



Reviews of Science for  
Science Librarians:  
A Bibliographic  
Examination of Grizzly  
Bear (*Ursus arctos*  
*horribilis*) Science

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## Abstract

Grizzly bears inhabit wilderness areas in the northwestern region of the lower forty-eight states, western Canada, and areas of Alaska. Because of the settlement of the west and loss of prime habitat, populations declined rapidly in the nineteenth century, and in 1975 federal action was taken to protect grizzlies under the Endangered Species Act. Since 1950 about 722 technical papers have been written on the grizzly bear. Major research has focused on ecology, conservation, reproductive biology, behavior, dietetics, anatomy, and physiology, among other topics. Due to geographic distribution of the species, much of the research has been carried out by authors and organizations in western regions of the United States and Canada where major grizzly populations exist. A significant number of technical papers appear in three key journals: *Ursus*, the *Journal of Wildlife Management*, and the *Canadian Journal of Zoology*. According to data in *WorldCat*, about 1,167 records, covering monographs and technical reports, contain information on grizzlies and present research findings. The bulk of monographs appeal mainly to a general audience. However, citation analysis reveals a core of highly cited technical papers, many written with an emphasis on special themes or topics, whereas others focus on the grizzly itself, all together advancing the science on this species.

**Keywords** Grizzly bear, *Ursus arctos horribilis*, brown bear, zoology, ecology, wildlife, Yellowstone ecosystem, conservation, recovery, bibliography, citation analysis, Alaska, California, Montana, Wyoming, Idaho, Washington.

## Introduction

The grizzly bear (*Ursus arctos horribilis*) is an iconic symbol of America's wilderness. Its historic range once covered much of North America, from central Mexico, north to Alaska, and from the Great Plains, west to the Pacific Ocean. At the beginning of the 1800s, an estimated 50,000 grizzlies lived in this vast region. However, because of the settlement of the west and loss of suitable habitat, populations declined rapidly over the next hundred years (US Fish and Wildlife Service 2011a). By 1975 the grizzly bear was nearly extinct in the lower forty-eight states, with fewer than 1,000 remaining. In response, the federal government listed it as a threatened species, and the grizzly bear became protected under the Endangered Species Act. Soon after, a recovery plan was formulated to restore grizzly populations in several major wild ecosystems in northwestern areas of the United States (US Fish and Wildlife Service 2000). Today many grizzlies inhabit the mountainous regions of the Pacific Northwest, in Montana, Wyoming, Idaho, and Washington. Population estimates indicate about 300–400 living in the mountains of northwestern Montana, 400–600 in the greater Yellowstone ecosystem, 45–50 in the Selkirk Mountains of Idaho and Washington, 35–40 in the Cabinet-Yaak ecosystem of Idaho and Montana, and 5–30 in the northern Cascades of Washington. Populations having attained healthy numbers in the greater Yellowstone ecosystem and mountainous areas along the northern continental divide indicate the success of the recovery effort. Larger populations are found in Canada and Alaska, with about 30,000 living in Alaska and another 22,000 in western Canada (US Fish and Wildlife Service 2000).



**FIGURE 1** Grizzly Bear in Yellowstone National Park. Source: Photo by Terry Tollefsbol. Courtesy US Fish and Wildlife Service.

The grizzly is a very large mammal, and males of the species often stand seven feet tall and weigh between 300–600 pounds. The female is somewhat smaller and weighs between 200–400 pounds. Both genders have high-humped shoulders that distinguish them from other bear species. A grizzly's color ranges from light brown to almost black, and long, curved claws make it a formidable mammal (US Fish and Wildlife Service 2000).

Grizzlies, though considered carnivores, are in truth omnivores, eating both plants and animals. Their plant diet consists of berries, wild fruits, nuts, roots, bulbs, green vegetation, and various forms of insects including larvae. Its animal diet is often carrion or dead carcasses of other large mammals, such as elk and deer. In some areas of Alaska, they consume prodigious quantities of salmon (US Fish and Wildlife Service 2000).

Grizzlies enjoy a long life span, some living as much as thirty years, although a fifteen- to twenty-year life span is more typical. It is not a highly productive species, as the female breeds in intervals of three years or longer. Following mating in June or July, cubs are born in January while the mother is still in hibernation. A single female can give birth from one to three cubs who will remain with their mother for two to three years (US Fish and Wildlife Service 2000).

