

Distribution of grizzly bears in the Greater Yellowstone Ecosystem in 2004

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Abstract: The US Fish and Wildlife Service (USFWS) proposed delisting the Yellowstone grizzly bear (*Ursus arctos horribilis*) in November 2005. Part of that process required knowledge of the most current distribution of the species. Here, we update an earlier estimate of occupied range (1990–2000) with data through 2004. We used kernel estimators to develop distribution maps of occupied habitats based on initial sightings of unduplicated females ($n = 481$) with cubs of the year, locations of radiomarked bears ($n = 170$), and spatially unique locations of conflicts, confrontations, and mortalities ($n = 1,075$). Although each data set was constrained by potential sampling bias, together they provided insight into areas in the Greater Yellowstone Ecosystem (GYE) currently occupied by grizzly bears. The current distribution of 37,258 km² (1990–2004) extends beyond the distribution map generated with data from 1990–2000 (34,416 km²). Range expansion is particularly evident in parts of the Caribou–Targhee National Forest in Idaho and north of Spanish Peaks on the Gallatin National Forest in Montana.

Key words: distribution, grizzly bear, kernel density, range analysis, *Ursus arctos*, Yellowstone ecosystem

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We recently updated the distribution map (Schwartz et al. 2002) of the grizzly bear (*Ursus arctos horribilis*) in the Greater Yellowstone Ecosystem. However, the USFWS released a rule in November 2005 (70 Federal Register 69654, 50 Code of Federal Regulations Part 17) to remove the grizzly bear from protection under the Endangered Species Act (16 US Code 1531–1544) because recovery criteria (USFWS 1982, 1993) have been met in the GYE.

Understanding the current distribution of bears within the GYE is a required part of the delisting process, but is also useful to the US Forest Service and their efforts to address habitat needs for the grizzly bear under their new Forest Management Plans (US Department of Agriculture Forest Service 2004). Here, we present range distribution maps for the grizzly bear in the GYE updated through 2004. We compare our results with a previously published distribution map, and discuss data biases and problems implicit to the analysis.

Study area and methods

The study area encompassed the GYE, which included Yellowstone and Grand Teton National Parks and adjacent federal, state, and private lands in Montana, Wyoming, and Idaho. A detailed description was provided by Schwartz et al. (2002).

We followed the protocol presented by Schwartz et al. (2002). Data sources included: (1) initial observations of unduplicated females with cubs of the year, (2) relocations of radiocollared bears, and (3) locations of conflicts and confrontations between grizzly bears and humans, and locations of documented grizzly bear mortalities (hereafter referred to as conflicts). For this analysis, unlike that of Schwartz et al. (2002), we also included data from 34 bears fitted with GPS (global positioning system) telemetry collars. To ensure adequate sample size as discussed below and to avoid issues of autocorrelation, we constructed individual ranges with ≤ 1 fix/day using the first daily fix obtained. Because fixed kernel ranges tend to become asymptotically smaller with increasing sample size up to about 30–40 fixes (Arthur and Schwartz 1999), including these GPS ranges did not unduly weight the distribution toward

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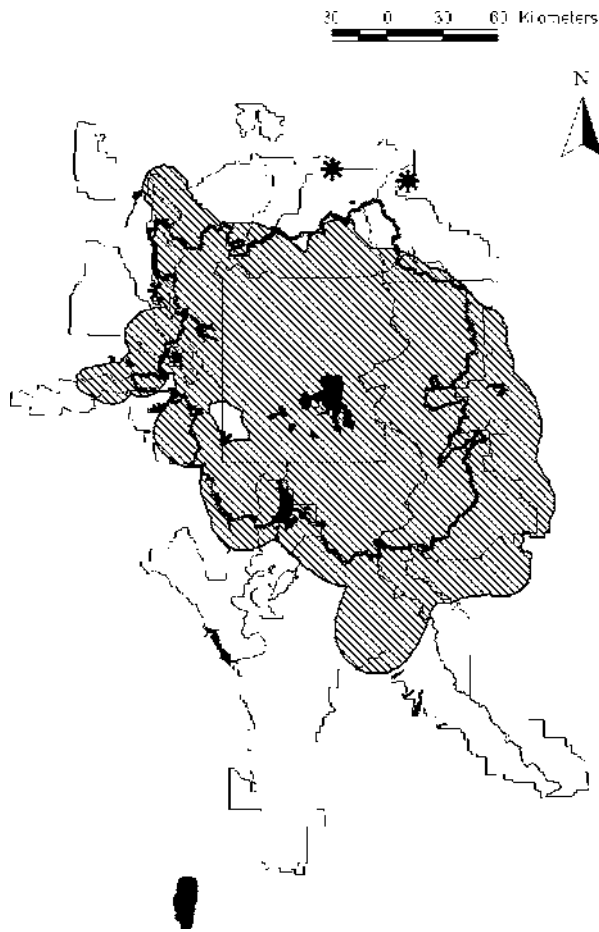


