PRELIMINARY ASSESSMENT OF A BALLOT INITIATIVE BANNING TWO METHODS OF BEAR HUNTING IN OREGON: EFFECTS ON BEAR HARVEST

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Abstract: In 1994, Oregon voters passed Measure 18, a citizen-sponsored ballot initiative that banned the use of dogs or bait for hunting black bears (*Ursus americanus*). A minority of bear hunters used dogs, bait, or both prior to the passage of Measure 18; however, hunters who used these methods killed the majority of bears, especially in western Oregon. Although estimated harvest was lower after Measure 18, the elimination of these hunting techniques did not significantly decrease the statewide harvest. However, the annual estimated harvest in western Oregon was significantly lower following Measure 18. Because hound hunting and baiting can be selective hunting methods, we suspected that their elimination might alter the age- and sex-structure of the harvest. We analyzed voluntary tooth return data to determine the effects of Measure 18 on harvest composition. Before Measure 18, hunters using bait took younger bears than hunters using dogs ($P = 0.05$). There was no difference between the average age of bears killed by hunters using other methods and those killed by hunters using either dogs ($P = 0.91$) or bait ($P = 0.19$). Male bears accounted for a higher ($P < 0.01$) proportion (66%) of the harvest than did females during all years, 1991–97; however, the proportion of males in the harvest did not differ between hunting techniques ($P = 0.21$). There was no difference detected in harvested bears between the 2 periods (pre-Measure 18 [1991–94] and post-Measure 18 [1995–97]) for either mean age of both sexes combined ($P = 0.84$) or proportion of males in the harvest ($P = 0.95$). Although more time may be required under the new hunting regulations before any differences can be detected, we concluded that the method of take had little initial effect on the sex and age composition of the harvest. Due to the regional effects of Measure 18, the loss of hound hunting and baiting may not directly affect statewide bear harvest levels but may present challenges to management of bear population levels and human–bear conflicts in localized areas, particularly in western Oregon.

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Key words: bait, ballot initiative, ballot measure, black bear, harvest, hound hunting, hunting, hunting method, Oregon, *Ursus americanus*, voter initiative

In 1994, Oregon voters passed Measure 18, a citizen-sponsored ballot initiative that banned the use of dogs and bait for hunting black bears and banned the use of dogs for hunting cougars (*Felis concolor*). Voters rejected another citizen-sponsored ballot initiative (Measure 34) in 1996 that would have repealed Measure 18 and given sole authority for managing wildlife to the Oregon Fish and Wildlife Commission (Boulay et al. 2000). Citizen-sponsored ballot measures on wildlife management issues are becoming more common in states that have the initiative process (Minnis 1998). Because ballot measures may affect how fish and wildlife agencies manage wildlife resources, the impacts of measures on wildlife populations and habitat need to be examined.

During 1990–92, hunters who took bears incidentally while hunting other species killed 40% of the bears statewide, hunters who used dogs killed 31%, those who stalked bears killed 15%, and those who used bait killed 14% (n = 2,865, Oregon Department of Fish and Wildlife [ODFW] 1993). Because almost half of the harvested bears statewide were killed by hunters who used dogs or bait before Measure 18, we expected that the measure would have a substantial impact on hunter success and the number of bears harvested

Hound hunting and baiting are thought to be selective hunting methods in that they provide the hunter an opportunity to examine the bear before shooting it and potentially provide the opportunity to see ≥1 bear in a hunting session (Litvaitis and Kane 1994). Given a greater opportunity for selection, hunters using these methods would be expected to select larger, thus predominantly older and male, bears. Consequently, elimination of these methods could alter the age- and sex-structure of the harvest. To determine the effects of Measure 18 on the bear harvest in Oregon, we tested the following null hypotheses: (1) there was no difference in the average age of bears taken by different methods in western Oregon before Measure 18, (2) there was no difference in the sex ratio of bears killed by different methods in western Oregon before Measure 18, and (3) there would be no difference in average age and percent females in the bear harvest from western Oregon before and after the implementation of Measure 18.

METHODS

To estimate harvest levels, hunter pressure, and hunter success, ODFW has surveyed a random sample of bear tag holders since 1975 (ODFW 1998). In all surveys, hunters were asked standardized questions on hunting methods and success, location and number of days spent hunting, and species primarily hunted. To generate statewide estimates, the samples were expanded based on the actual number of tags sold.