Common Names	Taxonomy	
grizzly bear	Kingdom: Animalia	Family: Ursidae
grizzly	Phylum: Chordata	Genus: <i>Ursus</i>
brown bear	Subphylum: Vertebrata	Species: <i>Ursus arctos</i>
	Class: Mammalia	Subspecies: <i>Ursus arctos horribilis</i>
	Order: Carnivora	

TABLE 1 Grizzly Bear (*Ursus arctos horribilis*): Common Names and Taxonomy

## Early Accounts of Grizzlies

Before the great American westward expansion in the 1800s, little was known about the grizzly. This began to change with the Lewis and Clark Expedition of 1804–1806. Numerous encounters with grizzlies were meticulously recorded in daily journals compiled by Meriwether Lewis and William Clark, leaders of the expedition. On April 25, 1805, in an area near the mouth of the Yellowstone River, Lewis describes sighting a grizzly. Lewis writes, “[I]t’s colour is yellowish brown, the eyes small, black, and piercing; the front of the forelegs near the feet is usually black; the fur is finer thicker and deeper than that of the black bear.” In a further comparison with the black bear, Lewis notes, “[the grizzly] was a male not fully grown, we estimated his weight at 300 lbs. not having the means of ascertaining it precisely. The legs of this bear are somewhat longer than those of the black, as are it’s tallons and tusks incomparably larger and longer” (Moulton 2003, 102).

A few days earlier, on April 13, 1805, before sighting his first grizzly, Lewis speculated about its behavior as told by Indians of the region. Lewis wrote, “[T]he Indians give a very formidable account of the strength and ferocity of this animal, which they never dare to attack but in parties of six eight or ten persons; and are even then frequently defeated with the loss of one or more of their party” (Moulton 2003, 96).

On June 13, 1805, near present-day Great Falls, Montana, Lewis again delved into the science of grizzlies. Having observed bears with fur of different colors, Lewis questioned whether all were of the same species. Lewis wrote in his journals, “I am induced to believe that the Brown, the white and the Grizly bear of this country are the same species only differing in colour from age or more probably from the same natural cause that many other animals of the family differ in colour” (Moulton 2003, 130). In the decades following the Lewis and Clark Expedition, grizzly bear science was largely dormant, but this slowly started to change in the early twentieth century.

Around eighteen papers written on the grizzly before 1950 are indexed in the *Zoological Record* database hosted on the Thomson Reuters Web of Knowledge. One of the earliest papers, “Domestication of the Grizzly Bear” was published in the *American Naturalist*. Reporting on anecdotal evidence (Caton 1886, 435), proposed that a grizzly cub, while instinctively wild when first captured, could become quite docile and even as tractable as a domestic dog. In the example given, a female when grown went on excursions into the wilds with her master, fought to defend him against other grizzlies, and while asleep around the campfire, acted much as a watchdog.

Since the grizzly was so prominent in California, scientists were very interested in sightings and understanding characteristics of the species. Dixon (1916) reported an examination of a skull of a bear, thought to be a grizzly, killed in 1915 in Humboldt County. In a triumph for science, by analyzing morphology and other characteristics of the skull, evidence showed that the skull belonged to a black bear, not a grizzly.

Grinnell (1938) observed that, in California, grizzlies lived in lowland areas and foothills of mountains. Further, they did not coexist with the native black bear, and if the grizzly population shrank in an area, black bears moved in when habitat conditions and climate were suitable for them. At any one time prior to 1830, Grinnell extrapolated a population of 2,595 adult grizzlies in California.

By 1925, or by some estimates, 1922, grizzlies became extinct in California. Because of agriculture and other pursuits, the presence of grizzlies was impractical for humans, and many were killed for sport rather than for their hides or meat. In 1837, one man reportedly shot and killed forty-five grizzlies in the area of San Luis Obispo. On a positive note, many specimens, including fragmentary pieces of skulls, were deposited at the Museum of Vertebrate Zoology, University of California, for the benefit of scientific research (Hall 1939, 237, 239).

In early writings, scientists sought to understand grizzly behavior and reported on the experiences of early explorers and pioneers. Before the introduction of the breech-loading rifles, grizzlies were much less afraid of man, often attacking at the least provocation. Because of firearm improvements, the grizzly changed its behavior, acting with “more discretion and less valor toward man” (Warren 1910, 289).

At about this time scientists also attempted to understand the taxonomy of grizzlies living in the west with diverse results. Merriam (1918, 14–15) reported multiple species or subspecies lived in Colorado. Still another scientist speculated that only one species of grizzly existed in the state (Warren 1932, 24).

