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Author(s): ROBERT M. INMAN, CECILY M. COSTELLO, DONALD E. JONES, KRISTINE H. INMAN, BRUCE C. THOMPSON, and HOWARD B. QUIGLEY
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Research Article

Denning Chronology and Design of Effective Bear Management Units

ROBERT M. INMAN,[1,2] *Hornocker Wildlife Institute and New Mexico Cooperative Fish and Wildlife Research Unit, 2023 Stadium Drive 1A, Bozeman, MT 59715, USA*

CECILY M. COSTELLO,[2] *Hornocker Wildlife Institute and New Mexico Cooperative Fish and Wildlife Research Unit, 2023 Stadium Drive 1A, Bozeman, MT 59715, USA*

DONALD E. JONES, *New Mexico Department of Game and Fish, 215 York Canyon Road, P.O. Box 1145, Raton, NM 87749, USA*

KRISTINE H. INMAN,[2] *Hornocker Wildlife Institute and New Mexico Cooperative Fish and Wildlife Research Unit, 2023 Stadium Drive 1A, Bozeman, MT 59715, USA*

BRUCE C. THOMPSON,[3] *New Mexico Cooperative Fish and Wildlife Research Unit, United States Geological Survey–Biological Resources, Box 30003 MSC 4901, Las Cruces, NM 88003, USA*

HOWARD B. QUIGLEY,[4] *Hornocker Wildlife Institute, 2023 Stadium Drive 1A, Bozeman, MT 59715, USA*

ABSTRACT Reports on the effectiveness of using late fall hunting seasons to reduce the proportion of female black bears (*Ursus americanus*) in the harvest are limited, and the geographic scale over which the technique functions as intended has not been examined. During 1992–2000, we radio-equipped black bears in New Mexico, USA, obtained estimates of 175 den entry and 137 den emergence dates, and used New Mexico Department of Game and Fish harvest data (1985–2000) to test for differences in proportion of females in the harvest relative to denning chronology. Bears in northern New Mexico entered dens earlier and emerged later than bears in southern New Mexico ($P \leq 0.001$). In northern New Mexico bears displayed the typical pattern of earlier entry and later emergence by reproductive females, proportion of females in the harvest varied over time as expected, and late fall seasons were effective ($P \leq 0.10$). In contrast, denning chronology did not differ by sex in southern New Mexico, proportion of females in the harvest did not change over time, and late fall seasons were not effective ($P \geq 0.18$). Manipulation of hunting season dates to influence female mortality can be an effective tool, however our study provides an example of an area where denning chronology did not differ by sex and late seasons were not effective. We also observed regional differences in timing of entrance and emergence, which suggest that scale of application may be key. In management jurisdictions that encompass ecologically distinct areas, cover a wide range of latitudes, or are mountainous, successful use of the technique may depend on knowledge of denning chronology at multiple locations and appropriate designation of hunting unit boundaries, season dates, and data analysis units. (JOURNAL OF WILDLIFE MANAGEMENT 71(5):1476–1483; 2007)

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KEY WORDS bear, chronology, den, harvest, hunting seasons, management units, New Mexico, *Ursus americanus*.

Black bear (*Ursus americanus*) hunting seasons often coincide with periods of den entry and emergence, and denned bears may be less vulnerable to hunting mortality (Troyer 1961, Alt 1977). Because females typically enter dens earlier and emerge later (Johnson and Pelton 1980, Smith et al. 1994), manipulation of season timing has been proposed as a means of regulating harvest of females (Troyer 1961, Johnson and Pelton 1979, Lindzey 1981). Fall seasons that begin later and spring seasons that begin earlier are widely regarded as a means of reducing proportion of females in the harvest and maintaining reproductive capacity of bear populations. However, bear populations from more northern latitudes and higher elevations tend to enter dens earlier, remain denned longer, and emerge later (Smith et al. 1994), and differences in denning chronology could occur within bear management or harvest data analysis units. Although the technique has been used successfully (Tennessee Wildlife Resources Agency 2006), there has been no examination of how to apply it at a scale that produces the intended effect (i.e., designation of bear management units). Our objective was to assess whether denning chronology warrants consideration in designation of bear management units. We hypothesized that 1) bears in northern New Mexico, USA, would enter dens earlier and emerge later than bears in southern New Mexico, 2) earlier entrance and later emergence by females would result in lower vulnerability of females to harvest, and 3) a statewide late fall hunting season designed to reduce proportion of females in the harvest would achieve different levels of success if regional differences in denning chronology exist.