In 1993, ODFW initiated 2 radiotelemetry research projects to provide baseline data on bear ecology and to validate the statewide management plan. Special bear hunting regulations were enacted for the Indigo and McKenzie Wildlife Management Units (WMUs) in western Oregon and the Starkey WMU in eastern Oregon, within which the 2 study areas were located. Hunters were required to have their bear tag certified before hunting in these WMUs, and all bears killed from these WMUs were required to be validated at an ODFW office. We used hunter check stations within the Indigo and McKenzie WMUs to estimate hunter compliance with the special regulations.

Other than the special regulations, validation of bears and tooth return is voluntary in Oregon. Oregon's black bear management policy states that if tooth return rates drop below 30% of the estimated statewide harvest for 2 successive years, a mandatory validation or report card for all harvested bears will be initiated (ODFW 1993). Tooth return envelopes are issued with bear tags, and hunters are requested to mail in 1 premolar tooth with data on sex of bear and date and location of kill. Teeth are aged by the cementum annuli technique (Willey 1974) at Matson's Laboratory (Milltown, Montana, USA). The error rate for cementum annuli analysis has not been determined for Oregon but has been estimated to be 8.1% for bear teeth collected in Pennsylvania and aged at Matson's Laboratory (Harshyne et al. 1998).

We analyzed the tooth return data to determine potential effects of Measure 18 on the sex and age composition of harvested bears. Analysis was restricted to fall harvest data from western Oregon because hound hunting primarily occurred in western Oregon before Measure 18. Also, western and eastern Oregon (as divided by the crest of the Cascade Mountain Range) differ substantially in vegetative community types, bear densities (ODFW 1993), human population levels, land ownership patterns, and hunting regulations and pressure. Because non-resident hunters were biased by method (most hired houndsmen as guides), we excluded bears killed by non-residents from analysis. We analyzed data collected since 1991, when ODFW began collecting complete information on method of bear take. We analyzed data from voluntary tooth returns from 1991–97 fall hunting seasons with a Kruskal-Wallis k sample test (Steel and Torrie 1980:544–545, SPSS Incorporated 1993). We tested differences between harvest characteristics before and after Measure 18 with the Student's t-test for bear age and χ^2 goodness of fit test for percent males in the harvest (SPSS Incorporated 1993). Significance was set *a priori* at $P \leq 0.05$.

RESULTS

Although a minority of bear hunters used dogs, bait, or both before the passage of Measure 18, hunters who used these methods were more successful (defined as the percent of bear hunters who killed a bear in a given year; Table 1). Most surveyed hunters who hunted bears in western Oregon during 1991–94 used stalking, calling, or incidental methods ($\bar{x}$ = 1,203.0 ± 481.8 hunters) rather than hound hunting or baiting ($\bar{x}$ = 540.8 ± 101.6 hunters, t_6 = -2.69, P = 0.04). However, hunters who used hound hunting or baiting killed more bears (dog or bait: $\bar{x}$ = 123.8 bears ± 36.8; other: $\bar{x}$= 50.8 bears ± 7.2; t_6 = 3.89, $P < 0.01$) and had higher success (dog/bait: $\bar{x}$ =

Table 1. Estimated number of hunters, hunting method used, estimated legal black bear harvest by method, and hunter success, based on surveyed bear tag holders who hunted in western Oregon, USA, 1991–97 (n = 8,056).

		Hunters using method (%)			Harvest by method (%)			Hunter success by method[a]			
	Hunters[b]	Bait	Dogs	Other[c]	Bait	Dogs	Other[c]	Bait	Dogs	Other[c]	Total[d]
1991	9,569	9.3	15.9	74.8	20.4	52.7	26.9	17.1	25.7	7.7	12.2
1992	11,882	10.5	13.6	75.9	18.3	47.3	34.4	12.6	25.1	3.3	6.8
1993	13,749	12.5	16.5	71.0	27.8	46.6	25.6	22.3	28.1	3.6	8.6
1994	13,672	12.0	16.9	71.1	22.2	45.8	31.9	17.6	25.8	4.3	9.1
1995[e]	12,506			100.0			100.0			5.0	5.0
1996	20,672			100.0			100.0			4.3	4.3
1997	20,755			100.0			100.0			3.1	3.1

[a] Percent of hunters using method who killed a bear that year.
[b] Estimated number of bear hunters.
[c] Other methods include stalking, calling, still hunting, and incidental take while pursuing other species.
[d] Total annual hunter success.
[e] First year Measure 18 was in effect.