Fig. 1. Grizzly bear distribution in the Greater Yellowstone Ecosystem, 1990–2004. The fine black line defines public lands in the ecosystem; the heavier line depicts the US Fish and Wildlife Service grizzly bear Recovery Zone. The 2 asterisks represent unique sightings of females with cubs, suggesting occupancy by resident females in the area.

these individuals. GPS ranges were then compiled with individual ranges for bears fitted with conventional VHF (very high frequency) collars. We calculated the 95% utilization distribution using the fixed kernel estimator with least squares cross validation (LSCV) as the smoothing parameter, with a sample size ≥ 30 . We used the software package Animal Movement (Hooge and Eichenlaub 1997), which is available as an ArcView® GIS (geographic information system) program extension (http://www.absc.usgs.gov/gistools/animal_mvmt.htm). The LSCV follows Silverman (1986). Following methods of Schwartz et al. (2002), we merged the female with cubs, conflict and mortality, and composite individual telemetry home range polygons into a single polygon and

Table 1. Area and percent of total occupied by grizzly bears in the Greater Yellowstone Ecosystem by jurisdiction, 1990–2004.

Jurisdiction	Area (km ²)	Percent of total
Idaho	2,697	7.2
Montana	6,528	17.5
Wyoming	18,351	49.3
National Park system	9,683	26.0
Total	37,258	100.0

considered the outer perimeter the extent of the current distribution. We consider this polygon to represent a reasonable approximation of habitat occupied by the grizzly bear in the GYE. We compare this polygon to the previous one constructed using data from 1990–2000 (Schwartz et al. 2002).

A distribution map reflects where a species occurs on the landscape but does not necessarily reflect density across that distribution. To better understand how bear density might vary across the area, we used spatial distributions of unique sightings of females with cubs from 1990–2004 and determined the proportion within the Recovery Zone (RZ) or outside of it (USFWS 1993). We also looked at the proportion of telemetry locations inside and outside the RZ for radiocollared bears from 1990–2004. Because the number of locations varied among individuals, we calculated the mean number of locations inside the RZ for each individual. These means were averaged to estimate the proportion of time this sample of individual bears from the population spent inside and outside the RZ.

Results

The fixed kernel ranges constructed from observations of unduplicated female with cubs ($n = 481$), radiotelemetry relocations ($n = 170$ home ranges), and spatially unique conflict locations ($n = 1,075$), when merged into a single shape, encompassed 37,258 km² (Fig. 1, Table 1), with 22,889 km² (61.4%) inside the RZ.

From 1990–2004, we recorded 481 initial sightings of females with cubs of the year. Of these sightings, 90.4% ($n = 435$) were inside the RZ, whereas only 9.6% ($n = 46$) were outside the RZ boundary. We also looked at telemetry locations for collared bears and determined the proportion that each spent inside or outside the RZ. From 1990–2004, we monitored 306 unique bears (117 females, 189 males) and obtained 9,090 telemetry locations. We calculated the proportion of time each bear's locations were inside or outside the RZ. On average, these 306 bears were located 83.5% (SE = 29.9%) of the time inside the RZ and 16.5% outside the RZ.