STUDY AREA

We conducted research at 2 study sites in New Mexico. The northern, or Sangre de Cristo study area (SANGRE), was located at the southern terminus of the Rocky Mountains in the Sangre de Cristo Mountain Range of northeastern New Mexico. All SANGRE telemetry and harvest data were derived from within the Sangre de Cristo region of suitable bear habitat (Costello et al. 2001; Fig. 1). The SANGRE study area was approximately 310 km^2 and encompassed private, state, and federal lands. Elevations ranged from 2,073 m to 3,793 m. Dominant habitat types included pinyon–juniper (*Pinus edulis–Juniperus* spp.) woodlands;

[1] *E-mail: binman@wcs.org*
[2] *Present address: Wildlife Conservation Society, 2023 Stadium Drive 1A, Bozeman, MT 59715, USA*
[3] *Present address: New Mexico Department of Game and Fish, P.O. Box 25112, Santa Fe, NM 87504, USA*
[4] *Present address: Beringia South, P.O. Box 160, Kelly, WY 83001, USA*

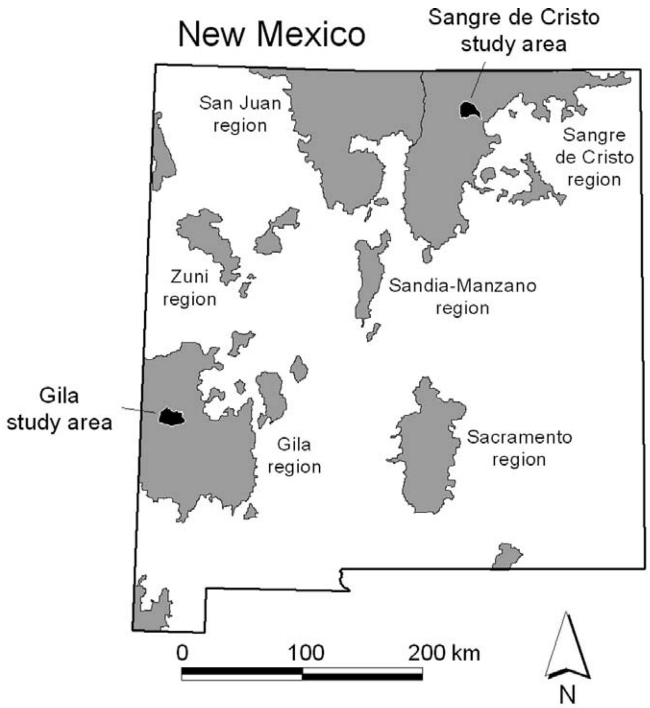

Figure 1. Locations of Sangre de Cristo and Gila study areas (black polygons) and regions of suitable black bear habitat (gray polygons; Costello et al. 2001), New Mexico, USA.

oak–mountain mahogany (*Quercus* spp.–*Cercocarpus* spp.) scrub; ponderosa pine (*P. ponderosa*), mixed conifer (*Pseudotsuga menziesii*–*Abies concolor*), aspen (*Populus tremuloides*), and spruce–fir (*Picea engelmannii*–*A. lasiocarpa*) forests; along with meadows of fescue (*Festuca* spp.), mountain muhly (*Muhlenbergia montana*), grama (*Bouteloua* spp.), and bluegrass (*Poa* spp.). An alpine tundra community of sedge (*Carex* spp.), alpine avens (*Geum rossii*), mountain current (*Ribes montigenum*), shrubby cinquefoil (*Potentilla fruticosa*), and grounsel (*Senecio* spp.) surrounded talus slopes at highest elevations (Brown 1982). Mean January temperature was $-7°$ C at Eagle Nest (2,506 m) and 0° C at Cimarron (1,939 m); mean July temperatures were 16° C at Eagle Nest and 21° C at Cimarron. Frost-free season varied with elevation and ranged from 70 days to 190 days. Annual precipitation averaged approximately 39.6 cm; most rainfall occurred during July–August. Monthly snowfall (Dec–Mar) averaged 25.4 cm at Eagle Nest and 15.0 cm at Cimarron (Western Regional Climate Center 2001).

The southern, or Gila study area (GILA), was located in the Mogollon Mountains of southwestern New Mexico. All GILA telemetry and harvest data were derived from within the Gila region of suitable habitat (Costello et al. 2001). The approximately 420-km^2 area was within the Gila National Forest, but it included some private parcels. Elevations ranged from approximately 1,750 m to 3,035 m. Dominant habitat types coincided with those described for SANGRE, with some variation in species composition. Mean January temperature was $-1°$ C at Beaverhead (2,023 m) and 5° C at Glenwood (1,432 m); mean July temperatures were 19° C at Beaverhead and 24° C at Glenwood. Frost-free season varied with elevation and ranged from 110 days to 230 days. Annual precipitation averaged approximately 39.0 cm; most rainfall occurred during July–August. Monthly snowfall (Dec–Mar) averaged 10.5 cm at Beaverhead and 4.0 cm at Glenwood (Western Regional Climate Center 2001).

