ONLY TO THOSE HUNTERS USING DOGS TO HUNT BEARS:
   A. HOW MANY HUNTERS ARE NORMALLY IN YOUR GROUP AT ONE TIME? . . . . . ___
   B. HOW MANY DOGS DO YOU NORMALLY USE ON A CHASE? ___
   C. WHAT PERCENT OF THE BEARS YOU START DO YOU ACTUALLY SEE? . . . . . ___
   D. WILL YOU CONTINUE TO HUNT BEARS IF THE USE OF DOGS IS PROHIBITED? ☐ YES ☐ NO
10. GENERAL COMMENTS:

FORM 8100-51 9-

DEAR BEAR HUNTER:

THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES HAS A RESEARCH PROGRAM TO GET MORE INFORMATION ON THE STATUS OF THE BEAR POPULATION. PART OF THIS PROJECT INVOLVES THE ABOVE QUESTIONNAIRE WHICH IS BEING SENT TO A SAMPLE OF THE HUNTERS WHO PURCHASED A BEAR LICENSE IN 1976.

PLEASE COMPLETE AND RETURN THIS QUESTIONNAIRE EVEN IF YOU DID NOT HUNT BEAR THIS YEAR. YOUR COOPERATION WILL BE GREATLY APPRECIATED.

THANK YOU.

SINCERELY,

Bruce Kohn

BRUCE E. KOHN, BIOLOGIST
FOREST WILDLIFE RESEARCH

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
BOX 7921
MADISON, WISCONSIN 53707

U.S. POSTAGE PAID
MADISON, WI
PERMIT 906

FIRST CLASS MAIL

APPENDIX D: Black Bear Data Sheet

BLACK BEAR DATA SHEET

Ear Tag Nos.: Left_____ Right_____ Sex_____ Weight_____

Date_____ Set No._____ Type of Trap_____

General Location_____

County_____ Sec._____ T_____ R_____ Habitat_____

Dosage_____ Time Given_____ Reaction_____

Dosage_____ Time Given_____ Reaction_____

Dosage_____ Time Given_____ Reaction_____

Dosage_____ Time Given_____ Reaction_____

Total Length_____ Head: Length_____ Width_____ Circum._____

Neck Girth_____ Chest Girth_____ Tooth Collected?_____ Age_____

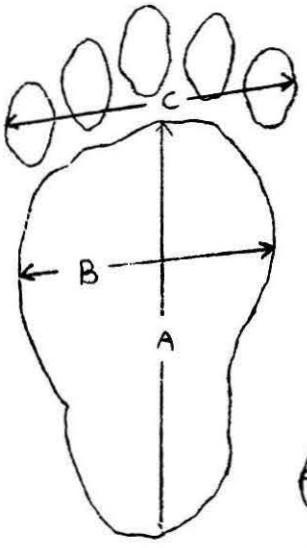
Breeding Condition_____ Lactating?_____

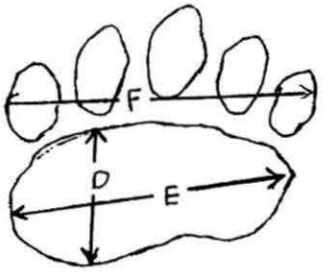
Coat Color_____ Unusual Markings_____

Hide Condition_____ Injuries_____

Foot Measurements: A_____ B_____ C_____ D_____ E_____ F_____

Remarks:_____





APPENDIX E: Instructions and Data Sheet for Wildlife Management Bait Station Transects

TO: Area Wildlife Managers

FROM: Bruce E. Kohn

SUBJECT: Bear Bait Station Transects

Enclosed are the instructions and materials for conducting the bear bait station transects as directed by C.D. Besadny. Our initial testing of this technique as an index to bear populations has been encouraging, and we would like to have the trial transects run again in Bayfield, Forest, Lincoln, Marinette, Taylor, and Washburn Counties.

This survey should be run between June 15 and July 15. It requires only one man, but it is alot easier if two men can work together on it, especially when setting up the bait stations. And, it is important that you notify the local conservation officer beforehand in case he gets a complaint.

Please run the same transects selected last year. On each transect place 50 bait stations at ½-mile intervals on the easterly or northerly side of the roads. They should be just far enough back in the woods so they cannot easily be seen from the road.

The survey will require 100 to 150 pounds of meat scraps and about 150 feet of stove wire. You should be able to buy the meat scraps at most larger grocery stores, and try to get scraps consisting mainly of fat and tainted meat, not large bones.

It is best to fill all of the 50 mesh bags enclosed with meat before going out on the transect. Put a two to three pound ball of meat in each bag. Then twist the bag and invert it over the ball of meat again so there are two layers of bag around the meat. Tie off the end of the bag with string.

Wire one of the bags of meat to a tree as high as you can reach at the starting point of the transect and at each ½-mile interval. We have found that smaller aspen, birch, and balsam trees are best because marks made by bears show up very well. Use about a three-foot piece of stove wire and tightly wrap it around the tree and bag of meat several times so it is almost impossible for animals other than bears to get the meat. Mark the stations inconspicuously with broken branches or small bits of flagging tape so they can be located when you check the transect.