## Six Decades of Research

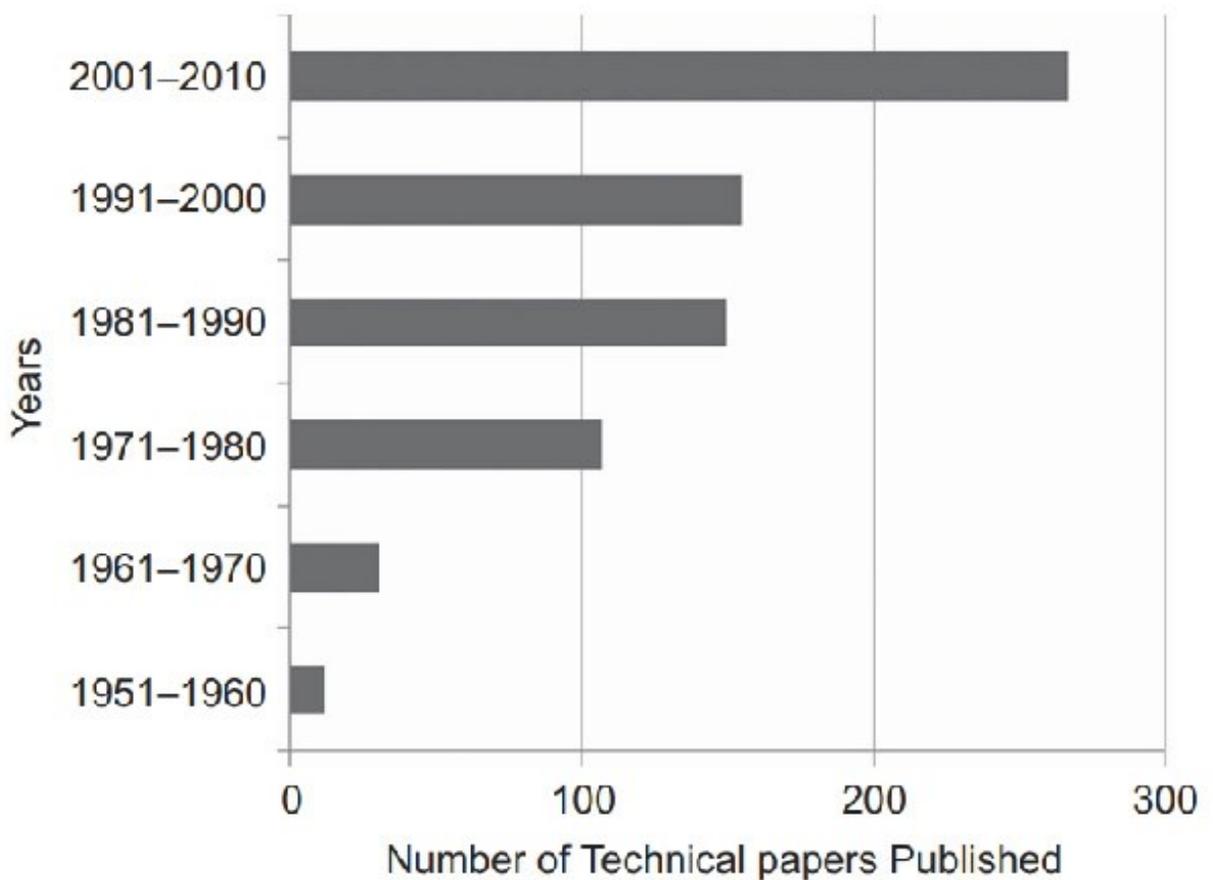
Scientific interest in grizzlies started to gain momentum in about 1951. Data from the *Zoological Record* show publication levels for the most recent six decades: from 1951–1960, 12 publications; from 1961–1970, 31 publications; from 1971–1980, 107 publications, from 1981–1990, 150 publications; from 1991–2000, 155 publications; and from 2001–2010, 267 publications. Research output more than doubled from the 1970s to the first decade of the twenty-first century. An awareness of the declining number of grizzly in the lower forty-eight states and its listing as a threatened species were likely key factors that propelled research.

A search completed in September 2011 for “grizzly bear” or “*Ursus arctos horribilis*” limited to the years 1951–2010, in *Zoological Record* yields a total of 722 technical papers (see Figure 2). When the same two keyword phrases, “grizzly bear” or “*Ursus arctos horribilis*” were limited to the title field, the results were somewhat less, a total of 531 technical papers were retrieved. In the set showing 722 technical papers, the papers often covered narrow topical themes, and the species is frequently treated as a subtopic.

An analysis of the full body of research shows considerable interest in grizzlies in the Yellowstone ecosystem. Since 2000, 125 articles in the *Web of Science* mention or report in-depth on grizzlies in the Yellowstone ecosystem.