METHODS

Capture and Handling

During 1992–1999, we captured bears using Aldrich foot snares and culvert traps. Most often, we immobilized them with 4.4 mg/kg ketamine hydrochloride (Ketaset, Fort Dodge Animal Health, Overland Park, KS) and 2.2 mg/kg xylazine hydrochloride (Rompun, A. H. Robbins Co., Richmond, VA). Occasionally, we used 5.5 mg/kg tiletamine hydrochloride + zolazepam hydrochloride (premixed as Telazol, A. H. Robins Co.), however use of Telazol was not ideal for trapping, because the protracted recovery period (White et al. 1996) limited our ability to handle multiple bears per day. We extracted a vestigial premolar tooth from bears $\geq$1 year old (Jonkel 1993) for age determination using cementum annuli counts (Stoneberg and Jonkel 1966, Willey 1974). We marked bears with ear tags (Allflex USA, Dallas, TX), gave them a lip tattoo, and fit them with radiocollars (Telonics, Mesa, AZ, and Ursus Technologies, Williamsburg, VA) or ear-tag radiotransmitters (Advanced Telemetry Systems, Isanti, MN). We placed radiotransmitters on all captured females; we fit males with transmitters as needed to maintain a sample of about 10 adults per study area each year. We visited dens as necessary to ascertain reproductive status, record den characteristics, change collars on adults, and place radiotransmitters on yearlings. We used Telazol for immobilization at den sites because of its reduced tendency to depress heart rate and respiration compared to Ketaset–Rompun (Jonkel 1993); we handled neonate cubs without immobilization. We conducted den investigations during January–April, however we limited handling of cubs to March and April when our handling would have negligible impact on their survival. We obtained permits for capture and immobilization from New Mexico Department of Game and Fish (NMDGF), New Mexico Board of Pharmacy, and United States Drug Enforcement Agency. Capture and handling protocols were approved by the Hornocker Wildlife Institute (1992–1998) and under the New Mexico State University Institutional Animal Care and Use Committee (1999–2000, Permit no. 99-0010).

Denning Chronology

We estimated den entrance and emergence dates using aerial telemetry data. During appropriate seasons (15 Sep–31 Dec and 15 Mar–15 Jun), we attempted to locate each bear once per 7–10 days. We did not attempt to determine exact dates of den entry or emergence by ground observation because of potential for disruption. We measured distance between aerial location(s) of dropped collars or mortality signals and actual location of the recovered collar to estimate our mean error radius of 519 m ($n = 69$, SE $= 74.4$ m). Bears often concentrate movements around den sites days or weeks before den entry and remain in the den vicinity after emergence (LeCount 1980, Tietje and Ruff 1980, Beecham et al. 1983, Kolenosky and Strathearn 1987). Our telemetry error prevented us from distinguishing very small movements associated with a specific den location. Thus we defined denning dates as those when bears moved to and remained in the den vicinity, not dates of actual movement into or out of a den cavity.

For each telemetry location, we assigned active or denned status based on proximity to actual den site (documented during a den visit) or proximity to consecutive locations. We considered locations to be the same if they were within mean error radius. We considered other relevant information, particularly observer notes and mortality (inactive) signal status. If all available information was insufficient to confidently assign active or denned status, we did not use the location. We considered bears active when we first located them at a distance greater than mean error radius from the den site. We excluded den emergence observations when first active location occurred following our den visit. We defined fall den entry date as midpoint between last active location and first denned location (O'Pezio et al 1983) and classified each entry date according to week number. Similarly, we defined spring den emergence date as midpoint between last denned location and first active location. We limited our analyses to observations where number of days between relevant locations was ≤ 15.

Harvest Composition

Since 1985, NMDGF has collected records of hunter-killed black bears through mandatory reporting that requires proof of sex and collection of a premolar tooth for age estimation. Legal harvest methods included still-hunting and use of dogs during all years and on both study areas; baiting and snaring were not allowed. From 1985 to 1991, bear hunting seasons varied over periods of 6–8 months, including periods during April–May and August–December. In 1992, due to concerns about potential over-harvest, NMDGF eliminated the spring bear season and reduced the fall season to 1 September–31 October. This season remained in place until 1998, when the season began later during fall in an attempt to reduce harvest of females. Season dates were 15 October–15 December during 1998 and 1 October–15 December during 1999–2000. For our analyses we used data from spring harvest during 1985–1991, and limited our analyses of fall harvest to 1992–2000 to coincide with the period of telemetry-based study and reduce any effects that spring harvest may have had on population structure. We included harvest records from those game management units (GMUs) that overlapped the Sangre de Cristo or Gila regions of suitable bear habitat (Costello et al. 2001; Fig. 1).

