PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
RESEARCH DIVISION
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TITLE: Black Bear Research/Management

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TITLE: Black Bear Populations

PERIOD COVERED: July 1, 1999 to June 30, 2000

COOPERATING AGENCIES: Appointed biologists, technicians, and WCOs, PGC

WORK LOCATION: Statewide

PREPARED BY: Mark Ternent

DATE: September 2000

Abstract: Wildlife Conservation Officers, biologists, and technicians captured and ear-tagged 422 different black bears between the 1998 and 1999 hunting seasons, of which 18 were known to have died. We recovered 58 of the remaining 404 tags at bear check stations during the November 22-24, 1999 hunting season, resulting in a harvest rate of 14.4% and a preseason population estimate of 11,957 (95% CI: 9,659-15,394). The 1999 harvest rate was considerably lower than the 1998 rate (26.1%) and the second lowest since 1980. We are uncertain about why such a low value was observed, but unequal vulnerability to hunting between tagged and untagged bears, failure to record or recognize tags at check stations, fewer hunters, shortages of fall foods that encouraged early denning and foggy, warm weather on the first day of the season are possibilities. Conversely, the 1999 preseason population estimate was 21% higher than the 1998 estimate and the largest ever reported because hunters appeared to sample only a small percentage of the available bears (i.e., low harvest rate). During 1999, 101,904 bear licenses were sold with 1.7% of those hunters harvesting 1,741 bears. This compared to 114,767 licenses and 2,598 bears (2.3% success rate) in 1998, or an 11% and 33% decrease in license sales and harvest, respectively. Similar to past years, 63% of the harvest occurred on the first day of the season, harvested bears averaged 2.3 years-old, and almost equal numbers of males and females were harvested. An additional 385 bear mortalities were documented outside of the hunting season, including 340 automotive collisions which was more than any other year, presumably from bears traveling longer distances due to natural food shortages. A 3-day bear hunting season to be held November 20-22, 2000 was recommended and adopted.

OBJECTIVE

To document bear harvest and population trends and make bear management recommendations based on these trends.

PROCEDURES

Free-ranging black bears were captured and immobilized throughout the state by Wildlife Conservation Officers (WCOs), biologists, and technicians using techniques described by Alt (1989). Trapping typically occurred between May-October in areas with nuisance bear conflicts or at established bait sites. All bears were released, though we transported some to different areas. We also captured bears and dependent offspring (i.e., cubs and yearlings) by visiting dens during January-April.

We attached uniquely numbered metal ear tags or replaced missing tags on each bear handled. Some bears were tattooed on the inside upper lip or inside thigh of the groin, and some were fitted with radio-transmitting neck-collars. We extracted a first premolar and submitted it for aging at Mattson's Laboratory (Milltown, Montana). A Capture Report describing the dates and locations of capture and release, ear tags used or observed, sex and estimated weight was completed for each capture. To promote wide distribution of captures, we established tagging quotas for the 44 counties encompassing the primary bear range in Pennsylvania. Quotas were based on each county's average contribution to the statewide harvest during 1991-95 and a statewide goal of 600 captures, which facilitates calculation of 95% confidence intervals within 15% of the statewide population estimate (Pollock et al. 1990).

We manned 23 check stations during the November 22-24, 1999 bear hunting season and completed a Kill Report with sex, age, kill location, hunter information, and ear tag/tattoo data for every bear inspected. At 8 check stations, we used an electronic Kill Form and computer instead of the traditional paper form. Black bear hunters are required to stop at a check station within 24 hrs of harvesting a bear.

We maintained a database of all Capture/Kill Reports. Using captures as a marked sample and the 1999 harvest as a recapture sample, we estimated the size of Pennsylvania's black bear population at the start of the 1999 hunting season using the unbiased Peterson equation (Caughley 1977, Seber 1982) and 95% confidence intervals (Cormack 1992). Harvest rate was determined by dividing the number of captured bears recovered in the harvest by the total number of captures.

