State and provincial estimates of American black bear numbers versus assessments of population trend

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Abstract: Wildlife management agencies in US states and Canadian provinces and territories routinely assess population trends of American black bears (*Ursus americanus*) and estimate population size. State or province-wide population estimates are often extrapolated from small, short-term studies or are based on other expert opinions. We compiled black bear population estimates provided by 51 states and provinces for the period 1988–2001. Only 57% of trends ascertained from these serial population estimates (or less, depending on the method for determining trend and what was considered a match) agreed with corresponding agency assessments of trend for the same period. That is, nearly half the management agencies felt that the trend in their bear population was different than indicated by the estimates they produced. Most mismatches were cases where agencies perceived their populations as increasing but their estimates showed no discernible trend. Pooling all population estimates for North America suggested that continent-wide black bear numbers had increased by about 2%/year, but this growth cannot be statistically corroborated because of the subjective nature of the individual estimates (guesstimates). State or province-wide black bear population estimates may aid in managing bear harvests, but for the most part, they are not precise or rigorous enough to provide useful information on population trend.

Key words: American black bear, management, North America, population estimate, population trend, *Ursus americanus*

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Estimation of population size and trend is central to the management of many harvested wildlife species. This is especially important for long-lived, slow-reproducing taxa, which are most susceptible to overharvest. Compared to other Northern American big game species, American black bears (*Ursus americanus*) mature relatively late (generally 4–6 years) and have an extended interval between litters (averaging 2–3 years; Garshelis 1994), so recovery from overharvest may be slow (Miller 1990*a*). Therefore, most agencies managing black bear harvests rely on estimates of bear abundance and trend to guide their harvests.

American black bears range through Canada, the US, and northern Mexico. They are presently harvested as a game species in 12 Canadian provinces or territories (following the split of Northwest Territories and Nunavut) and 28 (or sometimes 29) US states. Garshelis (1991) summarized the methods used by management agencies to assess population size and trend. By the late 1980s, all jurisdictions that harvested bears had some form of population monitoring program; most relied heavily on harvest data (total harvest, kill density, sex ratio, age structure, hunter success). Harvest statistics tend to be a poor indicator of changes in population size (Harris 1986*a*; Miller 1990*a*; Garshelis 1991, 1993). Other population trend indicators included levels of bear nuisance activity, number of bears killed in vehicle collisions, sign or sighting surveys, and questionnaires to hunters and hunting guides.

In the late 1980s, more than half the US and Canadian jurisdictions that harvested black bears had estimated bear numbers from a bear capture and telemetry program on a small study area (Garshelis 1991). Since then, all but a few jurisdictions conducted mark–recapture population studies. Often, results of these studies aided in producing a state or province-wide population estimate through a subjective process of extrapolation. Likely violated assumptions related to population estimation in

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the actual study (Garshelis 1992, Schwarz and Seber 1999, Boulanger et al. 2002, Diefenbach et al. 2004) and lack of rigorous methodology in the extrapolation process weaken the reliability of resulting estimates, and few jurisdictions conducted follow-up studies. Other state and provincial estimates were derived from harvest data, bait-station surveys, or modeling (Williamson 2002). Not all management agencies produce estimates each year, but of those that did in 1999, >90% reported a "reasonable (medium–high) level of comfort with [their] black bear population estimates" (Whittaker and Burns 2001:33).

It would be valid to question whether these state and provincial estimates of black bear numbers were indeed estimates or guesstimates. Differentiating those based on fairly rigorous methodology from those based more on expert opinion would be tedious and also would likely entail subjective judgment. For example, although only 9 jurisdictions used empirical data to estimate black bear numbers in 2001 (H. Hristienko, unpublished data), others likely relied on projections of previous estimates that were based in part on empirical data. For simplicity, we refer to all assessments of bear numbers as estimates, regardless of the basis for their formulation.

