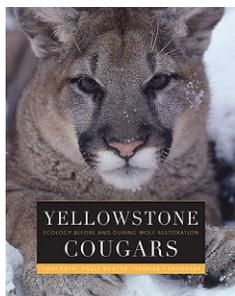


## Yellowstone Cougars: Ecology Before and During Wolf Restoration

By Toni K. Ruth, Polly C. Buotte, and Maurice G. Hornocker. 2019. University Press of Colorado. 336 pages, 65.00 USD, Cloth, 53.00 USD, E-book.

*Yellowstone Cougars* is an academic-style book written primarily for biologists and wildlife managers. It contains a treasure trove of data on Cougar (*Puma concolor*) and is the first book written on an apex carnivore to examine their ecology before and after the recovery of another keystone predator—in this case, Gray Wolf (*Canis lupus*). Given its scientific focus, the reading is very dense and time consuming with an impressive amount of data within its 300+ pages. The 8.25 × 10.25 inch (20.8 × 26.1 cm) hardcover contains small font and double columns per page so the book really felt like over 500 pages! Each chapter took me a couple hours to read given the length along with the technical information on each page. However, everything you want to know about Cougars in the world's first national park is told here. This book and *Cougar: Ecology and Conservation* (2010, University of Chicago Press) are now the two reference books for this animal to which other works will be compared.



Ruth and her colleagues conducted a 14-year study—seven years before wolves returned to Yellowstone National Park (1987–1994) and seven years (1998–2005) covering the tail end of wolf reintroduction to the beginning of a recovered population. The book is broken into five main sections, the first consisting of three introductory chapters discussing their methods and the study area, followed by three middle sections on Cougar diet and their competition with wolves (five chapters), landscape use (four chapters), and Cougar population characteristics pre- and post-wolf recovery (four chapters), and the final section contains two synthesis chapters on carnivores and humans. Each of the three middle sections has an introductory chapter which frames where the next three to four chapters will take us. Each chapter ends with a convenient summary of the most pertinent information from that section, making it easier to digest the scientific information presented in that chapter—I often read those sections first before starting each chapter, then re-read it after I finished a given chapter.

The authors spent an amazing amount of time in the field, marking 87–94% of the adult Cougars annually with 80 total Cougars radio-collared and ear-tagged (including all age classes) during pre-wolf studies and 88–93% post-wolf adult Cougars collared

annually with 83 total tagged post-wolf (pp. 28, 69). Cougars were treed by hounds and then darted by biologists to sedate them. They were then followed so their movements and predation patterns could be recorded, with 40–50 kills found annually (p. 34). The researchers collected about 12 000 VHF (very high frequency) radio locations and over 19 500 GPS (global positioning system) points on these animals over 14 years. Their study area consisted mainly of the Northern Range of Yellowstone because Cougars only seasonally lived in the remaining 75–80% of the park due to deep snow and ungulates leaving those areas in winter, except for Bison (*Bison bison*) which they did not prey on (p. 58).

We learned that Cougars were at the bottom of the large carnivore hierarchy, with wolves and Grizzly Bears (*Ursus arctos*) dominating them (pp. 93, 116), wolves most commonly, though rarely, killing them and bears most frequently usurping their kills (p. 244). Elk (*Cervus canadensis*) were the staple prey for Cougars and wolves throughout both study periods, with Mule Deer (*Odocoileus hemionus*) second for Cougars (p. 50). Calf Elk were the most important prey class throughout the study for Cougars (p. 52). This remained the case even when Elk decreased at the end of the study owing to recovery of carnivore populations, including bears, causing the system to change from bottom-up regulation of Elk before wolves to top-down post-wolf (p. 117). In general, wolves were superior at exploiting Elk adults and Cougars at exploiting Elk calves. Given their high niche overlap (82%, pp. 243–244), the sympatric carnivores were unwittingly engaged in exploitation competition for a common food source (pp. 119, 244).

Cougars survived by avoiding competitors, mainly wolves, by living in more forested and rougher terrain (p. 62), which contained a lower density of prey (p. 66). When prey Cougars killed was not taken over by competitors, Cougars often spent two to five days at a carcass before moving on to travel and eventually kill again, usually three to four days after leaving their previous food cache (pp. 71–73). The authors believed that Cougars benefited from using areas of lower densities of prey as this reduced potentially fatal encounters with wolves (pp. 179, 240, 242). Even so, wolves killed at least three adult Cougars and five kittens during the study (pp. 180, 208, 212).