Only captures occurring between the 1998 and 1999 hunting seasons (26 November 1998 to 21 November 1999) were used in the calculation of population size and harvest rate to reduce the effects of tag loss (Alt et al. 1985), dispersal (Alt 1978), and recruitment. Likewise, bears released outside Pennsylvania, recaptures of recently (>25 November 1998) captured bears, and bears that were known to have died were excluded from all calculations. Preseason mortalities were determined from Bear Kill Reports, which are completed by Pennsylvania Game Commission personnel for every dead bear seen (e.g., vehicle collisions, crop damage removals, illegal kills).

FINDINGS

The 1999 preseason statewide bear population estimate was 11,957 with a 95% confidence interval of 9,659

to 15,394. This was noticeably larger than the 1998 estimate of 9,902 and its associated confidence interval (8,588–11,666), although confidence intervals have overlapped each year since 1991 (Table 1). The 1999 estimate was the largest value reported since modern bear management began in Pennsylvania during the 1970s and corroborates an increasing trend in bear population estimates apparent since 1980.

The width of confidence intervals is inversely related to the number of bears tagged (Pollock et al. 1990). From 1980 through 1984, 614 to 692 bears were tagged and available for harvest (no recaptures, out-of-state relocations, or known mortalities) and confidence intervals averaged 1,332. During the next 7 years (1985-91), confidence intervals increased by more than 100% as tagging diminished by half, reaching a low of 79 bears in 1991 and a confidence interval of 6,184 - a value of little use to managers. This lead to distribution of tagging equipment to all WCOs working in bear habitat and establishment of county tagging quotas that tallied 600 statewide (Table 2).

Quotas have remained in place since 1992 with capture numbers increasing almost every year (Table 1). In 1999, 404 bears were captured and not reported dead prior to the hunting season, a decrease of 8% from 1998 but still more than when quotas were absent. Of the 46 quotas in place, 18 were filled ≥75% and 15 were filled ≤25%. Increasing captures has narrowed confidence intervals considerably since 1991, making population estimates more meaningful, but the goal of 600 captures statewide has never been met. Furthermore, it was developed when the statewide population was believed to be approximately 10,000; if population growth has since occurred, a proportionate increase in quotas is needed.

There were 462 captures in 49 counties during 1999. One was released in New Jersey, 39 were recaptures of bears already caught, and 18 died prior to the 1999 hunting season (Table 2), leaving 404 tagged bears afield at the start of the season. Fifty-eight were harvested, producing a harvest rate of 0.144 which was the second lowest since 1980 (Table 1). We are unclear as to why the 1999 harvest rate was low, but one explanation is that tagged bears were less accessible to hunters, which may have occurred if more bears were tagged near residential or otherwise unhunted areas than in past years. Another possibility is that tags were not recognized or recorded at check stations, or there were fewer hunters. However, bear license sales in 1999 were the third highest ever reported despite them being 12,863 less than in 1998 (Table 3), and a thorough review of check station records indicated no errors. Without a better understanding of why tagged bears were harvested less than expected, the 1999 population estimate should be used with caution. For example, increasing the 1999 harvest rate to 0.203, which was the 1980-98 average (Table 1), produces a population estimate of 8,498 or 3,459 fewer bears.

A total of 1,741 bears were harvested during the November 22-24 season, a decrease of 33% from 1998 and 13% from the average harvest of the past 5 years (Table 1). Bears were harvested in 47 of Pennsylvania's 67 counties (Table 4), whereas less than 40 counties reported harvests in all years prior to 1992. The three top counties in 1999 were Clinton (129 bears), Clearfield (122), and Centre (115; Table 4). The northcentral region had the largest harvest with 818 bears (47%), followed by the northeast (308 bears; 18%) and northwest (221 bears; 13%) regions.

The average age of harvested bears, based on analysis of teeth collected at check stations, was 2.3 years-old.

The oldest bear was 22 years-old and cubs were part of the harvest in every county except five (Table 4). Ages were similar across all counties and regions, except for Lebanon county which had an average age of 5.1 (n=5). Approximately equal numbers of males and females were harvested in most areas (Table 4). During 1999, 101,904 bear licenses were sold with 1.7% of hunters harvesting a bear. This was slightly down from 1998 and the past 5-year average (1994-98), but equal to the long-term average (1981-98). Possible explanations for low hunter success include early denning due to fall food (acorns) shortages and foggy, warm weather on the first day of the season (i.e., poor visibility and no snow). In 1999, 63% (1,093) of the harvest occurred on the first day, 25% (440) on the second, and 12% (208) on the third. This was very similar to other 3-day seasons (Table 5).