21.6% ± 1.4; other: $\bar{x}$ = 4.9% ± 2.4; t_6 = 11.96, $P < 0.01$). Based on phone surveys, hunters using dogs or bait accounted for 65.6–74.4% of the estimated bear harvest in western Oregon (Table 1). Telephone survey data were not available for eastern Oregon. Based on tooth return data prior to Measure 18, hunters killed significantly more bears using dogs in western Oregon (χ^2_2 = 38.77, n = 1886, $P < 0.01$) than in eastern Oregon, where hunters who used other methods killed more bears (χ^2_2 = 34.93, n = 1886, $P < 0.01$). Prior to Measure 18, hunters who used bait killed an equal proportion of bears in the 2 regions (χ^2_2 = 0.11, n = 1886, P = 0.92)

Although harvest was reduced after Measure 18, the mandated change in hunting techniques did not significantly decrease the estimated statewide harvest (Table 2). The average annual (± SD) estimated statewide harvest was not different between 1995–97 ($\bar{x}$ = 717.7 ± 141.1 bears) and 1989–91 ($\bar{x}$ = 908.0 ± 254.6 bears; t_4 = 1.13, P = 0.32) or 1992–94 ($\bar{x}$=1,078.0 ± 239.1 bears; t_4 = 2.25, P = 0.09). However, the annual estimated harvest was lower in western Oregon following Measure 18 (1992–94: $\bar{x}$ = 736.0 ± 160.0 bears; 1995–97: $\bar{x}$ = 405.0 ± 107.5 bears; t = 2.97, P = 0.04). The annual estimated harvest was not lower in eastern Oregon following Measure 18 (1992–94: $\bar{x}$= 342.0 ± 91.6 bears; 1995–97: $\bar{x}$ = 312.7 ± 34.1 bears; t_4 = 0.52, P = 0.63). In all years, the annual estimated harvest was higher in western Oregon compared to eastern Oregon (western: $\bar{x}$ = 570.5 ± 218.5 bears; eastern: $\bar{x}$ = 327.3 ± 63.9 bears; t_6 = 2.62, P = 0.04). Hunter participation in the voluntary tooth program varied by year (Table 2).

Before Measure 18, there was a difference in the average age of bears harvested by the 3 techniques (F_2 = 5.97, n = 958, P < 0.01; Table 3). Bears killed by hunters

Table 2. Regional differences in the effect of Measure 18 on voluntary tooth return and estimated black bear harvest from the fall hunting season in Oregon, USA, 1991–97.

	Voluntary tooth return				Estimated harvest		
Year	West[a]	East[b]	Total	Participation (%)[c]	West[a]	East[b]	Total
1991	316	144	460	34	n/a[d]	n/a[d]	1,172
1992	284	133	417	43	552	253	805
1993	403	104	507	38	842	337	1,179
1994	284	136	420	29	814	436	1,250
1995[e]	102	83	185	27	329	295	624
1996	132	125	257	26	528	352	880
1997	72	56	138	23	358	291	649

[a] West = west of the crest of the Cascade Mountains.
[b] East = east of the crest of the Cascade Mountains.
[c] Estimated percent of successful hunters who turned in teeth; includes spring harvest.
[d] n/a = data not available.
[e] First year Measure 18 was in effect.

Table 3. Average age and percent of male black bears in harvest by method, based on tooth return from the fall harvest in western Oregon, USA, 1991–97 (n = 1,251).