### Concepts That Define Research

Research on grizzlies is heavily concentrated in three subject areas. Indexing in the *Zoological Record* shows that a preponderance of technical papers report on environmental sciences/ecology, biodiversity/conservation, and nutrition/dietetics. When all 741 records in the database (covering 1864–2010) on grizzly are considered, these three subject areas are used as indexing for about 71 percent, 32 percent, and 24 percent, respectively (see Table 2).



**FIGURE 2** Number of Technical Papers Published on Grizzly Bears, 1951–2010. Search for “grizzly bear” or “*Ursus arctos horribilis*” 1951–2010 yielded a total of 722 technical papers. Source: *Zoological Record*, published by Thomson Reuters.

The next three most frequently indexed subject areas report on reproductive biology, behavioral sciences, and anatomy/morphology. The subject areas, in this second group, are used as indexing for about 15 percent, 13 percent, and 8 percent of the records, respectively.

Subject area	Record count	% of 741	Bar chart
Zoology	741	100.00%	
Environmental sciences/Ecology	523	70.58%	
Biodiversity/Conservation	238	32.12%	
Nutrition dietetics	178	24.02%	
Reproductive biology	109	14.71%	
Behavioral sciences	98	13.23%	
Anatomy morphology	58	7.83%	
Forestry	42	5.67%	
Biochemistry molecular/Biology	30	4.05%	
Physiology	28	3.78%	
Parasitology	25	3.37%	
Genetics heredity	23	3.10%	
Evolutionary biology	17	2.29%	
Mathematics	15	2.02%	
Developmental biology	13	1.75%	
Infectious diseases	12	1.62%	
Entomology	11	1.48%	
Pathology	11	1.48%	
Meteorology/Atmospheric sciences	10	1.35%	
Paleontology	9	1.22%	

TABLE 2 Major Subject Areas for Technical Papers on the Grizzlies. Data cover 1864-2010. Source: *Zoological Record* by Thomson Reuters.

## Source Publications

The bulk of research on grizzlies is published in a relatively small number of journals. Fewer than a dozen journals account for about 50 percent of published papers. *Ursus*, the official publication of the International Association for Bear Research and Management, is the top journal for grizzly technical papers. It accounts for eighty-seven of the published articles in this analysis. See Table 3. Other journals in the top tier include the *Journal of Wildlife Management* (sixty published papers), *Canadian Journal of Zoology* (forty-five published papers), and the *Wildlife Society Bulletin* (thirty-three published papers).

Management issues are a topic of major interest for wildlife scientists. As such, numerous authors have presented information about grizzlies in the *Wildlife Society Bulletin*, a journal that, before it combined with the *Journal of Wildlife Management* in 2007, focused on management-related articles aimed at wildlife managers. Together, the two journals account for ninety-three of the technical papers on grizzlies published since 1951.

Since public agencies manage wildlife, publications originated by federal and state governments include significant information on grizzly bears. For example, the Alaska Department of Fish and Game Division of Wildlife Conservation Federal Aid in Wildlife Restoration Research Progress Report produced several issues on population dynamics. In the federal government, the US Forest

Service is actively engaged in grizzly studies as well. Its *General Technical Report INT*, with thirty-six technical articles, ranks in the top four publications.

Source	Record Count	% of 741	Bar chart
<i>Ursus</i>	87	11.74%	■
<i>Journal of Wildlife Management</i>	60	8.10%	■
<i>Canadian Journal of Zoology</i>	45	6.10%	■
<i>US Forest Service General Technical Report INT</i>	36	4.86%	■
<i>Wildlife Society Bulletin</i>	33	4.45%	■
<i>Alaska Department of Fish and Game Federal Aid in Wildlife Restoration Projects Progress Report</i>	23	3.10%	■
<i>Journal of Mammalogy</i>	23	3.10%	■
<i>Canadian Field Naturalist</i>	22	2.97%	■
<i>Biological Conservation</i>	20	2.70%	■
<i>Conservation Biology</i>	20	2.70%	■
<i>IUCN Publications New Series</i>	19	2.56%	■
<i>Western Wildlands</i>	14	1.89%	■
<i>Arctic</i>	13	1.75%	■
<i>Bear Biology Association Conference Series</i>	13	1.75%	■
<i>Journal of Wildlife Diseases</i>	12	1.62%	■
<i>Alaska Department of Fish and Game Final Report</i>	8	1.08%	■
<i>Bioscience</i>	8	1.08%	■
<i>Transactions of the North American Wildlife and Natural Resources Conference</i>	8	1.08%	■
<i>Ecology (Washington, D.C.)</i>	7	0.95%	■
<i>Alaska Department of Fish and Game Division of Wildlife Conservation Federal Aid in Wildlife Restoration Research Progress Report</i>	6	0.81%	■
<i>Ecological Applications</i>	6	0.81%	■
<i>Northwest Science</i>	6	0.81%	■
<i>Wild Earth</i>	6	0.81%	■
<i>Alaska Department of Fish and Game Report of Survey Inventory Activities</i>	5	0.68%	■
<i>American Midland Naturalist</i>	5	0.68%	■
<i>Forest Ecology and Management</i>	5	0.68%	■
<i>Journal of Applied Ecology</i>	5	0.68%	■
<i>Alberta Species at Risk Report</i>	4	0.54%	■
<i>Ecological Monographs</i>	4	0.54%	■
<i>Wildlife Biology</i>	4	0.540%	■
<i>Wildlife Monographs</i>	4	0.54%	■
<i>Yellowstone Science</i>	4	0.54%	■