An additional 385 bear mortalities were documented outside of the 3-day hunting season during 1999. This included 340 automotive collisions, 20 illegal shootings, 3 damage removals, and 22 other miscellaneous causes of death (Table 6). These numbers, with the exception of automotive collisions, were similar to past years. Automotive collisions increased 35% from 1998 and were 102 bears more than the 1994-98 average (Table 6). A large number of vehicle collisions suggests that bears were traveling frequently, as would be expected in years of short food supply.

There were 249 damage-related captures or mortalites during 1999. This was the second highest number in the last 10 years (1997 was the highest with 360) and 68 incidents more than in 1998. These numbers do not represent all nuisance bear incidents since many never result in capture or mortality, but they should represent relative trend. Notably, many Pennsylvania Game Commission personnel did feel that 1999 was an above average year for nuisance black bear problems.

Symptoms of mange have been reported on 98 Capture/Kill Reports since 1991, including 26 in 1998 and 20 in 1999. These cases occurred in 22 counties centered in the westcentral part of the state. During 1999, Capture/Kill Reports with comments about mange were received from Jefferson (5), Blair (3), Clearfield (2), Huntingdon (2), and 7 other adjacent counties (1 each; Fig 1). Capture/Kill Reports only provide a minimum estimate of the prevalence of mange since they do not include bears that die without being discovered. Nevertheless, they do confirm that mange is present in part of the bear range and possibly expanding.

RECOMMENDATIONS

Based on the results of capture, recovery, and harvest data from 1999, a 3-day bear season to be held on November 20-22, 2000 was recommended and approved. The increase in hunting pressure brought on by making bear licenses available at over 1,000 license-issuing agents seems to have been mitigated by higher license fees ($10 to $15), and the bear population appears to be increasing as indicated by the record-high estimate in 1999. However, changing season parameters to increase harvest was not recommended because our population estimate is calculated from harvest of tagged bears, which decreased for unknown reasons in 1999. I recommend that any attempt to increase harvest which relies on the 1999 population estimate for justification be approached cautiously. Given that our bear management program relies on measuring the harvest rate of tagged bears, every effort should be made to tag 600 bears during the year 2000, and alternative procedures be evaluated for estimating Pennsylvania's bear population. The influence of current

tagging procedures on the vulnerability of tagged bears to hunting should also be examined. I further recommend that the process of writing a statewide black bear management plan be started within the next year, and that a public survey and/or public comments play a significant role in the process.

I recommend that we use a computer entry system at all bear check stations so that bear harvest results can be available within a day of the end of bear season. Limited use of a similar system at 8 stations in 1999 was a success. One final recommendation is that we develop a point-of-sale license issuing system so that we can once again capture information on where bear hunters are hunting.

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Table 1. Statewide black bear harvest and associated preseason population estimates, 1980-99.

Year	Season length (days)	Harvest	No. tagged bears available	Harvest rate of tagged bears	Population Estimate [a]	95% Confidence Interval [b]	
						Lower	Upper
1980	1	921	676	0.205	4,452	3,925	5,153
1981	1	819	614	0.147	5,533	4,692	6,717

1982	2	588	692	0.131	4,430	3,771	5,356
1983	2	1,528	656	0.239	6,348	5,632	7,289
1984	2	1,549	640	0.219	7,035	6,183	8,170
1985	2	1,029	315	0.145	6,903	5,576	9,201
1986	3	1,362	336	0.181	7,387	6,056	9,417
1987	3	1,560	346	0.228	6,751	5,697	8,296
1988	3	1,614	298	0.219	7,292	6,043	9,189
1989	3	2,220	307	0.277	7,928	6,765	9,630
1990	3	1,200	288	0.174	6,782	5,450	8,901
1991	3	1,687	79	0.227	7,019	5,100	11,284
1992	3	1,589	301	0.189	8,252	6,726	10,618
1993	3	1,790	356	0.199	8,880	7,370	11,062
1994	3	1,365	386	0.158	8,525	6,945	10,870
1995	3	2,190	439	0.235	9,269	7,957	11,055
1996	3	1,796	420	0.207	8,596	7,266	10,454
1997	3	2,110	566	0.208	10,057	8,213	11,204
1998	3	2,598	441	0.261	9,902	8,588	11,666
1999	3	1,741	404	0.144	11,957	9,659	15,394
Averages							
5-year		2,087	454	0.211	9,956	8,337	11,955
10-year		1,807	368	0.200	8,924	7,327	11,251
20-year		1,563	428	0.200	7,665	6,381	9,546

[a]Peterson population estimate from Caughley (1977) and Seber (1982).