We classified each harvest record by sex, week (no.), period (active or denning), and season (fall or spring). Some weeks were represented by <10 observations, therefore we combined data for weeks 14–15 (weeks at beginning of spring season), 22–24 (weeks at end of spring season), and 45–50 (weeks at end of fall season) and entered week as 15, 22, and 45, respectively. We defined active periods as weeks when $<5\%$ of study bears were denned (i.e., prior to onset of den entry in fall and following conclusion of den emergence in the spring), whereas we defined the fall and spring denning periods as weeks when $\geq 5\%$ of bears were denned. We allowed these periods to differ by study area, as indicated by denning chronology analysis. We considered fall hunting seasons during 1992–1997 early (1 Sep–31 Oct) and seasons during 1998–2000 late (1 Oct or 15 Oct–15 Dec).

Predictions and Statistical Analysis

We hypothesized denning chronology would follow typical patterns and made the following predictions: 1) mean week of den entry would be earlier in northern than southern New Mexico; 2) mean week of den emergence would be later in northern than southern New Mexico; 3) mean week of den entry would differ by demographic group, where pregnant females would enter dens earlier than other females, and other females would enter dens earlier than males; and 4) mean week of den emergence would differ by demographic group, where males would emerge from dens earlier than other females, and other females would emerge from dens earlier than females with neonate cubs. We used 2-factor analysis of variance (ANOVA) with interactions and Bonferroni adjustments (Neter et al. 1996) to test the null hypotheses of no differences in den week (response) by area (factor 1) and demographic group (factor 2). We selected $\alpha = 0.10$ and dropped insignificant interaction terms from models. Data sets were normally distributed. The assumption of homogeneous variance was met for the den entry data set but was not met for the den emergence data set. However, ANOVA analysis is robust against violation of this assumption with sample sizes as large as ours (Neter et al. 1996).

We examined the hypothesis that earlier den entrance and later den emergence by female bears would reduce their vulnerability to harvest, and made the following predictions: 5) proportion of females in the harvest would decrease by week during fall; 6) proportion of females in the harvest would increase by week during spring; 7) proportion of females in the harvest would be greater during the fall active period than during the den entrance period; 8) proportion of females in the harvest would be lower during the den emergence period than during the spring active period; and 9) proportion of females in the harvest would be lower during late fall hunting seasons than during early fall hunting seasons. We used simple linear regression (Ott 1993) and $\alpha = 0.10$ to test null hypotheses of no trend in proportion of females (response) by week (predictor). We used chi-square analysis (Ott 1993) and $\alpha = 0.10$ to test null hypotheses of no differences in proportion of females by period or season type. For comparative purposes, we also performed regression (F proportion by week) and chi-square (proportion in early vs. late fall seasons) analyses on harvest data from the San Juan, Sacramento, Sandia-Manzano, and Zuni regions of bear habitat (Fig. 1). We used SPSS statistical software (Chicago, IL) for all analyses.