Interestingly, Cougar home ranges and core areas were more stable after wolf restoration compared to before (pp. 134–136). While Cougars used less area (females 10–46% and males 43–65%) on the landscape

when wolves were back, they overlapped with more conspecifics sharing non-defended areas (i.e., females and philopatric daughters; pp. 137–138). In avoiding open and flat areas when wolves were back on the landscape, the authors repeatedly stressed the importance of forested and rough terrain for Cougars (e.g., pp. 159, 176, 181, 235). The heterogenous habitats of northern Yellowstone likely makes carnivore coexistence possible as each species used different areas (pp. 181, 242).

Some unexpected findings of the study were, despite wolves engaging in exploitation (eating similar prey) and interference (direct killing) competition with Cougars, the cats had similar litter sizes (averaging 2.9 cubs) throughout the study (p. 216) and kitten survival actually increased post-wolf (pp. 216, 202, 205) with less infanticide by adult male Cougars (p. 212). Because territories were more stable post-wolf, kittens actually stayed with their mothers for five months longer (12–14 versus 17–19 months) than before wolves came back (pp. 204, 220, 240), and living in small groups of adult-sized Cougars likely offered enhanced protection, intimidation, and vigilance from other predators (p. 230). In addition, the Cougar population increased post-wolf with about 30–40 total Cougars living in northern Yellowstone despite using a smaller percentage of overall habitat in the park (pp. 226, 230). Part of this can be explained by Cougars recolonizing the area in the 1980s (p. 21) and then becoming saturated on the landscape as wolves came back. Densities of Cougars of two adults and 3.9 total per 100 km<sup>2</sup> in the study area were actually on the high end compared to other Cougar populations (p. 225). With this fully occupied area, females—with no room to stay near their mothers—averaged the same dispersal distance as young males (70 km; p. 221) and females moved more home range diameters away than did males (pp. 224, 254). Similarly, while 35% of females before wolves were philopatric only 11% were so post-wolf (p. 220). These young dispersers contributed to Yellowstone being a source population to nearby areas (pp. 255–256). Source populations are helping Cougars recover and colonize long vacant areas like the midwestern and even eastern United States (Way 2017: 249).

*Yellowstone Cougars* is comparable to the incredibly detailed and well-researched books *Desert Puma* (2001, Island Press) and *Mountain Lions of the Black Hills* (2018, Johns Hopkins University Press; Way 2018) in that it does a superb job of describing an in-depth long-term study on Cougars in a specific region. *Yellowstone Cougars* includes: 10 pages of Appendices explaining their study variables; 10 pages of “Notes” which are detailed statistics described in the chapters but shown at the end of the book to avoid too much detail in each section; an impressive 30

pages of double-columned references; and a seven-page index. It takes six pages at the beginning of the book to list the titles of the illustrations, including 118 figures and 60 tables. Many of those figures are black and white pictures of wild Cougars from the study, impressive because Cougars are notoriously difficult to photograph. My only complaint was that there was no map displaying dispersal distances from the source population when the authors discussed emigration (pp. 219, 221). Also, I did notice a few errors on some of the figures, including wrong labels in the charts (e.g., Figure 11.1 on p. 155, Figure 11.14 on p. 173, Figure 15.4 on p. 207, and Figure 16.4 on p. 230).

The reading material is labourious to go through thoroughly but is vital to understanding Cougar ecology in Yellowstone. I found Part 5, *Carnivores and Humans: Competition and Coexistence*, to be particularly important because it provided a synthesis of the book and offered management and conservation recommendations for the big cats. I was a little disappointed with the last chapter (18) in that it described management and conservation of Cougars but did not actually offer any concrete management options for state agencies. For instance, their data (see Figure 18.1, p. 253) showed that many female Cougars killed by hunters left orphaned offspring that died via starvation (p. 250). The authors do suggest management regimes where non-parklands also include areas closed to hunting to mimic natural populations (p. 250). These areas can be managed adaptively through rest rotation, whereby periods of hunting alternate with periods of rest (p. 248). However, without any specific suggestions of where these could occur, my experience with carnivore management suggests that even with involving citizens in a bottom-up approach (p. 258) it is difficult to envision state wildlife agencies doing anything other than continuing with killing the maximum sustainable amount of a species—even an ecologically important predator.

For enthusiasts of Yellowstone or carnivores, this is an important book. Unfortunately, and like many academic-style texts, *Yellowstone Cougars* is expensive. However, the book is truly a benchmark in detailing the life history of an elusive and difficult to study species.

### Literature Cited

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