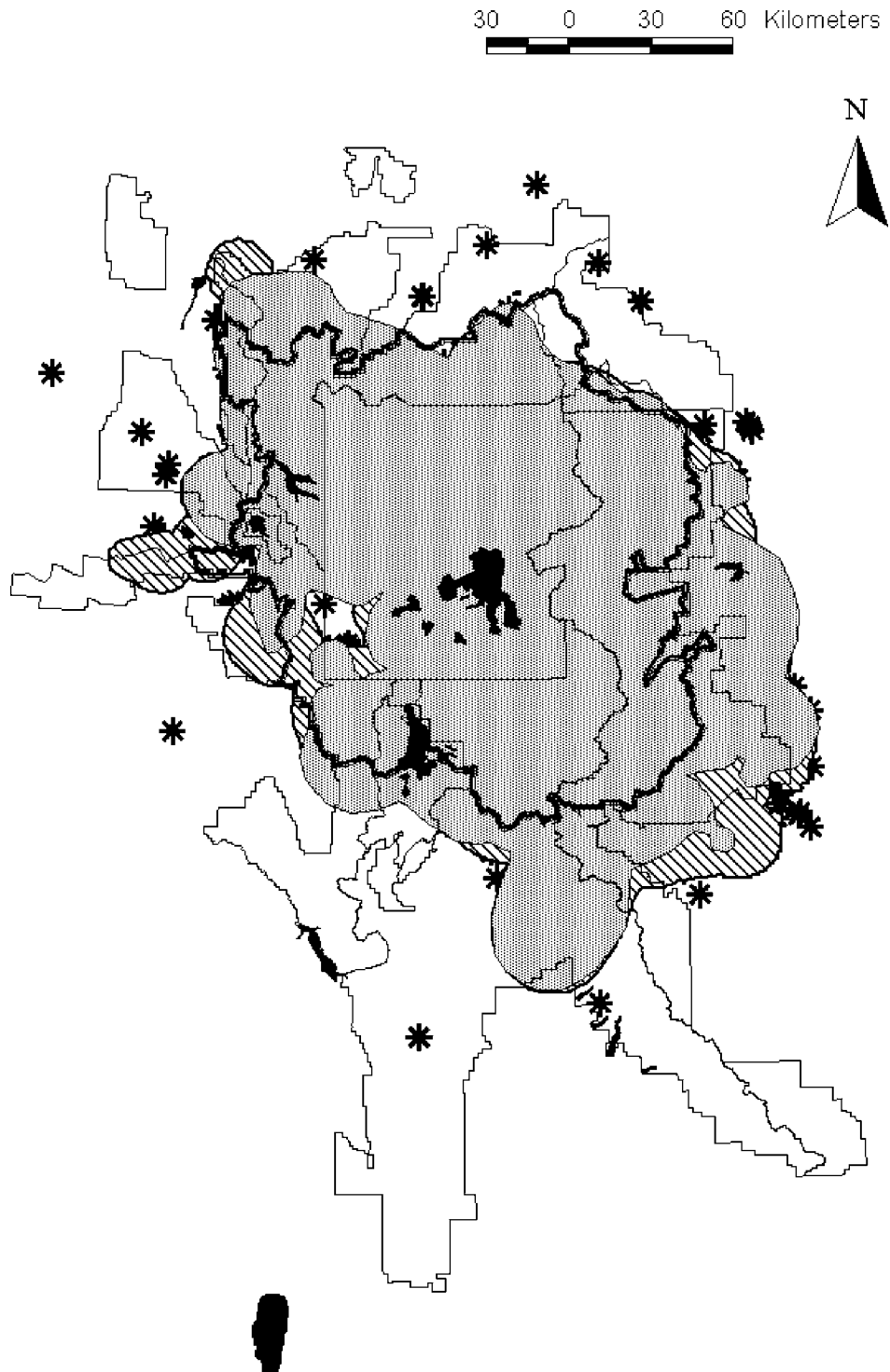


Fig. 2. Distribution of grizzly bears in the Greater Yellowstone Ecosystem as determined by Schwartz et al. (2002) (solid gray) overlaid onto the current distribution (1990–2004, diagonal lines). Asterisks represent conflicts, telemetry locations, and sightings of unduplicated females with cubs not contained within the 95% fixed kernel ranges.

Discussion

The distribution map presented here, which encompassed 37,258 km², is an update from the one created in 2000 (34,416 km²) and represents an increase in occupied habitat of 2,842 km². The new distribution map is slightly larger in area (Fig. 2) and indicates an increase of known occupied habitat. Our understanding of the current distribution of grizzly bears in the GYE is a product of known bear distribution, trapping and collaring efforts, especially on the periphery of occupied habitat, and locations of conflicts and mortalities. The increase in distribution likely reflects bears continuing to expand into suitable but unoccupied habitats on the edge of the current distribution. We considered this composite polygon a reasonable reflection of habitat occupied by grizzly bears in the GYE. However, because of the methods we employed, we cannot rule out occupancy beyond the perimeter, especially in areas where we have limited information or have not conducted trapping activities.

The increased distribution we witnessed during 2002–2004 principally occurred west onto the Caribou–Targhee National Forest both in the Centennial Mountains and the Pitchstone Plateau south and east of Island Park Reservoir. Occupied habitat also expanded north on the Gallatin National Forest in the Spanish Peaks area and south in Wyoming near Dubois. Most of the expansion was attributed to radiocollared bears and addition of home ranges to that distribution. These increases likely reflect increased sampling. Schwartz *et al.* (2002) recommended that additional sampling was needed in: (1) the Gravelly Mountain Range, (2) northern portions of the Gallatin National Forest, particularly on the Boulder Plateau, (3) that portion of Custer National Forest contained within the GYE, and (4) portions of the Targhee National Forest on the Pitchstone Plateau and the Centennial Mountains.

The Interagency Grizzly Bear Study Team (IGBST) attempted to mark grizzly bears in the Gravelly Mountains in 2002–2004. We baited, camera-trapped, and barrel-trapped with limited success. We have verified photos and tracks of grizzly bears in this range but were unable to capture and collar any bears. Our efforts were more successful on the Caribou–Targhee National Forest. We marked 2 individuals with GPS collars and verified habitat use beyond the 2000 distribution. We likewise collared a bear on the northern Gallatin National Forest that eventually moved into the Spanish Peaks area, expanding the known distribution in that area. Although our map does not indicate occupancy on the northern portions of the Gallatin and Custer National Forest east of Livingston, Montana, we documented 2 unique sightings of females with cubs in

this area (Fig. 1). These are mature resident females that more than likely occupy this portion of the ecosystem. However, because of the nature of the fixed kernel estimator, and because we chose a 95% isopleth, they were not included in the current distribution map.

Our distribution map is a reflection of area occupied by grizzly bears in the GYE as of 2004. It is not a reflection of bear density within this area. Although 38.6% of occupied habitat in the GYE exists outside the RZ, our analysis suggests only 10–16% of the bears currently utilize this area.

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