Also questionable is how management agencies assess population trend. Trend data may be obtained independent of population estimates using some of the potential indices mentioned above, or may be derived directly from a series of population estimates. Given the process of extrapolating estimates from generally short-term studies on small areas, it seems unlikely that management agencies would have access to a reliable series of state or province-wide population estimates from which to ascertain trend. Nevertheless, such data have commonly been the basis for evaluating population trends in American black bears (Williamson 2002).

Our goal was to evaluate the level of concordance between the series of state and provincial black bear population estimates and corresponding management agency assessments of population trend. Neither parameter is claimed to represent the actual situation. That is, we were not testing whether either the series of population estimates or management agency assessments reflected reality. Instead, data were only adequate to test whether estimates that have been used for management purposes reflected perceived results of management actions. For example, if a management agency striving to grow their bear population estimated bear numbers in year 1, would their estimate after 10 years of perceived population increase be noticeably higher than in year 1? If not, then either the perceived trend was wrong, or the population estimates that formed the basis of that agency's bear management were flawed (or both).

Methods

In 1989, we sent a questionnaire to all US states and Canadian provincial or territorial agencies that managed black bears and asked them to estimate bear population size and assess bear population trend. We conducted another survey by email in 2002 (reflecting 2001 data). Seven similar surveys were conducted during the intervening period (Servheen 1990, Sheeline 1990, McCracken et al. 1995, Burch 1997, Pelton et al. 1999, Whittaker and Burns 2001, Williamson 2002). We compiled results from all surveys along with various reports from states and provinces to generate a series of population assessments and estimates through time (1988–2001). Where agencies reported a range of estimates for any year, we used the midpoint.

Agency assessments of population trend were categorized as follows: increasing, slightly increasing, stable, slightly decreasing, clearly decreasing, or uncertain. Whereas all agencies employed the same categories, these categories were not defined, so personnel within or among agencies may have differentiated them differently. We looked across the series of agency status assessments through time and pooled them into 1 overall trend assessment for the late 1980s to late 1990s. Assessments generally were consistent over this period. However, where categorizations for an individual state or province varied among years, we combined them into a single category (e.g., if a state reported stable bear populations in some years and increasing populations in other years, we categorized their assessment as slightly increasing). If assessments changed dramatically over the years, we classified it as overall uncertain and redefined this category to include populations that were believed to be varying.

We categorized trend in the series of population estimates for each state and province into the same 6 categories. We attempted to establish objective criteria for doing so, based on perceived population growth rates. We calculated population growth rate for each jurisdiction by comparing estimates in the late 1980s with those from the mid–late 1990s; that is, we compared the endpoints in the series of estimates (sometimes using the mean of the first 2 or last 2 points) and calculated the average annual growth rate that would account for the difference. We excluded data from 2001 in this analysis because, as discussed later, many states and provinces seemed to readjust their numbers about

then. A more restrictive time frame also reduced the possibility of the population fluctuating (e.g., due to management actions) rather than exhibiting a consistent trend. We sought to investigate average rates of increase over a specified time, not a pattern of population change; Link and Sauer (1997) defined the former as population trend and the latter as a population trajectory. Finally, as our goal was to compare agency assessments with the trend in their estimates, we felt it was inappropriate to project too far ahead (i.e., to compare assessments in the late 1980s with trend >10 years later).

We tried to match our categorization of trend in population estimates with agency assessments of trend so that any disparity between them would not be due to our categorization process. We initially distinguished increasing populations as those that grew by at least 5%/year, but we had to relax this to 3%/year to better match agency assessments of increasing populations. We used half this rate (1.5%/year) to distinguish slightly increasing populations. Accordingly, those populations that increased or decreased by less than that rate over the 8–10 years were considered stable. The actual data series between the endpoints did not affect calculation of growth rate, and hence categorization of trend, as long as it showed a consistent directional change. Cases in which the series of estimates fluctuated wildly or showed large peaks or troughs, which we defined as both a rise and fall (or vice versa) of at least 20%, were re-categorized as uncertain/varying.