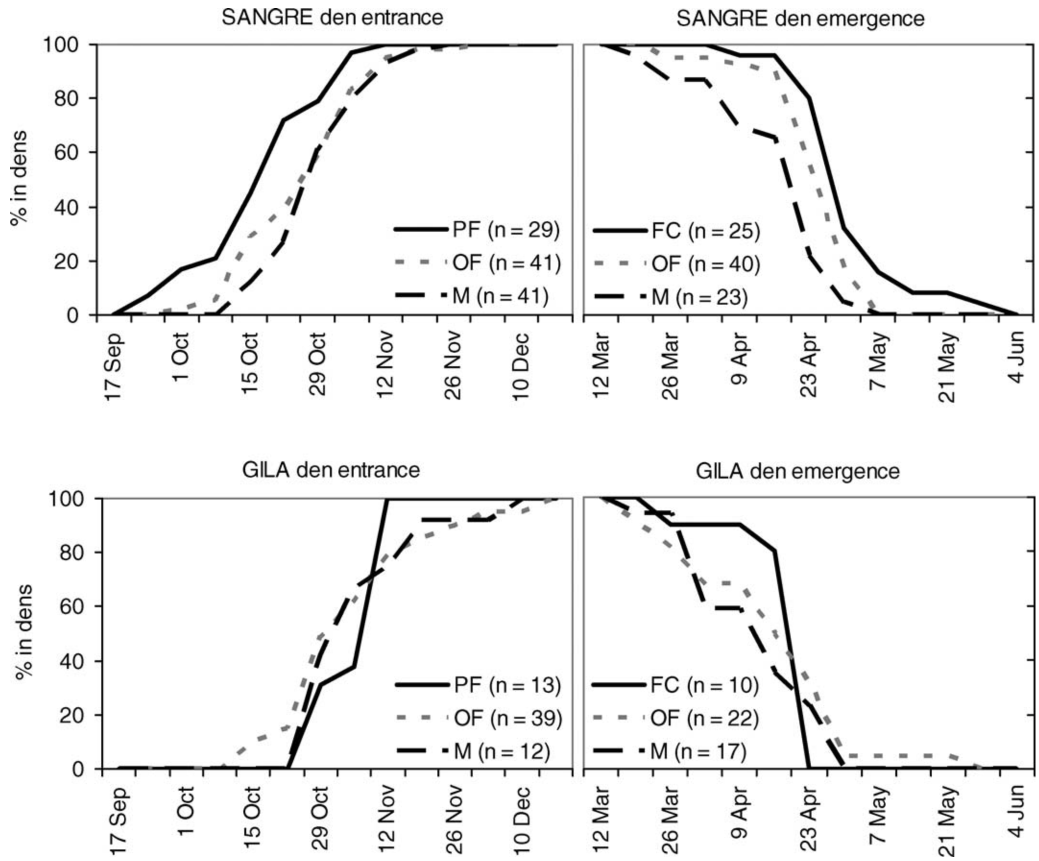

Figure 2. Percentage of black bears denned by week for pregnant females (PF), females with cubs (FC), other females (OF), and males (M) in the Sangre de Cristo (SANGRE) and Gila (GILA) study areas, New Mexico, USA, 1992–1999.

RESULTS

Denning Chronology

We obtained 175 estimates of den entry date (122 F, 53 M) by 102 bears. Time between last active location and first denned location ranged from 3 to 15 days, with a mean of 10.0 (SE = 0.22) days and a median of 10 days. Most bears entered dens between mid-October and mid-November (Fig. 2). Earliest den entry week was 39 (24–30 Sep), which we observed in SANGRE. We observed den entry as late as week 4 (28 Jan–3 Feb, recoded as week 56) and week 6 (4–10 Feb, recoded as week 58) by females in GILA, however we considered these 2 observations outliers and excluded them from ANOVA analysis. Latest den entry week we used in analyses was 50 (10–16 Dec). We detected differences in mean den entry week between study areas (area $F_{1,167} = 29.1$, $P \leq 0.001$) and among groups within an area (group $F_{2,167} = 2.5$, $P = 0.09$, area $\times$ group $F_{2,167} = 3.3$, $P = 0.04$, Fig. 3). On average, SANGRE bears entered dens 1.6 weeks earlier than GILA bears (Bonferroni 90% CI: 1.1–2.1 weeks), with a mean week of 43.6 for SANGRE and 45.2 for GILA. Pattern of mean den entry among groups followed our prediction for SANGRE but not for GILA. In SANGRE, mean week of den entry was 42.6 for pregnant females, 1.3 (90% CI: 0.3–2.3) weeks earlier than other females and 1.7 (90% CI: 0.7–2.6) weeks earlier than males. In GILA, den entry week did not differ among groups, with a mean week of 45.3 for pregnant females, 44.9 for other females, and 45.4 for males.

We obtained 137 estimates of den emergence date (97 F, 40 M) by 86 bears. Time between last denned location and first active location ranged from 3 to 15 days, with a mean of 10.8 (SE = 0.20) days and a median of 11 days. Most bears emerged from dens during April (Fig. 2). We observed den emergence as early as week 12 (19–25 Mar) and as late as week 23 (4–10 Jun). We detected differences in mean week of den emergence between study areas (area $F_{1,131} = 16.1$, $P \leq 0.001$) and among groups (group $F_{2,131} = 8.3$, $P \leq 0.001$; Fig. 3). As predicted, SANGRE bears emerged from dens 1.3 (90% CI: 0.7–1.8) weeks later than GILA bears, with a mean week of 17.4 for SANGRE and 16.1 for GILA. The group effect was similar between areas and the pattern followed our prediction. Males emerged 0.9 (90% CI: 0.1–1.6) weeks earlier than other females and 1.6 (90% CI: 0.8–2.5) weeks earlier than females with cubs. Other females emerged 0.8 (90% CI: 0.01–1.6) week earlier than females with cubs. In SANGRE, mean week of den emergence was 16.6 for males, 17.4 for other females, and 18.2 for females with cubs. In GILA, mean week was 15.3 for males, 16.2 for other females, and 17.0 for females with cubs.

