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## BOOK REVIEW

### **And then there were none: the demise of desert bighorn sheep in the Pusch Ridge Wilderness**

Paul R. Krausman. 2017. University of New Mexico Press, Albuquerque, USA. 229 pages (hard cover). \$65.00. ISBN 978-0-8263-5785-4

*“... wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use.”*

— 88th Congress (Second Session), 1964  
*The Wilderness Act*

*“We can wring our hands and do nothing about the destructive policies that harm the wild big-game populations of the world, or we can figure out how to modify or work around benighted government policies ...”*

— Ronald S. Gabriel, 2013  
*A Sheep Hunter’s Diary*

*“Society’s role in wildlife management and conservation is critical. It needs to be taken seriously; without such support, all other efforts by humans on wildlife’s behalf will be of marginal value.”*

— Paul R. Krausman, 2017  
*And Then There Were None...*

*“This is no time for refusing to look facts in the face.”*

— Agatha Christie, 1939  
*And Then There Were None*

Paul Krausman and his students have spent more than 40 years studying the population of desert bighorn sheep (*Ovis canadensis*) inhabiting the Santa Catalina Mountains, and specifically the Pusch Ridge Wilderness, in southern Arizona, USA. Paul is an authority on southwestern wildlife in general and on the ecology of desert bighorn sheep in particular. In this book, Krausman has compiled much of the history of the Catalina Mountains and the Pusch Ridge Wilderness—an area of ~230 km<sup>2</sup> established in 1978—located

adjacent to and just north of the metropolis of Tucson. In the introduction, Paul details the early habitation by the Hohokam Indians, who disappeared from the area more than 500 years ago; early exploration of the area by expeditions led by Padre Kino; establishment of a game preserve in 1934; and a brief history of what is known about the numbers of bighorn sheep occupying the Santa Catalina Mountains.

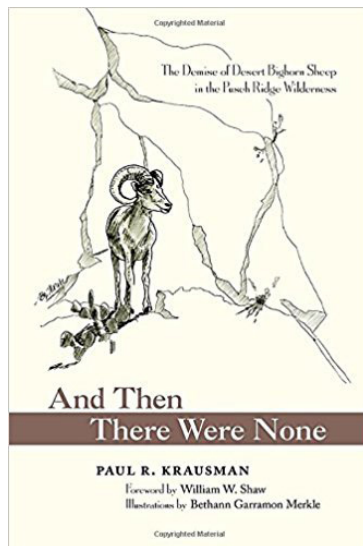
Chapter 1 is dedicated to describing the Santa Catalina Mountains study area, and how land developers and others used the proximity of the Pusch Ridge wilderness as a marketing tool. Also included is a history of the Catalina State Park, and its transition to ownership by the U.S. Forest Service.

Chapter 2 consists mostly of a description of the life history characteristics and taxonomy of desert bighorn sheep, and is based largely on a review paper published earlier by Krausman and Bowyer (2003).

A detailed description of the study area is included, but the basic material in this chapter is somewhat dated. Although useful to those not familiar with the biology of bighorn sheep, it would have been more complete if a greater amount of more current literature was referenced. Much of the material included in this chapter is based on results of research conducted by Krausman's students at the University of Arizona.

Krausman provides the details of what is known about the population of bighorn sheep inhabiting the Santa Catalina Mountains in Chapter 3. Therein he details the historical literature on the subject, observations reported by individuals as documentation that bighorn sheep persisted in the area, and population estimates based on records of USFS personnel from 1925 to 1954 and those based on ground and aerial surveys by Arizona Game and Fish Department personnel from 1955 to 1997, the year when the last official survey was conducted. There may have been a "sheep or two" remaining in the area and unconfirmed sightings continued until 2010, but the population was, by 1997, no longer viable.

"Human Intervention and Management" is the title of chapter 4, and in it Paul discusses the potential for "Urbanization, recreation, fire suppression, hunting, water shortages, predation, other ungulates, and disease..." as potential contributors to the demise of bighorn sheep in the Pusch Ridge Wilderness. Each of these factors are plausible explanations of the extirpation of those unique ungulates from an area in which they formerly occurred, and my friend and colleague dwells at length on urbanization, unbridled recreation (i.e., disturbance), and habitat fragmentation as primary factors in the extirpation of bighorn sheep from that federally protected area. He concludes that fire suppression was instrumental in eliminating bighorn habitat and, hence, played an important role in the demise of those native ruminants. Additionally, Paul provides a detailed description of bighorn sheep harvested from the Catalina Mountains, and states that, "It is possible... that along with urbanization and fire suppression, the hunting of bighorn sheep contributed to their demise... because of their small population size." Although unlikely and speculative, that possibility cannot be completely ignored. He goes on to dismiss an absence of water