	Average age					Male (%)				
Year	Sample	Bait	Dogs	Other[a]	Total	Sample	Bait	Dogs	Other[a]	Total
1991	209	3.57	5.52	5.49	5.10	209	68.2	57.3	63.2	61.7
1992	206	4.66	5.40	5.72	5.10	219	73.7	63.7	63.2	66.2
1993	296	4.88	4.97	5.18	5.00	302	70.1	64.6	71.8	67.9
1994	217	5.13	5.18	4.55	4.97	226	71.4	70.1	57.1	66.8
1995[b]	91			4.90	4.90	94			70.2	70.2
1996	123			5.53	5.53	128			63.3	63.3
1997	71			4.75	4.75	73			65.8	65.8

[a] Other methods include stalking, calling, still hunting, and incidental take while pursuing other species.
[b] First year Measure 18 was in effect.

using bait were younger than bears killed by hunters using dogs (t_{680} = -2.00, P = 0.05), but not by hunters using other methods (t_{483} = -1.32, P = 0.19). There was no difference in the average age of bears killed by hunters using dogs versus other methods (t_{378} = 0.12, P = 0.91).

Male bears accounted for a higher proportion (66%) of the harvest than did females during all years, 1991–97 (χ^2_1 = 127.26, n = 1,251, P < 0.01). The proportion of males in the harvest did not differ between hunting techniques before Measure 18 (χ^2_2 = 3.09, n = 956, P = 0.21).

There was no difference detected in harvested bears between the 2 periods (pre-Measure 18 [1991–94] and post-Measure 18 [1995–97]) for either mean age of both sexes combined ($t_{1,211}$ = -0.20, P = 0.84) or proportion of males (χ^2_1 = 0.004, n = 1151, P = 0.95).

DISCUSSION

We expected that the number of bear tags sold would decline after the ban was implemented in 1995. However, bear tag sales dropped during the first year but increased substantially in 1996 and 1997 (Carter 1998, Boulay et al. 2000). The increase in tag sales in 1996 was most likely due to an extension of the bear tag sale deadline and an increase in hunters purchasing bear tags for the first time (Carter 1998, Boulay et al. 2000). In 1997, ODFW increased spring bear hunting opportunities in some parts of the state, which further increased tag sales. The substantial increase in bear tag sales after Measure 18 may have offset some of the effects of the ban, even though most of the bear tag holders hunted bears incidentally to other species after Measure 18 (Boulay et al. 2000). Measure 18 resulted in somewhat lower hunter success and levels of bear harvest, but the change was neither a significant decrease nor a dramatic change in harvest levels since hunter surveys began in 1975. Compliance with the ban is unknown and may not be measurable due to the difficulties in enforcing Measure 18. Hunter survey data indicate that some hunters are still using the banned methods (Oregon Department of Fish and Wildlife, Roseburg, Oregon, USA, unpublished data); however, the amount of hound hunting and baiting and the level of illegal kill is unknown.

Before Measure 18, hound and bait hunters took up to 74.4% of the estimated harvest in western Oregon (Table 1). Based on tooth return data, the amount of hound hunting was substantially lower in eastern Oregon than in western Oregon. Since hound hunting was the most successful of all the methods, the ban had a greater impact to bear harvest in western Oregon than eastern Oregon. This regional difference is due to differences in vegetative communities and historical hunting techniques and hunter pressure. Because of a milder climate and greater levels of rainfall, understory vegetation tends to be much more dense in western Oregon than eastern Oregon. As a result, stalking bears was considered more difficult in western Oregon, and hunters probably relied more on hound hunting and baiting. Also, hunting pressure on bears traditionally has been higher in western Oregon than eastern Oregon (ODFW 1998). Although only a third of Oregon is west of the Cascades crest, 87.0% of the estimated human population lived in western Oregon in 1994 (Keisling 1995). Lastly, controlled hunts are used for managing deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) populations in eastern Oregon. The availability of deer and elk tags is limited through public drawing, and bear hunters must have valid deer or elk tags to hunt bear during those seasons. These restrictions do not apply to most hunting seasons in western Oregon. Because hunting pressure due to hound hunting and baiting were localized before Measure 18, the effects of banning these methods would be expected to be localized as well.