Harvest Composition

During fall, week was a negative predictor of proportion of females in the harvest for the Sangre de Cristo region ($R^2_{1,9}$

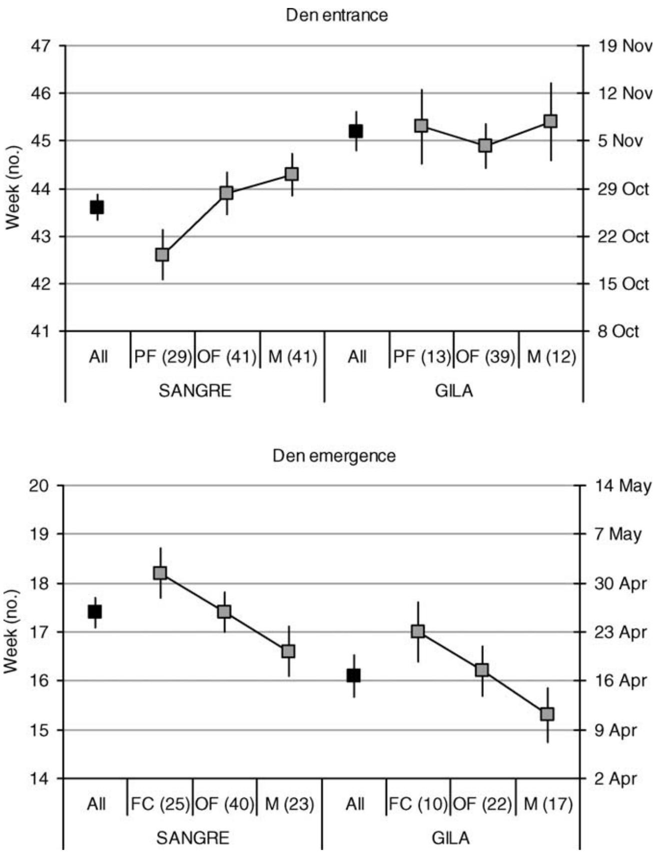

Figure 3. Mean (90% CI) week of den entrance and emergence (with sample sizes in parentheses) for all black bears, pregnant females (PF), females with cubs (FC), other females (OF), and males (M) in the Sangre de Cristo (SANGRE) and Gila (GILA) study areas, New Mexico, USA, 1992–2000.

$= 0.74$, $P = 0.01$) but was not a predictor for the Gila region ($R^2_{1,9} = 0.01$, $P = 0.73$; Fig. 4). Proportion of females in the harvest was higher during the fall active period than during the den entrance period in the Sangre de Cristo region ($P = 0.001$) but did not differ between periods in the Gila region ($P = 0.56$, Table 1). During spring, week was a positive predictor of proportion of females in the harvest in the Sangre de Cristo region ($R^2_{1,6} = 0.76$, $P = 0.005$) but was not a predictor in the Gila region ($R^2_{1,6} = 0.01$, $P = 0.80$; Fig. 4). However, we based half the proportions used in the spring model for the Gila on <10 observations. Proportion of females harvested during the den emergence period was nearly half that of the spring active period in both areas, however the difference was not significant in the Sangre de Cristo ($P = 0.10$) or Gila ($P = 0.18$; Table 1). In the San Juan region, week was a negative predictor of proportion of females in the harvest during fall ($R^2_{1,9} = 0.70$, $P = 0.001$) and a positive predictor in spring ($R^2_{1,4} = 0.63$, $P = 0.06$). No relationship between week and proportion of females was apparent in the Sacramento ($P = 0.32$), Sandia-Manzano ($P = 0.27$), or Zuni regions ($P = 0.84$) during fall or in the Sacramento ($P = 0.53$) during spring.

Proportion of females in the harvest was lower during years of late fall hunting seasons than during early fall seasons in Sangre de Cristo region ($P \leq 0.001$; Table 2), but did not differ in Gila region ($P = 0.85$). Similarly, proportion of females in the harvest was lower in the other region of northern New Mexico (San Juan; $P \leq 0.001$), but we did not detect differences in central and southern regions (Sacramento, Sandia-Manzano, and Zuni; $P \geq 0.32$; Table 2).