as an explanation, and concludes that abundance of forage was a problem because, "...it hinders visibility, more than because it is of low quality or in limited quantity." In summary, he concludes that there is no evidence that predation, limited water, disease, or the presence of other ungulates were factors contributing to the extirpation of bighorn sheep from the Pusch Ridge Wilderness. Instead, encroachment of Tucson and surrounding urban areas have not had positive influences on the population of bighorn sheep despite "protection" afforded by designation as wilderness. In the penultimate sentence of chapter 4, he concludes that there are "numerous, cumulative influences" that challenged the viability of bighorn sheep on Pusch Ridge.

In Chapter 5, Krausman describes in some detail the ongoing effort — now several years into implementation — to restore bighorn sheep to the Santa Catalina Mountains and the Pusch Ridge Wilderness, and the importance of public support for that and similar efforts. He provides a somewhat detailed review of translocation successes and failures, credits many non-governmental organizations for their advocacy and financial support of bighorn sheep conservation, and concludes that current efforts are now more efficient and effective than in the past. He then continues with a list of "Keys to Successful Translocations." Based on my experience overseeing dozens of capture or translocation projects over a period of >30 years, that section is a must read for all managers addressing the restoration of bighorn sheep to historically occupied range. Paul also goes on to emphasize that, "Wilderness areas and national parks are places where anthropogenic influences are minimal, but the wildlife in those places still has to be managed."

Krausman's research on bighorn sheep in the southwestern United States is nearly legendary in scope. This is especially true with respect to the contributions that he and his many students have made on behalf of understanding the decline and eventual extirpation of bighorn sheep from the Pusch Ridge Wilderness. From that perspective, this is a work that every wilderness advocate and political operative, as well as politicians themselves, must read. Indeed, the road to Hell is filled with good intentions and, in this case, bighorn sheep were the losers despite good intentions. Protecting an island of bighorn sheep habitat that advocates thought would ensure natural processes occur in perpetuity clearly was not an adequate strategy in the absence of active management on behalf of that iconic species.

Krausman concludes the book with several appendices, one of which is comprised of Section 1 and Section 2(a), (b), and (c) of the Wilderness Act; it is noteworthy that Section (c) emphasizes that wilderness areas must be of sufficient size as to make practicable its preservation and use in an unimpaired condition, and that such areas "may also contain *ecological* [emphasis added], geological, or other features of scientific, educational, scenic, or historical value" (US Congress 1964). Clearly, designation of the Pusch Ridge Wilderness was a futile effort to preserve the ecological integrity of that area, in large part because most such areas have been established with little, if any, ecological forethought and its implications for wildlife conservation (Bleich 2014, 2016).

Two additional appendices are included. Appendix 2 addresses the agreement between the University of Arizona and a corporate land developer that resulted in funding for the research conducted by Krausman and his students. The third includes a summary of important components of an adaptive mountain lion management plan that was a precursor to the ongoing efforts to reestablish bighorn sheep in the Pusch Ridge Wilderness. That plan was a critically important component of the restoration effort and was supported by

stakeholders despite the many differing opinions regarding the management and conservation of Puma concolor.

This book is not the best-edited piece that Paul has produced in his career, but part of that shortcoming might lie with the copy editors. There are numerous misspellings and minor editorial inconsistencies, particularly early in the book (e.g., areas are referred to as refugium, not refugia; gallapova, not gallipavo, for the specific epithet of the wild turkey; infraorbital foramen instead of infraorbital foramen; the use of a singular reference [that] to refer to a plural term [anatomy and physiology]; wildlife mammals instead of wild mammals; the occasional misspelling of names (Akeson instead of Akenson); and mistaken dates of publication [Jones 1959 instead of Jones 1949], etc. My intent is not to diminish the value of Krausman's contribution but, rather, to encourage refinement if there is a second edition. Additionally, the book likely would be more useful to individuals not familiar with the ecology of bighorn sheep if the literature had been updated a bit and was more current.

Despite these minor flaws, Paul Krausman has produced a volume providing a history of what is known about the demise of bighorn sheep in a federally protected wilderness area, an extirpation that occurred despite the good intentions of that designation. Moreover, he provides the reader with suggestions regarding the importance of intervening on behalf of wildlife conservation to maintain the ecological integrity of such areas. I can only hope that the well-planned and widely supported efforts to restore bighorn sheep in the Santa Catalina Mountains will be successful. If that is the case it will be, at least in part, a result of the efforts of Krausman and his students over the past four decades.

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