We made a second evaluation of trend by regressing the natural log of the population estimates against years, thus using the entire series of data. We used a log transformation to obtain a linear slope from data that were expected to follow a multiplicative rather than additive function (that is, constant growth rate). Slopes that were significantly different than zero (F-tests, $P < 0.05$), with $\beta \geq 0.03$ and $0.03 > \beta \geq 0.015$ would be commensurate with our definitions of increasing and slightly increasing populations, respectively. We recognize that because the population estimates are not independent from 1 year to the next, statistical tests are biased toward type I errors (inclined to detect a trend when it does not exist). Nevertheless, we present results of this analysis because it is easily repeatable and because this approach is commonly used to evaluate population trends from serial population estimates in many other taxa (Morrison et al. 1994, Meyer et al. 1998, Sydeman and Allen 1999, Holmes and Sherry 2001). Moreover, we do not use the regression for hypothesis testing, but just as a descriptive means of summarizing the whole series of data so it can be compared to our first approach, which considers mainly the endpoints.

We had no means of truly evaluating the statistical significance of the perceived trend in the estimates because they were, for the most part, point estimates without a variance. In reviewing the literature, we found that sampling variation in mark–recapture studies of bears generally result in confidence limits of at least ±25% of point estimates. Thus, for investigative purposes, we compared endpoint estimates within each state and provincial series assuming similar precision, had it been measurable.

We summed population numbers within each survey year to derive estimates for the North American continent (excluding Alaska, which may have 60,000–200,000 black bears, but the range of variability is too large to include, and Mexico, where population estimates do not exist). None of the North American surveys except ours in 2002 estimated a population for all 51 jurisdictions (median = 44, range = 34–48; some surveys involved only hunted populations), so we filled in missing information using estimates from adjacent years, including those obtained from separate state and provincial reports. One of the 9 surveys included only western states and provinces so was not included in the continental tallies.

Results

Thirty-two of 51 agencies (63%) considered their bear population to be increasing or slightly increasing during 1988–99, but only 19 of these 32 (59%) had population estimates that showed either an increasing or slightly increasing trend (Table 1). If a perceived increasing or slightly increasing trend by agency personnel was considered to agree with population estimates that showed some increase over time (≥1.5%/year growth calculated from endpoints, not derived from regression), and perceived stability to agree with a series of relatively unchanging estimates, then among all 51 comparisons, 29 (57%) matched (Table 1). If increasing and slightly increasing categories are considered different, only 23 cases (45%) matched.

More than half the mismatches (13 of 22, using the more lenient definition of a match) were cases where agencies believed their population was increasing but estimates showed no discernible trend. Using the regression approach to categorize trend, 4 more cases of perceived population increase from agency assessments were not supported by the series of estimates. Conversely, we discerned an increasing trend in estimates

Table 1. Population trends of American black bears as assessed by management agencies in US states and Canadian provinces and territories, compared to trends apparent in the series of population estimates that they provided during 1988–1999.

Trend from estimates[a]	Agency assessment[b]						
	I	SI	S	SD	D	U/V	Total
I	10[c]	6[c]	3	0	0	1	20
SI	0[c]	3[c]	1	0	0	1	5
S	3	7	10[c]	2	0	1	23
SD	0	0	0	0[c]	0[c]	0	0
D	0	0	0	0[c]	0[c]	0	0
U/V	2	1	0	0	0	0[c]	3
Total	15	17	14	2	0	3	51
Matches[c]	10	9	10	0	0	0	29
Mismatches	5	8	4	2	0	3	22

[a]Data were compiled and the series of population estimates categorized (using mainly the endpoints in the series) as increasing (I), slightly increasing (SI), stable (S), slightly decreasing (SD), decreasing (D), or uncertain/varying (U/V). Jurisdictions with insufficient data were excluded.

[b]Management agencies categorized black bear population trend in their jurisdiction as in footnote a; we combined the series of yearly assessments into a single assessment for the period. Jurisdictions that did not assess population trend were excluded.

[c]Assessments by management agencies seemed to correspond with the trend gleaned from population estimates (considering increasing and slightly increasing to be a match).

from 4 of 14 populations (29%) that agencies considered stable (Table 1). Two agencies thought their bear population was decreasing (slightly), but no population trend data from any jurisdiction showed a consistent decline.