DISCUSSION

Our analysis indicates there are significant regional differences in denning chronology within New Mexico, including both general timing of denning period and patterns of entrance and emergence by demographic group. Denning dates in GILA were similar to those in central Arizona (LeCount 1983), whereas dates in SANGRE were more similar to Colorado and Idaho (Beecham et al. 1983, Beck 1991). Pregnant females at southern latitudes typically enter dens earlier and remain in dens longer than other females and males (LeCount 1983, Wooding and Hardisky 1992, Weaver and Pelton 1994, Oli et al. 1997), thus our telemetry data indicating no distinct pattern in GILA is unique. It is possible the pattern exists, but we were unable to detect it due to smaller sample sizes obtained for GILA. However the corroborative evidence from harvest data suggests the lack of differences between sexes in GILA was real, and that these regional differences warrant consideration in management decisions.

The concept of protecting females with season dates based on denning chronology has existed for some time (Troyer 1961, Johnson and Pelton 1979, Lindzey 1981). The area where we observed differences in denning chronology by sex (SANGRE) also displayed reduced proportions of the denned bears (F) in the harvest as expected over time and between active and denned periods; the area where females did not den differently than males (GILA), did not display reduced proportions of females in the harvest. Thus our data support the ideas that denned bears are less vulnerable to hunting mortality and that it is possible to influence female mortality with manipulation of hunt season timing (but only in areas where denning chronology differs by sex). Nonetheless, our data also suggest that successful application of this technique depends on designation of bear management units and season dates that consider site-specific differences in denning chronology.

Statewide late fall hunting seasons during 1998–2000 succeeded in achieving the goal of reducing female harvest in SANGRE, but failed in GILA. Later den entrance and less distinct sexual chronology of GILA bears suggests that regional differences in denning chronology were at least partially if not primarily responsible for the contrasting success of the technique. Average indices of oak production, percentage of hunters using dogs, and underlying sex ratios between early and late hunting season periods (1992–1997 vs. 1998–2000) suggested that these potentially confounding annual effects were not significant influences. Even if distinct patterns by sex had been present in GILA, the late hunting seasons were still unlikely to result in a significantly

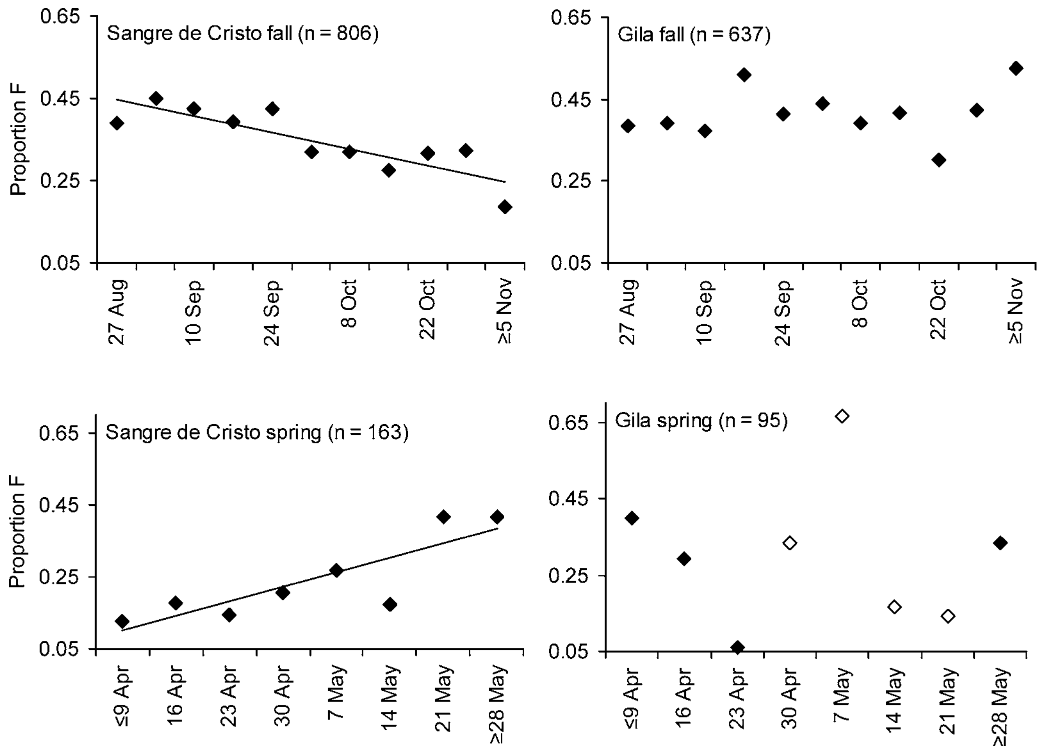

Figure 4. Proportion of female black bears in the harvest, by week, in Sangre de Cristo and Gila regions, during spring 1985–1991 and fall 1992–2000 hunting seasons, New Mexico, USA. Open symbols represent proportions based on <10 observations.