TABLE 3 Sources with Most Technical Papers on Grizzlies. Complete list of source titles includes more than 190 source titles with a total of 741 technical papers. Source: *Zoological Record* by Thomson Reuters.

Research on grizzlies is conducted by a relatively small number of scientists, making it a narrow field of specialization in the life sciences. Data in the *Zoological Record* show a total of 210 authors with two or more technical papers, and within the full discipline, a core group of scientists is especially productive.

This core group, mainly living and working in geographic areas with grizzly populations, consists of about eighty-three scientists with four or more technical papers written. Noteworthy among this group are David Mattson, US Geological Survey Southwest Biological Science Center, Colorado Plateau Research Station (forty-four papers); Harry Reynolds, Alaska Department of Fish and

Game, (thirty-five papers); Gordon Stenhouse, Foothills Research Institute in Alberta (thirty-four papers); Charles Schwartz, US Geological Survey, Northern Rocky Mountain Science Center, Interagency Grizzly Bear Study Team, Forestry Sciences Laboratory, Montana State University (twenty-nine papers); Bruce McLellan, British Columbia Ministry of Forests, Lands, and Natural Resource Operations (twenty-eight papers); and Stephen Herrero, Environmental Science, Faculty of Environmental Design, University of Calgary (twenty-eight papers).

Other productive scientists include Christopher Servheen, US Fish and Wildlife Service (twenty-six papers); Mark Boyce, University of Alberta, Department of Biological Sciences (twenty-five papers); Mark Haroldson, US Geological Survey, Northern Rocky Mountain Science Center, Interagency Grizzly Bear Study Team, Forestry Sciences Laboratory, Montana State University (twenty-three papers); Richard Knight, Interagency Grizzly Bear Study Team, Forestry Sciences Laboratory, Montana State University (twenty-three papers); John Craighead, Craighead Wildlife-Wildlands Institute (eighteen papers); and Bonnie Blanchard, Interagency Grizzly Bear Study Team, Forestry Sciences Laboratory, Montana State University (sixteen papers).

## Highly Cited Technical Papers

In citation analysis, the number of citations to a technical paper is related to many factors such as significance of the research, the volume of research conducted in the discipline, and trends in research. Some technical papers in grizzly bear science tend to be cited less often if recently published. Relatively low-citation levels of some papers may be related to low production in the discipline rather than reflecting the importance of the work done.

**TABLE 4** Highly Cited Technical Papers on Grizzly Bear. Source: *Web of Science*

Title of article	Author(s)	Journal title	Year published	Times cited
Edge effects and the extinction of populations inside protected areas	Woodroffe, R.; Ginsberg, J. R.	<i>Science</i>	1998	388
Estimation of growth and extinction parameters for endangered species	Dennis, B.; Munholland, P. L.; Scott, J. M.	<i>Ecological Monographs</i>	1991	288
Density dependence in time series observations of natural populations: Estimation and testing	Dennis, B.; Taper, M. L.	<i>Ecological Monographs</i>	1994	264
Genetic tagging of free-ranging black and brown bears	Woods, J. G.; Paetkau, D.; Lewis, D.	<i>Wildlife Society Bulletin</i>	1999	200
Relating populations to habitats using resource selection functions	Boyce, M. S.; McDonald, L. L.	<i>Trends in Ecology and Evolution</i>	1999	208
Human-caused disturbance stimuli as a form of predation risk	Frid, A.; Dill, L.	<i>Conservation Ecology</i>	2002	188
Use of stable isotopes to determine diets of living and extinct bears	Hilderbrand, G. V.; Farley, S. D.; Robbins, C. T.	<i>Canadian Journal of Zoology</i>	1996	186
Predicting extinction times from environmental stochasticity and carrying capacity	Foley, P.	<i>Conservation Biology</i>	1994	161
Conservation biology and carnivore conservation in the Rocky Mountains	Noss, R. F.; Quigley, H. B.; Hornocker, M. G.	<i>Conservation Biology</i>	1996	159
Use and interpretation of logistic regression in habitat selection studies	Keating, K. A.; Cherry, S.	<i>Journal of Wildlife Management</i>	2004	156
Variation in genetic diversity across the range of North American brown bears	Paetkau, D.; Waits, L. P.; Clarkson, P.L.	<i>Conservation Biology</i>	1998	138
An empirical exploration of data quality in DNA-based population inventories	Paetkau, D.	<i>Molecular Ecology</i>	2003	131