[b]Calculations from Cormack (1992).

Table 2. (Cont.) Preseason capture and mortality statistics, bear tagging quotas, and percent of quota achieved during 1999 for counties and regions.

Region	County	Captures	Recaptures	Mortalities	No. Tagged Bears Alive	Quota	Percent Filled
Northwest	Butler	1	0	0	1	1	100
	Clarion	1	0	0	1	6	17
	Crawford	1	0	0	1	1	100
	Erie	0	0	0	0	0	N/A
	Forest	2	0	0	2	8	25

	Jefferson	3	0	1	2	10	20
	Mercer	0	0	0	0	3	0
	Venango	2	1	0	1	9	11
	Warren	2	0	0	2	9	22
	Total	**12**	**1**	**1**	**10**	**47**	**21**
Southwest	Allegheny	1	1	0	0	0	N/A
	Armstrong	0	0	0	0	3	0
	Beaver	1	0	0	1	0	N/A
	Cambria	22	2	0	20	20	100
	Fayette	0	0	0	0	7	0
	Indiana	20	4	1	15	8	>100
	Somerset	25	1	1	23	22	>100
	Westmoreland	33	4	0	29	28	>100
	Total	**102**	**12**	**2**	**88**	**88**	**100**
Northcentral	Cameron	0	0	0	0	8	0
	Centre	11	0	0	11	38	29
	Clearfield	8	0	1	7	24	29
	Clinton	28	2	0	26	31	84
	Elk	2	0	0	2	16	13
	Lycoming	35	3	0	32	32	100
	McKean	19	1	0	18	18	100
	Potter	14	0	0	14	19	74
	Tioga	32	3	2	27	16	>100
	Union	2	0	0	2	15	13
	Total	**151**	**9**	**3**	**139**	**217**	**64**
Southcentral	Bedford	9	0	1	8	7	>100
	Blair	10	0	0	10	11	91
	Cumberland	4	2	0	2	0	N/A
	Franklin	2	0	0	2	0	N/A
	Fulton	1	0	1	0	0	N/A
	Huntingdon	7	0	0	7	20	35
	Juniata	0	0	0	0	0	N/A
	Mifflin	5	0	0	5	11	45
	Perry	0	0	0	0	0	N/A
	Snyder	6	0	0	60	4	>100
	Total	**44**	**2**	**2**	**40**	**53**	**75**
Northeast	Bradford	7	0	0	7	12	58

	Carbon	3	0	1	2	14	14
	Columbia	1	0	1	0	10	0
	Lackawanna	5	1	0	4	14	29
	Luzerne	10	0	0	10	21	48
	Monroe	17	1	2	14	26	54
	Northumberland	4	1	0	3	0	N/A
	Pike	52	4	3	45	36	>100
	Sullivan	4	0	0	4	14	29
	Susquehanna	3	0	0	3	2	>100
	Wayne	6	1	0	5	17	29
	Wyoming	4	0	0	4	7	57
	Total	**116**	**8**	**7**	**101**	**173**	**58**
Southeast	Berks	3	0	0	3	2	>100
	Bucks	2	0	1	1	0	N/A
	Dauphin	2	0	1	1	2	50
	Lebanon	0	0	0	0	1	0
	Lehigh	9	3	1	5	1	>100
	Montgomery	2	0	0	2	0	N/A
	Northampton	14	3	0	11	1	>100
	Schuylkill	4	1	0	3	14	21
	Total	**36**	**7**	**3**	**26**	**21**	**>100**
Statewide	**Total**	**461**	**39**	**18**	**404**	**599**	**67**

[a] One bear captured in Montgomery county and released in New Jersey is excluded.

Table 3. Bear license sales and percentage of Pennsylvania bear hunters who harvested bears, 1981-99.