Of 20 jurisdictions in which endpoints in the series of estimates indicated population growth of $\geq$3%/year, 16 had significant regression slopes for the whole series of estimates, suggesting a statistically discernible trend (λ range = 1.03–1.14). However, had these been mark–recapture estimates with typical 95% CIs spanning at least $\pm$25% of the mean, and if agencies had obtained only 1 estimate for the late 1980s and 1 for late 1990s, CIs would have overlapped, suggesting no difference over this period in 10 cases. In all but 3 cases, CIs of $\pm$25% would not have overlapped for estimates from 1988–89 and 2001.

The increased spread between the late 1980s and 2001 estimates compared to that from the late 1980s versus late 1990s is attributable to both the extended time (enabling populations to grow more) as well as some rather large readjustments in estimates from some jurisdictions. Of 49 jurisdictions having population estimates for both 1997 and 2001, 27 (55%) reported an increase of at least 21% ($\geq$5%/year), and 8 reported an increase

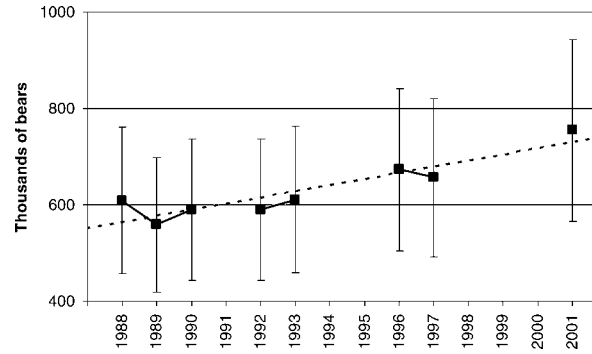

Fig. 1. Population estimates for black bears in North America (excluding Alaska and Mexico), based on summation of estimates from individual US states and Canadian provinces and territories. Actual CIs are unavailable from the data; 95% CIs based on $\pm$25% of the mean are for demonstration purposes only. Trend line is significant ($r^2 = 0.84$, $P = 0.001$).

of >100%. Also in 2001, 20 agencies made appreciable adjustments (25–300%) to their late 1980s population estimates, compared to the numbers they had provided in 1988–89.

The series of population estimates for North America showed an increasing trend ($r^2 = 0.84$, 7 df, $P = 0.001$) of about 2% per year (slope of the regression of ln[numbers] through time). This trend was significant even without the 2001 data point ($r^2 = 0.69$, $P = 0.02$). However, estimates from later years were contained within presumed CIs of $\pm$25% from earlier years. Thus, with fewer points, the trend would not have been significant (Fig. 1). Only the 2001 estimate, which topped 750,000, began to diverge from the presumed CIs of earlier estimates.

Discussion

Comparison of agency assessments of population trend versus the trend surmised from their serial population estimates corresponded less than expected given that data were obtained from the same sources and were likely not independent. In fact, some agencies indicated that they adjusted their population estimates to reflect a perceived trend and some, in hindsight, revised past estimates.

One explanation for mismatches between agency assessments and trend in their estimates is that some agencies may have purposefully erred conservatively when assessing trend to reduce the chance of overharvest (thereby accepting the risks of underharvest). For example, 6 agencies whose population estimates

showed increasing or slightly increasing trends may have nonetheless managed their populations as if they were stable, varying, or uncertain (maintained fixed harvest pressure despite the increasing population estimates). Conversely, some agencies, also being conservative, may have relied on their stable series of estimates rather than a subjectively derived assessment of an increasing population to manage harvest, accounting for as many as 10 apparent mismatches (Table 1). The first situation indicates agencies that do not trust their population estimates, and the latter represents agencies that do not trust their population trend assessments; whether such mistrust stems from a conservative management approach, it nevertheless signifies a disconnect between population estimates and trend assessment.