**Continued**

The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears	Hilderbrand, G. V.; Schwartz, C. C.; Robbins, C. T.	<i>Canadian Journal of Zoology</i>	1999	125
Gene flow between insular, coastal, and interior populations of brown bears in Alaska	Paetkau, D.; Shields, G. F.; Strobeck, C.	<i>Molecular Ecology</i>	1998	125
Recolonizing carnivores and naive prey: Conservation lessons from Pleistocene extinctions	Berger, J.; Swenson, J. E.; Persson, I. L.	<i>Science</i>	2001	124
Grizzly bears and resource-extraction industries—Effects of roads on behaviour, habitat use, and demography	McLellan, B. N.; Schackleton, D. M.	<i>Journal of Applied Ecology</i>	1988	117
Carnivores as focal species for conservation planning in the Rocky Mountain region	Carroll, C.; Noss, R. F.; Paquet, P. C.	<i>Ecological Applications</i>	2001	107
Population dynamics of Yellowstone grizzly bears	Knight, R. R.; Eberhardt, L.L.	<i>Ecology</i>	1985	104
Density dependence, compensation, and environmental effects on elk calf mortality in Yellowstone National Park	Singer, F. J.; Harting, A.; Symonds, K. K.	<i>Journal of Wildlife Management</i>	1997	104
Estimating population size of grizzly bears using hair capture, DNA profiling, and mark-recapture analysis	Mowat, G.; Strobeck, C.	<i>Journal of Wildlife Management</i>	2000	100
Relationships among grizzly bears, roads, and habitat in the Swan Mountains, Montana	Mace, R. D.; Waller, J. S.; Manley, T. L.	<i>Journal of Applied Ecology</i>	1996	96
Noninvasive genetic sampling tools for wildlife biologists: A review of applications and recommendations for accurate data collection	Waits, L. P.; Paetkau, D.	<i>Journal of Wildlife Management</i>	2005	95
Food habits of Yellowstone grizzly bears, 1977–1987	Mattson, D. J.; Blanchard, B. M.; Knight, R. R.	<i>Canadian Journal of Zoology</i>	1991	93
Resilience and conservation of large carnivores in the Rocky Mountains	Weaver, J. L.; Paquet, P. C.; Ruggiero, L. F.	<i>Conservation biology</i>	1996	93
Digestive and metabolic efficiencies of grizzly and black bears	Pritchard, G. T.; Robbins, C. T.	<i>Canadian Journal of Zoology</i>	1990	90
Movements of Yellowstone grizzly bears	Blanchard, B. M.; Knight, R. R.	<i>Biological Conservation</i>	1991	89
Source-sink models and the problem of habitat degradation: General models and applications to the Yellowstone grizzly	Doak, D. F.	<i>Conservation Biology</i>	1995	87
A mammalian predator-prey imbalance: Grizzly bear and wolf extinction affect avian neotropical migrants	Berger, J.; Stacey, P. B.; Bellis, L.	<i>Ecological Applications</i>	2001	83
Constraints on frugivory by bears	Welch, C.A.; Keay, J.; Kendall, K. C.	<i>Ecology</i>	1997	82
Using stable carbon ( $\delta^{13}C$ ) and nitrogen ( $\delta^{15}N$ ) isotopes to infer trophic relationships among black and grizzly bears in the upper Columbia River basin, British Columbia	Hobson, K. A.; McLellan, B. N.; Woods, J. G.	<i>Canadian Journal of Zoology</i>	2000	75
Trophic relations of brown and black bears in several western North American ecosystems	Jacoby, M. E.; Hilderbrand, G. V.; Servheen, C.	<i>Journal of Wildlife Management</i>	1999	70
The history of effective population size and genetic diversity in the Yellowstone grizzly ( <i>Ursus arctos</i> ): implications for conservation	Miller, C. R.; Waits, L. P.	<i>Proceedings of The National Academy of Sciences of the United States of America</i>	2003	69
Yellowstone grizzly bear mortality, human habituation, and whitebark pine seed crops	Mattson, D. J.; Blanchard, B. M.; Knight, R. R.	<i>Journal of Wildlife Management</i>	1992	68
Landscape evaluation of grizzly bear habitat in western Montana	Mace, R. D.; Waller, J. S.; Manley, T. L.	<i>Conservation Biology</i>	1999	68
Microsatellite analysis of paternity and reproduction in Arctic grizzly bears	Craighead, L.; Paetkau, D.; Reynolds, H. V.	<i>Journal of Heredity</i>	1995	68
Factors leading to different viability predictions for a grizzly bear data set	Mills, L. S.; Hayes, S. G.; Baldwin, C.	<i>Conservation Biology</i>	1996	65
Population trend of the Yellowstone grizzly bear as estimated from reproductive and survival rates	Eberhardt, L. L.; Blanchard, B. M.; Knight, R. R.	<i>Canadian Journal of Zoology</i>	1994	57