Check the transect after seven nights for bear visitations. Usually it is very easy to determine when a bear has hit the bait because the bag is gone, the wire is untwisted or broken, the trees are broken or scratched up, and there may be a visible trail into the station. Mark (X) whether or not the stations were definitely visited by bears on the form. If you cannot find a station or it looks like the meat was taken by animals other than a bear, mark it "inoperable" on the form along with a brief explanation. Remove all bags and wire remaining at the stations.

When the survey is completed, return the form and a county map showing the starting point and transect route to: Forest Wildlife Research Group, DNR Ranger Station, Box 576, Rhinelander, Wisconsin 54501. If you have any questions, please call me or Bill Creed at (715)-369-3193.

Thank you.

APPENDIX E: (cont.)

BEAR BAIT STATION DATA SHEET

COUNTY _____ OBSERVER(S) _____

DATE SET _____ DATE CHECKED _____

Station Number	Mileage	Mark (X) Inoperable Stations*	Station Visited by Bears? Yes	No	Remarks
1					
2					
3					
4					
5					
6					
7					
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* Inoperable stations are those not found or destroyed by animals other than bears

English-Metric Measures and Weights Equivalents

1 inch	=	2.54 cm
1 ft	=	30.48 cm or 0.3048 m
1 mile	=	1.609 km
1 mile^2	=	2.589 km^2
1 lb	=	0.373 kg
1 gal	=	3.785 l

ACKNOWLEDGMENTS

This project could not have been completed successfully without the support and cooperation of literally hundreds of people. The information provided and collected by bear hunters, cooperative registration station operators and many DNR personnel was essential to meeting the study's objectives, and is greatly appreciated.

Ned Norton and Gordon Bertagnoli assisted on the trapline from 1975 through 1977 and from 1978 through 1979, respectively. Their abilities to make emergency equipment repairs, develop and maintain the support of cooperators, and obtain all necessary data, often under very adverse conditions, were outstanding and kept the project going. Special credit must also be given to Dr. Lynn Rogers of the North Central Forest Range and Experiment Station, St. Paul, for showing us his trap design and allowing us to publish it in this report.

The residents and bear hunters in Iron County, Wisconsin, earned our greatest respect and appreciation through their friendliness, willingness, and ability to provide help and advice whenever needed, and continuous encouragement. Special thanks and acknowledgments are extended to the following individuals and businesses on the study area: Harold Schmude (DNR Conservation Officer) and family for relaying the countless messages we received while in the field, and for their public relations efforts on our behalf. I am certain we would have had problems with people molesting the traps and bears if Harold had not taken the time to explain to residents of the study area what "those filthy men in that truck filled with rotten meat" were actually doing and why.

Rudy Kangas (DNR Fire Control Assistant) and Gary Glonek (DNR Backlog Forester) for helping with vehicle repairs and the use of their facilities for vehicle and equipment maintenance and storage. Rudy was also instrumental in development of the bait station survey and shared his vast knowledge of Iron County's forest with us.

Jerry Brauer, James Kaffine, Joe Levra, John Neta, William Tutt, Jack Vandevoorde, and John Wiita and their families for their cooperation and providing extremely valuable information on potential trap sites in their respective bear hunting areas.

And, the management of Copps Food Market and Erspamer's Supermarket in Hurley, Wisconsin, and Carlson's Super Market in Ironwood, Michigan, for providing the tons of meat scraps needed for bait each summer.

The Wisconsin Bear Hunters Association donated $1,000 during the course of the study which paid for much of the specialized equipment needed. Their generosity, cooperation, and genuine concern for the bear resource contributed greatly to the success of this project.

Several University of Wisconsin (UW) personnel also cooperated in this study. Dr. Lyle Nauman (UW-Stevens Point) and students under his direction processed, aged, and recorded pertinent information for all of the bear teeth collected. Drs. Neil Payne (UW-Stevens Point) and Robert Ruff (UW-Madison) critically read the manuscript and offered many helpful suggestions.

Department of Natural Resources personnel contributed in many ways. James Ashbrenner (Technician, Forest Wildlife Research Group) was involved in the initial development of trapping and handling equipment and procedures, data tabulations, and capably filled in whenever additional or substitute field personnel were needed. William Creed (Leader, Forest Wildlife Research Group) provided supervision, planning assistance, and critical review of the manuscript, and also participated in field data collection when necessary. DNR Bureau of Research staff members Cyril Kabat and Kent Klepinger (Bureau Directors), James Hale and James March (Wildlife Research Section Chiefs), and Donald Thompson (Chief, Technical Services) gave the support, guidance, and advice needed for the completion of this study. I am indebted to the North Central District Headquarters' secretarial staff who suffered through the many revisions of this manuscript.

Finally, a very special thanks goes to my wife, Lynn, who became an unofficial member of the project by assisting on the trapline almost every weekend we worked, and attending countless meetings with bear hunters and other interested groups. Her enthusiasm, endurance, and understanding added immensely to the enjoyment of working on this project.

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About the Author

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