Our regression analyses might be viewed as supportive of increasing population trends in many individual jurisdictions as well as for the North American continent as a whole. However, the strength of these regressions depends on the number of data points (years). We might envision a situation where an agency had only 2 estimates with broadly overlapping CIs 10 years apart. These would not be statistically different. Filling in a series of guesstimates between the 2 endpoints, however, could create a seemingly significant regression trend. We attempted to avoid this potential problem by using only estimates made at the time of each survey, not estimates generated or revised in hindsight. Nevertheless, few estimates were based on empirical data so they were, in a sense, filled in between occasional reassessments. For this reason, we felt more justified in assessing trend from endpoints, 8–10 years apart, than from a regression of the whole series of estimates. Making the generous assumption that precision of these estimates was equivalent to empirically derived statewide mark–recapture results (Garshelis and Visser 1997, Diefenbach et al. 2004, Garshelis and Noyce 2006), we found that even in cases where population estimates showed a rapid upward trend (averaging $\geq$3%/year), confidence in that trend would not have been assured in most cases until $>$10 years elapsed between the first and last estimate. In reality, few states and provinces could calculate a true CI because estimates were subjectively derived through extrapolation and expert opinion.

This analysis does not condemn provincial or statewide population estimates as useless or unnecessary. Estimates may be functional for adjusting harvests and also for informing the public, who are invariably interested in knowing numbers of animals. Agencies may be able to adequately manage harvests by considering the limits of precision in their estimates and by attempting to err on the side of caution (presuming the population is near the lower confidence limit). Also, as apparent from the large adjustments to many estimates in 2001, agencies can and do periodically re-evaluate and correct their estimates.

Whereas non-rigorous population estimates may serve a management purpose, agencies should reflect on how they are used. Population estimates may become ingrained in agency management and decision-making, with managers and administrators keying on point estimates. Probable low precision may become obscured in the process. It seems worthwhile to ask: What is the basis for the population trend assessment? What is the basis for the population estimates? And are the two linked because they are both driven largely by common opinion, or do they independently show the same trend?

Our results seem to argue for more rigorous estimates of state and provincial population size (Garshelis and Visser 1997, Diefenbach et al. 2004, Garshelis and Noyce 2006). This would be beneficial but may be prohibitive in terms of cost and manpower. Moreover, measurement error and year-to-year variability in population size and composition make interpretation of trends difficult, even from empirically-derived population estimates, because estimates could be obtained, at most, once a year, and typically less often (Harris 1986*b*). Hence, serial population estimates would have limited utility for tracking population trend except over a long term (McLean and Pelton 1994, Amstrup et al. 2001, Diefenbach et al. 2004) or following a substantial change in population size (Miller 1990*b*, Sargeant and Ruff 2001, Garshelis and Noyce 2006).

Agencies must weigh the value of a monitoring program based on estimates of population size against a less rigorous but more cautious adaptive management approach with rules of thumb to tie data collection to management actions (Fraser 1985). Most have opted for the latter, and if their trend assessments are correct, seem to have succeeded in managing for stable or increasing black bear populations (Table 1). Certainly, if populations were steadily declining this would have become apparent from long-term changes in harvest, hunting success, sightings, nuisance activity, and other potential indicators of population change. Agencies responsible for black bear management in North America generally have access to 2 or more decades of such records (Garshelis 1991).

Nevertheless, there seems to be room for improvement in how black bear populations are monitored. In North America much more effort has been directed at

trend monitoring of grizzly bears than black bears. Techniques used to monitor grizzly bears (Boulanger et al. 2002, 2004; Garshelis et al. 2005), although expensive and limited to small study sites, could be incorporated into a carefully designed study of black bears aimed at testing the potential indices of trend that management agencies often use (harvest statistics, nuisance complaints, bait-station surveys). As black bear numbers increase both numerically and geographically, leading to increased conflicts with people, agencies will face different management concerns than when their chief goal was recovery from overexploitation. This new management era may be well served by a modified set of rules of thumb that account for both natural and urbanized black bear populations, and also for changes in public attitudes toward bears and changes in the ways that agencies deal with human–bear conflicts. These factors may lead to more discordance between trends in the number of bears and the number of reported human encounters with bears.