The passage of Measure 18 may decrease the influence of hunting method on bear harvest and increase the influence of other factors, especially in western Oregon. Bear habitat use and movements are influenced by the distribution and availability of food (Reynolds and Beecham 1980). Hunter success and thus harvest levels can be influenced by bear behavioral responses to variation in food availability (Noyce and Garshelis 1997). With more people hunting bears incidentally, chance encounters with bears will determine an individual hunter's success, so bear movements and behavior will have a greater effect on harvest rates. Harvest levels also are influenced by the number of hunters and amount of hunting pressure (Lindzey et al. 1983, Kolenosky 1986). Again, with the more efficient hunting methods eliminated, the number of bears killed incidentally will also be influenced by the number of hunters purchasing bear tags. Because bear mobility and vulnerability to hunting and hunting pressure can vary greatly on an annual basis, harvest levels may be increasingly variable.

There was a difference in the average age of bears killed by the 3 methods before Measure 18, with hunters using bait killing younger bears than hunters using dogs. Our results are similar to those from New Hampshire, where hunters who used bait took the youngest bears (Litvaitis and Kane 1994). In contrast, hound hunters in New Hampshire killed the oldest bears (Litvaitis and Kane 1994), whereas hound hunters in western Oregon did not kill older bears than other methods (stalking, calling, and incidental). In the New Hampshire study, hunt-

ers who used dogs demonstrated the greatest selectivity, whereas hunters who used bait had significantly less hunting experience and were less selective. Because there was no difference in the average age of bears killed by other methods as compared to dogs or bait before Measure 18, the elimination of dogs and bait did not affect the average age of harvested bears post-Measure 18. Similarly, there was no difference in the proportion of males killed by the different methods before Measure 18, and the ban did not change the percent of males in the fall harvest. Although more time may be required under the new hunting regulations before any differences can be detected, the method of take may have little effect on the composition of the harvest.

In all years, there were significantly more male bears killed than females. However, none of the methods was more selective for males. Elowe (1990) reported that hunters who used dogs took 48–58% males in Maine during 1982–89. He suggested that it was difficult for even experienced observers to judge the size of a treed bear, so that hound hunting was not necessarily more selective for males (Elowe 1990). In contrast, hunters in New Hampshire who used bait or dogs killed a greater proportion of males than hunters who used other methods (bait, 72.7%; dogs, 71.4%; still, 59.8%; and stalk, 51.9%; Litvaitis and Kane 1994).

In addition to hunter selectivity, harvest bias toward males has been attributed to differences in their mobility, home range size, behavior, and denning dates (Lindzey and Meslow 1977, Bunnell and Tait 1980, Lindzey 1981, Kolenosky 1986). However, the preponderance of males could also reflect reporting bias in voluntary tooth return. Lindzey and Meslow (1980) determined sex of bears killed in Oregon by measuring the maximum canine root length and compared the results to what was reported by the hunters. The determined sex agreed with the reported sex 75% of the time when reported by questionnaire and 80.3% of the time when reported by interview with hunter or taxidermist. In that study, hunters reported taking 64.1% males; however, hunters sometimes reported males as females. When the tooth data were adjusted, the sex ratio was not significantly different from 1:1 (Lindzey and Meslow 1980). Voluntary tooth return similarly may result in biased age estimates. Even if such biases exists in our tooth data, they were probably consistent during the period examined, regardless of hunting methods.

Bear populations are affected by reproductive success, as influenced by food availability and hunting pressure (Beecham and Rohlman 1994:133). In Oregon, bear populations historically have been influenced by factors that influence reproductive success, particularly human-induced changes in habitat and natural variability in mast production, in addition to hunting pressure. With the absence of hound hunting and baiting, bear population dynamics will be more constrained by habitat quality and mast production than by mortality through hunting. However, further changes in bear hunting regulations, such as changing season length, tag sale deadline, or bag limit, could affect harvest levels. Tooth return data, especially when tooth return is not mandatory, do not necessarily reflect the sex- and age-composition of bear populations (Garshelis 1990, Kane and Litvaitis 1992). As such, the impact of Measure 18 on bear populations in Oregon is unknown.

Bear damage to private property was high in some areas of western Oregon before Measure 18 (ODFW 1993), and damage would be expected to increase if bear harvest levels substantially decrease and if there are not compensatory mortality mechanisms. Thus, the reduction in bear harvest as a result of the loss of hound hunting and baiting may present challenges to management of bear population levels and human–bear conflicts in localized areas, particularly in western Oregon.

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