The most highly cited technical papers fall into two categories. The technical papers with highest citation levels report on specialized themes in which the grizzly is a subtopic or a general part of the presentation. An example of a paper in this category is “Genetic Tagging of Free-Ranging Black and Brown Bears,” by Woods, Paetkau, and Lewis (see Table 4).

A second group of highly cited technical papers focuses specifically on grizzlies. A paper on “Relationships among Grizzly Bears, Roads, and Habitat in the Swan Mountains, Montana,” by Mace, Waller, Manley (see Table 4) falls into this category.

## Major Monographs and Reports

An analysis of data in *WorldCat* shows more than 1,100 records (non-fiction and not juvenile) in the database related to grizzly bears. By far the greater number of the records point to books that appeal to a more general audience. Still, after such titles are accounted for, the database reveals several titles that make significant contributions to understanding the science and management of grizzlies.

Personal stories and experiences are a common theme in early books on grizzlies. Some of those accounts have special value and are still cited in contemporary scientific research. *The Grizzly Bear; The Narrative of a Hunter-Naturalist, Historical, Scientific, and Adventurous*, Wright (1909) chronicles historical mentions of grizzlies, beginning with observations by members in the Lewis and Clark Expedition, and he further relates personal experiences and adventures with the species along with details of its character and habits. As evidence of its scientific merit, Wright’s book was recently cited by Merrill and others (1999) in a technical paper published in *Biological Conservation*.

In a classic and evocative book, *The Grizzly Our Greatest Wild Animal*, Mills (1919, ix) characterizes behavior of grizzlies after observing them for years in the wilderness. Mills observed,

I have trailed the grizzly without a gun. I have repeatedly been outwitted by him, but never has he attacked me. I have not found him ferocious, and I consider him in most respects the greatest animal on the North American continent, if not in the world. He excels in mental development and physical prowess, and he possesses the rare quality of loyalty. He is full of curiosity and is a born adventurer. The species impresses one with its superiority, and the individuality of each grizzly ever stands out.

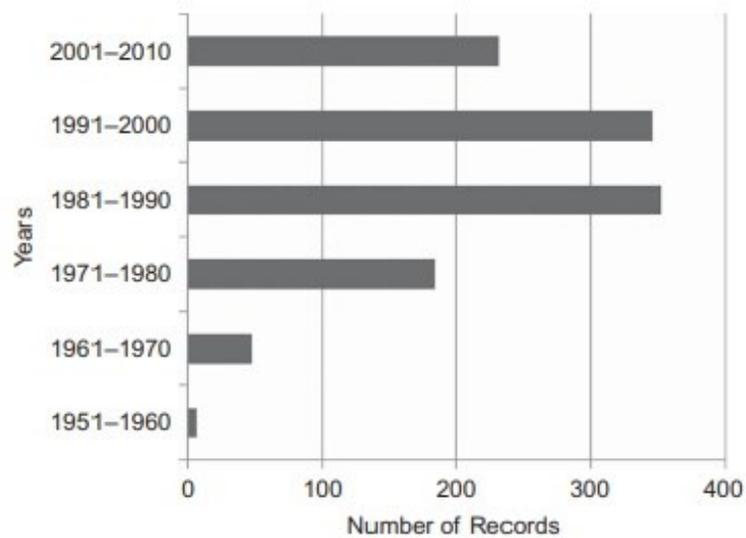
With such insight, this book is of interest to most scientists who study grizzlies.