lower proportion of females in the harvest because the hunting season began prior to onset of denning behavior there. Attributing success or failure of late fall seasons to denning chronology is further supported by the pattern seen across the state. The effectiveness of late seasons was most pronounced in the SANGRE and San Juan regions of northern New Mexico, where differences in female proportion were statistically detectable and dropped by ≥12% (Table 2). In regions of central and southern New Mexico, differences in female proportion were not statistically detectable and dropped by ≤7% or increased. This suggests the pattern of denning chronology we observed may occur as a gradient throughout the state and may be important for designation of bear management units (boundaries, season dates, and data analysis units). Consequences of analyzing harvest data across the entire area managed with the same seasons dates (i.e., state) are evident by the fact that the effect and larger number of bear harvests in the north was strong enough to mask the lack of effect in the south (Table 2), which could lead to unintended or unnoticed effects on regional populations.

Table 1. Proportions of females in the black bear harvest during active and denning periods of fall and spring, Sangre de Cristo and Gila regions, New Mexico, USA, 1985–2000.[a]

Region	Season	*n*	Active	Denning	χ^2	*P*
Sangre de Cristo[b]	Fall	974	0.42	0.32	10.62	0.001
	Spring	184	0.26	0.16	2.71	0.100
Gila[c]	Fall	733	0.41	0.39	0.33	0.564
	Spring	106	0.28	0.17	1.78	0.183

[a] Data obtained through mandatory reporting to New Mexico Department of Game and Fish. During fall, we defined active period as weeks when <5% of study bears had entered dens and denning period as weeks when ≥5% of bears had denned. During spring, we defined denning period as weeks when ≥95% of bears remained in dens and active period as weeks when <5% of bears were denned. We limited data for fall seasons to 1992–2000 and for spring seasons to 1985–1991.
[b] Includes Sangre de Cristo study area.
[c] Includes Gila study area.

Table 2. Proportions of females in the black bear harvest during early and late fall hunting seasons, by region, New Mexico, USA, 1992–2000.[a]

Region	*n*	Early	Late	χ^2	*P*
Northern NM					
San Juan	677	0.39	0.21	18.15	≤0.001
Sangre de Cristo[b]	974	0.40	0.28	12.28	≤0.001
Central NM					
Sandia-Manzano	113	0.50	0.43	0.31	0.577
Zuni	82	0.62	0.56	0.30	0.587
Southern NM					
Sacramento	461	0.43	0.37	1.00	0.317
Gila[c]	733	0.40	0.41	0.03	0.854
Statewide	3,075	0.41	0.31	23.30[d]	≤0.001[d]

[a] Data obtained through mandatory reporting to the New Mexico Department of Game and Fish. Regions defined by Costello et al. (2001), see study area figure herein. Early = 1 Sep–31 Oct 1992–1997. Late = 1 Oct–15 Dec 1998 and 15 Oct–15 Dec 1999–2000.
[b] Includes SANGRE study area.
[c] Includes GILA study area.
[d] Statistical test conducted pooling across parameters that differ by region for illustrative purposes.

Because bears in southern New Mexico enter dens later and emerge earlier than bears in northern New Mexico, statewide bear hunting seasons expose southern populations to hunting mortality for greater periods of time. This factor may, in part, explain the 45% lower estimated density of bears in GILA than SANGRE (Costello et al. 2001). Compared to the north, the reproductive portion of the population in the south has probably been unintentionally but effectively subject to several additional weeks of harvest for decades. Average annual proportion of females in the harvest 1985–2000 was higher in the GILA, Sacramento, Sandia-Manzano, and Zuni regions (0.39–0.51) of central and southern New Mexico than in the San Juan and SANGRE regions (both 0.35) of northern New Mexico. Other factors such as habitat quality or lower reproductive rates on GILA (Costello et al. 2003) may explain or contribute to reported differences in density. However, elasticity analysis (Heppel et al. 2000) suggests that any factor with potential to influence adult female survival warrants careful consideration.

MANAGEMENT IMPLICATIONS

Bear denning chronology may differ within a management authority's jurisdiction (e.g., state), and these differences can have important implications for influencing and monitoring sex ratio of bear harvest. Designating bear management units (hunt unit boundaries, season dates, and data analysis units) with knowledge of denning chronology at multiple locations may be necessary to successfully influence female mortality via hunt season timing. Where bear management units encompass areas with differential denning chronology, interpretation of harvest data can be misleading and could result in unintentional effects on regional populations.

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