Year	No. licenses sold	Harvest	% hunter success rate	Hunters/bear
1981	72,532	819	1.1	89
1982	90,000	588	0.7	153
1983	100,000	1,528	1.5	65
1984	99,975	1,549	1.5	65
1985	87,439	1,029	1.2	85

1986	94,700	1,362	1.4	70
1987	92,051	1,560	1.7	59
1988	91,604	1,614	1.8	57
1989	92,468	2,220	2.4	42
1990	93,348	1,200	1.3	78
1991	89,452	1,687	1.9	53
1992	91,165	1,589	1.7	57
1993	89,623	1,760	2.0	51
1994	89,408	1,365	1.5	66
1995	90,091	2,190	2.4	41
1996	93,893	1,796	1.9	52
1997	116,946	2,110	1.8	55
1998	114,767	2,598	2.3	44
1999	101,904	1,741	1.7	59
Average				
5-year (1994-98)	101,021	2,012	2.0	52
10-year (1989-98)	96,116	1,852	1.9	54
18-year (1981-98)	93,859	1,587	1.7	66

Table 4. Black bear harvest statistics by region and county, 1999.

Region	County	Harvest	Average Age (yrs)	Range	% Male
Northwest	Butler	6	3.3	(cub - 8)	33
	Clarion	30	2.1	(cub - 11)	43
	Crawford	7	1.6	(cub - 5)	14
	Forest [b]	65	1.6	(cub - 7)	60
	Jefferson	49	2.9	(cub - 18)	59
	Venango	31	2.8	(cub - 12)	42
	Warren	33	2.2	(cub - 14)	52
	Total	**221 (13%)**	**2.3**	**(cub - 18)**	**43**
Southwest	Armstrong	12	2.0	(1 - 6)	58
	Cambria [a,b]	30	2.1	(cub - 9)	60
	Fayette [b]	23	1.9	(cub - 6)	52
	Indiana [b]	51	1.9	(cub - 12)	39
	Somerset [b]	70	2.3	(cub - 14)	51
	Westmoreland [b]	33	2.2	(cub - 18)	52

	Total	**219 (13%)**	**2.1**	**(cub - 18)**	**52**
Northcentral	Cameron	52	1.9	(cub - 7)	48
	Centre [b]	115	2.0	(cub - 11)	48
	Clearfield [a]	122	2.4	(cub - 16)	43
	Clinton	129	2.3	(cub - 14)	51
	Elk	58	2.0	(cub - 7)	55
	Lycoming [b]	100	2.4	(cub - 15)	38
	McKean	91	2.6	(cub - 15)	57
	Potter	59	2.3	(cub - 9)	51
	Tioga	81	2.2	(cub - 12)	48
	Union	11	2.8	(cub - 8)	55
	Total	**818 (47%)**	**2.3**	**(cub - 16)**	**49**
Southcentral	Bedford	32	3.2	(cub - 17)	50
	Blair [b]	25	2.6	(cub - 11)	48
	Fulton	10	1.6	(cub - 5)	60
	Huntingdon	46	2.2	(cub - 9)	43
	Juniata	2	1.8	(cub - 3)	0
	Mifflin	10	3.0	(cub - 13)	60
	Snyder	11	2.0	(cub - 9)	82
	Total	**136 (8%)**	**2.5**	**(cub - 17)**	**49**
Northeast	Bradford	30	2.8	(cub - 10)	47
	Carbon	13	1.5	(cub - 5)	54
	Columbia	15	2.2	(cub - 8)	73
	Lackawanna	11	3.0	(cub - 10)	45
	Luzerne [b]	19	2.9	(cub - 12)	42
	Monroe	48	2.4	(cub - 22)	48
	Northumberland	2	1.5	(1 - 2)	100
	Pike [b]	73	3.1	(cub - 16)	48
	Sullivan	29	2.8	(cub - 18)	45
	Susquehanna	10	1.7	(cub - 5)	60
	Wayne [b]	47	2.2	(cub - 10)	49
	Wyoming	11	2.7	(1 - 8)	73
	Total	**308 (18%)**	**2.6**	**(cub - 22)**	**57**
Southeast	Berks	2	3.3	(cub - 6)	50
	Dauphin	4	2.3	(1 - 4)	50
	Lebanon	5	5.1	(cub - 14)	40

	Northampton	2	1.0	(1 - 1)	100
	Schuylkill	25	2.0	cub - 13)	48
	Total	**38 (2%)**	**2.5**	**(cub - 14)**	**58**
Statewide	**TOTALS**	**1741 [c]**	**2.3**	**(cub - 22)**	**52**

[a] Sex not recorded on at least one bear.
[b] Unable to age at least one bear due to broken or no tooth.
c Includes one bear that was found illegally killed, but county was not recorded.