While the grizzly had disappeared from California’s landscape around 1922, it was not forgotten. In *California Grizzly*, a highly informative book, Storer and Tevis (1955, v) describe the history of grizzly in the state, drawing on written and published records. The authors relate a substantial account of the bear, its life and contacts with humans, its impact on lives and activities of early Californians, and its enduring effect on the civilization of the state. Since 1970, scientists have cited this book twenty-four times in technical papers (Figure 3).

After the grizzly was listed as a threatened species, the US Fish and Wildlife Service in cooperation with the Montana Department of Fish, Wildlife, and Parks prepared a *Grizzly Bear Recovery Plan* (Brown 1982). According to Harting and LeFranc (1987, 1), in preparing the plan, the authors

sought to identify population goals that represent recovery, identify limiting factors that support existing populations, identify management measures to remove limiting factors to enable population increase and sustainability, and establish recovery of three populations in three distinct ecosystems in the lower forty-eight states.

In the mid-1980s, due to increasing interest in management issues, scientists and others perceived an unfulfilled need for a full account of available information on grizzlies. As such, *Grizzly Bear Compendium* was published by the National Wildlife Federation. On initiation, the project, in support of management goals, sought to review both published and unpublished information on the species in North America (Harting and LeFranc 1987, 1).



**FIGURE 3** The Number of Records (Books) in *WorldCat* for Grizzly Bears, 1951–2010. Source: *WorldCat*. Data represent a search for grizzly bear as descriptor. Search limited to non-fiction but not juvenile books for the years 1951–2010. Figure shows a total of 1167 records (format: books) and results include scientific titles as well as books which appeal to a general audience.

Reports that show progress represent a special category of publication. One example is *Grizzly Bear Ursus arctos horribilis: 5-Year Review Summary and Evaluation* (US Fish and Wildlife Service 2011b) which provides a status report of the recovery effort. This 2011 report represents a valuable source of information since much scientific and commercial data is considered. In addition, useful new information is included since the species was originally listed or last reviewed.

Progress reports may also show the results of annual studies. Hamer and others (1980) studied food habits and habitat use of grizzlies in the Front Ranges of Banff National Park, Alberta, Canada. The report contains data and conclusions for 1979 and supplements studies completed in earlier years.

Publications that bring together the results of earlier research are a valuable starting point for understanding any species. In *Grizzly Bear and Its Habitat*, Willard and Herman (1977, 1) offer a summary of the historical distribution, habitat, and status of the species, as well as other topics. Particularly beneficial references to important studies are also included in the summary. As the study progressed, the authors concluded that more could be learned about the habitat of the species.

Published two years after the grizzly was listed as a threatened species, the authors noted, “[T]here is a question about which particular elements of habitat are required for grizzly survival, which are only preferred, and which are relatively unimportant” (Willard and Herman 1977, 1).

Among authors of books on the species, John Craighead of the Craighead Wildlife-Wildlands Institute is the most prominent. Craighead, Sumner, and Mitchell (1995) prepared a landmark book, *The Grizzly Bears of Yellowstone: Their Ecology in the Yellowstone Ecosystem, 1959–1992*, which provides a historical perspective and details on population as well as bear hierarchy, reproductive biology, food habits and feeding behavior, mortality, and much more. Data in the Thomson Reuters Web of Science show this book has been cited 127 times since its publication.

An increase in publication of books and reports on grizzlies follows a pattern similar to that of the growth of technical papers. That is, the number of books and reports published starts to rapidly increase beginning in the 1970s. A partial explanation for the high interest may be the listing of the grizzly as a threatened species in the lower forty-eight states in 1975. Another reason may relate to the spiritual value that comes with knowing the grizzly’s presence remains in some of America’s spectacular wilderness areas.

## Conclusion

Grizzly bear science is a continually growing niche of zoology. Beginning in the 1950s and especially since 1975, a relatively small number of scientists living and working in areas of the western United States and Canada have conducted a wide range of detailed research on the species and produced an impressive number of publications. The current interest is high, as shown by about 267 technical papers published from 2001–2010. Studies have focused on ecology, conservation, dietetics, reproductive biology, anatomy, and numerous other special topics all important for the protection, understanding, and maintenance of the species. In a publication pattern similar to other areas of science, the bulk of research is published in a core group of journals, in this case around a dozen titles. As revealed by analyzing an extensive web of cited and citing technical papers, scientists have relied on and built upon earlier work by others to create new knowledge. Top technical papers have been cited, on average, 128 times. Synthesis of knowledge on grizzlies is less robust, although the *Grizzly Bear Compendium*, by Harting and LeFranc (1987), is highly useful and significant.

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