Our results also have implications for management and conservation of other species of bears. American black bears are more abundant than all other species of bears combined (Servheen et al. 1999), have been subjected to the highest rate of government-allocated harvest (that is, purposeful management), and have drawn the attention of more managers and researchers involved in studies and population assessments than any other bear species. Managers and biologists concerned with the conservation of less-studied bears may look at serial population estimates for American black bears with awe and inspiration. Instead, it appears such estimates should be viewed with some skepticism, prompting more investigations into other means of monitoring trend, rather than more population guesstimation. In areas where rigorous population estimation is likely to be a poor use of scarce resources, geographic range expansion or collapse may be a much more practical and telling indicator of population trend and may yield insights into appropriate management responses (McShea et al. 1999, Pyare et al. 2004, Scott-Morales et al. 2004).

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Literature cited

AMSTRUP, S.C., T.L. MCDONALD, AND I. STIRLING. 2001. Polar bears in the Beaufort Sea: a 30-year mark–recapture case history. Journal of Agricultural, Biological, and Environmental Statistics 6:221–234.

BOULANGER, J., G.C. WHITE, B.N. MCLELLAN, J. WOODS, M. PROCTOR, AND S. HIMMER. 2002. A meta-analysis of grizzly bear DNA mark–recapture projects in British Columbia, Canada. Ursus 13:137–152.

———, S. HIMMER, AND C. SWAN. 2004. Monitoring of grizzly bear population trends and demography using DNA mark–recapture methods in the Owikeno Lake area of British Columbia. Canadian Journal of Zoology 82:1267–1277.

BURCH, R.A. 1997. 1997 North American black bear report. Columbia, South Carolina, USA. (data available at: http://www.bear.org/Black/Black_Bear_Populations.html, accessed February 1, 2005).

DIEFENBACH, D.R., J.L. LAAKE, AND G.L. ALT. 2004. Spatio-temporal and demographic variation in the harvest of black bears: implications for population estimation. Journal of Wildlife Management 68:947–959.

FRASER, D. 1985. Piggery perspectives on wildlife management and research. Wildlife Society Bulletin 13:183–187.

GARSHELIS, D.L. 1991. Monitoring effects of harvest on black bear populations in North America: a review and evaluation of techniques. Eastern Workshop on Black Bear Research and Management 10:120–144.

———. 1992. Mark–recapture density estimation for animals with large home ranges. Pages 1098–1111 *in* D.R. McCullough and R.H. Barrett, editors. Wildlife 2001: Populations. Elsevier Applied Science, London, UK.

———. 1993. Monitoring black bear populations: pitfalls and recommendations. Western Black Bear Workshop 4: 123–144.

———. 1994. Density-dependent population regulation of black bears. Pages 3–14 *in* M. Taylor, editor. Density-dependent population regulation in black, brown, and polar bears. International Conference on Bear Research and Management Monograph 3.

———, AND L.G. VISSER. 1997. Enumerating megapopulations of wild bears with an ingested biomarker. Journal of Wildlife Management 61:466–480.

———, M.L. GIBEAU, AND S. HERRERO. 2005. Grizzly bear demographics in and around Banff National Park and Kananaskis Country, Alberta. Journal of Wildlife Management 69:277–297.

———, AND K.V. NOYCE. 2006. Discerning biases in a large scale mark–recapture population estimate for black bears. Journal of Wildlife Management 70:in press.

HARRIS, R.B. 1986*a*. Grizzly bear population monitoring: current options and considerations. Montana Forest and Conservation Experiment Station, University of Montana, Missoula. Miscellaneous Publication 45.

———. 1986*b*. Reliability of trend lines obtained from variable counts. Journal of Wildlife Management 50:165–171.

HOLMES, R.T., AND T.W. SHERRY. 2001. Thirty-year bird population trends in an unfragmented temperate deciduous forest: importance of habitat change. Auk 118:589–609.