Table 5. Number of bears and percentage of annual harvest taken during each day of the season, 1980-99.

		First Day		Second Day		Third Day		
Year	Season Dates	Harvest	%	Harvest	%	Harvest	%	Total
1980	Nov. 24	921	100.0					921
1981	Nov. 23	819	100.0					819
1982	Nov. 22 - 23	413	70.2	175	29.8			588
1983	Nov. 21 - 22	1,137	74.4	391	25.6			1,528
1984	Nov. 19 - 20	1,157	74.7	392	25.3			1,549
1985	Nov. 25 - 26	935	90.9	94	9.1			1,029
1986	Nov. 24 - 26	960	70.5	367	26.9	35	2.6	1,362
1987	Nov. 23 - 25	1,187	76.1	262	16.8	111	7.1	1,560
1988	Nov. 21 - 23	1,021	63.3	424	26.3	169	10.5	1,614
1989	Nov. 20 - 22	1,427	64.3	537	24.2	256	11.5	2,220
1990	Nov. 19 - 21	819	68.3	258	21.5	123	10.3	1,200
1991	Nov. 25 - 27	1,062	63.0	427	25.3	198	11.7	1,687
1992	Nov. 23 - 25	1,078	67.8	403	25.4	108	6.8	1,589
1993	Nov. 22 - 24	1,193	66.6	415	23.2	182	10.2	1,790
1994	Nov. 21 - 23	702	51.4	505	37.0	158	11.6	1,365
1995	Nov. 20 - 22	1,403	64.1	536	24.5	251	11.5	2,190
1996	Nov. 25 - 27	1,186	66.0	269	15.0	341	19.0	1,796
1997	Nov. 24 - 26	1,320	62.6	551	26.1	239	11.3	2,110
1998	Nov. 23 - 25	1,710	65.8	578	22.2	310	11.9	2,598
1999	Nov. 22 - 24	1,093	62.8	440	25.3	208	11.9	1,741
Averages								
5-year	(1994-98)	1,264	62.0	488	25.0	260	13.1	2,012

10-year	(1989-98)	1,190	64.0	448	24.4	217	11.6	1,855
19-year	(1980-98)	1,076	71.6	387	23.8	191	10.5	1,553

Table 6. Other documented black bear mortalities besides legal harvest and illegal kills that occurred during the hunting season, 1980-99. The category "Other" includes such things as unknown cause of death, malnutrition, disease, predation, non-vehicle accidents (i.e., collisions with trains), unsuccessful intra-litter adoptions, and handling accidents.

Year	Property or Agriculture Damage [a]	Automobile Collisions	Illegal shootings [b]	Other	Total
1980	34	114	28	34	210
1981	25	115	37	29	206
1982	58	168	27	31	284
1983	38	153	29	26	246
1984	29	141	28	37	235
1985	17	108	29	15	169
1986	17	155	17	25	214
1987	22	149	22	35	228
1988	10	209	26	39	284
1989	17	166	21	27	231
1990	08	190	31	24	253
1991	02	155	17	16	190
1992	14	221	29	25	289
1993	08	192	25	17	242
1994	04	209	22	28	263
1995	12	248	20	26	306
1996	03	209	13	24	249
1997	06	273	21	23	323
1998	03	251	22	21	297
1999	03	340	20	22	385
Averages					
5-year (1994-98)	06	238	20	24	288

10-year (1989-98)	08	211	22	23	264
19-year (1980-98)	17	180	24	26	248

[a] Includes both agency and landowner removals.

[b] Discovered outside the hunting season.

Figure 1. Distribution of Capture/Kill Reports that indicated mange symptoms were observed.