LINK, W.A., AND J.R. SAUER. 1997. New approaches to the analysis of population trends in land birds: comment. Ecology 78:2632–2634.

MCCRACKEN, C., D.A. ROSE, AND K.A. JOHNSON. 1995. Status, management, and commercialization of the American black bear (*Ursus americanus*). TRAFFIC USA, World Wildlife Fund, Washington, DC, USA.

MCLEAN, P.K., AND M.R. PELTON. 1994. Estimates of population density and growth of black bears in the Smoky Mountains. International Conference on Bear Research and Management 9(1):253–261.

MCSHEA, W.J., P. LEIMGRUBER, M. AUNG, S.L. MONFORT, AND C. WEMMER. 1999. Range collapse of a tropical cervid (*Cervus eldi*) and the extent of remaining habitat in central Myanmar. Animal Conservation 2:173–183.

MEYER, A.H., B.R. SCHMIDT, AND K. GROSSENBACHER. 1998. Analysis of three amphibian populations with quarter-century long time-series. Proceedings of the Royal Society of London, Series B 265:523–528.

MILLER, S.D. 1990*a*. Population management of bears in North America. International Conference on Bear Research and Management 8:357–373.

———. 1990*b*. Detection of differences in brown bear density and population composition caused by hunting. International Conference on Bear Research and Management 8: 393–404.

MORRISON, R.I.G., C. DOWNES, AND B. COLLINS. 1994. Population trends of shorebirds on fall migration in eastern Canada 1974–1991. Wilson Bulletin 106:431–447.

PELTON, M.R., A.B. COLEY, T.H. EASON, D.L. DOAN MARTINEZ, J.A. PEDERSON, F.T. VAN MANEN, AND K.M. WEAVER. 1999. American black bear conservation action plan. Pages 144–156 *in* C. Servheen, S. Herrero, and B. Peyton, compilers. Bears. Status survey and conservation action plan. IUCN/SSC bear and polar bear specialist groups. IUCN, Gland, Switzerland and Cambridge, UK.

PYARE, S., S. CAIN, D. MOOTY, C. SCHWARTZ, AND J. BERGER. 2004. Carnivore re-colonization: reality, possibility and a non-equilibrium century for grizzly bears in the southern Yellowstone ecosystem. Animal Conservation 7:71–77.

SARGEANT, G.A., AND R.L. RUFF. 2001. Demographic response of black bears at Cold Lake, Alberta, to the removal of adult males. Ursus 12:59–68.

SCHWARZ, C.J., AND G.A.F. SEBER. 1999. Estimating animal abundance: review III. Statistical Science 14:427–456.

SCOTT-MORALES, L., E. ESTRADA, F. CHÁVEZ-RAMÍREZ, AND M. COTERA. 2004. Continued decline in geographic distribution of the Mexican prairie dog (*Cynomys mexicanus*). Journal of Mammalogy 85:1095–1101.

SERVHEEN, C. 1990. The status and conservation of the bears of the world. International Conference on Bear Research and Management Monograph 2.

———, S. HERRERO, AND B. PEYTON, COMPILERS. 1999. Bears. Status survey and conservation action plan. IUCN/SSC bear and polar bear specialist groups. IUCN, Gland, Switzerland and Cambridge, UK.

SHEELINE, L. 1990. The North American black bear (*Ursus americanus*): a survey of management policies and population status in the U.S. and Canada. TRAFFIC USA, World Wildlife Fund, Washington, DC, USA.

SYDEMAN, W.J., AND S.G. ALLEN. 1999. Pinniped population dynamics in central California: correlations with sea surface temperature and upwelling indices. Marine Mammal Science 15:446–461.

WHITTAKER, D.G., AND A.G. BURNS. 2001. Black bear status in western North America: summary of western state and province bear status report surveys. Western Black Bear Workshop 7:32–55.

WILLIAMSON, D.F. 2002. In the black. Status, management, and trade of the American black bear (*Ursus americanus*) in North America. TRAFFIC North America, World Wildlife Fund, Washington, DC, USA.

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