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PUBLIC ATTITUDES, WILDLIFE, AND RECREATION MANAGEMENT IN PUSCH  
RIDGE WILDERNESS, ARIZONA

By

Patrick Kevin Devers

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A Thesis Submitted to the Faculty of the  
SCHOOL OF RENEWABLE NATURAL RESOURCES  
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For the Degree of  
MASTER OF SCIENCE  
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In the Graduate College  
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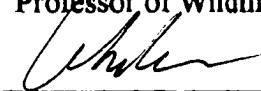
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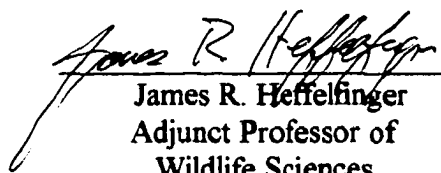
This thesis has been approved on the date shown below:

  
Paul R. Krausman  
Professor of Wildlife Sciences

10 Aug 99  
Date

  
William W. Shaw  
Professor of Wildlife Sciences

10 Aug 99  
Date

  
James R. Heffelfinger  
Adjunct Professor of  
Wildlife Sciences

10 Aug 1999  
Date

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## ABSTRACT

I present model for incorporating public attitudes in wildlife management involving desert bighorn sheep (*Ovis canadensis*) in Pusch Ridge Wilderness (PRW), Arizona. I conducted a mail survey on 4 user-groups including The Access Fund (TAF), La Reserve Homeowners Association (LRH), Southern Arizona Hiking Club (SAHC), and white-tailed deer hunters (WTH). Support for translocating sheep into PRW ranged from 59% - 80%. Support for banning dogs from PRW to reduce stress to bighorn sheep ranged from 49% - 79%. A majority (53% - 66%) of each user-group, except WTH (41%) supported seasonal closures during lambing season to reduce stress to bighorn sheep. A majority of each user-group (60% - 74%) supported using prescribed fires to reduce wildfire hazards and improve habitat for sheep. This information will help agencies develop goals and objectives for bighorn sheep and recreation management in PRW.

## **Introduction**

Throughout the world, preserves have been established to protect wildlife from human encroachment (Purdy 1981, Ishee 1995, Parenteau and Baur 1995). In the United States, wilderness buffer wildlife from human activities, but consideration is rarely given to the effects of adjacent land uses on wilderness (Wiens 1996). Most policy-makers, community planners, and the public believe once wilderness areas are established the problem of wildlife conservation is resolved (Wiens 1996). However, when human encroachment (e.g., urbanization and increased recreation) continues adjacent to wilderness areas, the activities of people can adversely affect wildlife inside and outside wilderness boundaries.

Habitat loss and fragmentation, primarily caused by human activities is the greatest threat facing wildlife today (Soulé 1991, Harris and Silva-Lopez 1992, Wiens 1996). Development adjacent to public lands creates a multitude of problems, including loss of habitat, isolation of populations, increased fire dangers, litter and roadside dumping, and human wildlife conflicts. Each of these can lead to habitat degradation that can cause changes in species composition, abundance, richness, and distribution (Knopf 1986, Mankin and Warner 1997, Taft 1997). Development adjacent to wilderness increases concerns about wildfires requiring resource managers to suppress natural fires and restrict their use of prescribed fire (Taft 1997, White and Harrod 1997). Fire suppression favors climax communities thus threatening wildlife populations that require early successional habitats (White and Harrod 1997). Increased recreation in wilderness is associated with

expanding urban centers and creates additional stress on wilderness wildlife (e.g., noise, displacement).

The number of people participating in non-consumptive recreational activities has increased since 1979 (Duffus and Dearden 1990). Recreational activities can negatively affect wildlife (Boyels and Samson 1985, Pomerantz et al. 1988, Coggins and Glicksman 1990, Flather and Cordell 1995) by increasing stress and disturbance, altering population structure and dynamics (Anderson 1995), and degrading habitat (Knight and Cole 1991). On an individual level, disturbance can alter behavior, reduce animal health and productivity, and cause death (Knight and Cole 1991). At the population level recreational disturbance can influence abundance, distribution, and demographics, and at the community level disturbance can alter species composition and interactions (Knight and Cole 1991). The designation of wilderness alone, is not sufficient for the conservation of wildlife. To effectively manage wildlife populations resource professionals must also manage human activities.

Wildlife management consists of three components: animals, habitat, and people (Giles 1978, Knuth and Nielson 1991). Animals and habitats have been studied over the years, but only recently have wildlife professionals begun to understand the need and usefulness of the human dimensions of wildlife management (Doig 1987, Knuth and Nielsen 1991, Lyons 1987). Because of changing attitudes and increased public involvement in wildlife conservation, successful management will depend on better understanding and incorporation of public values into management plans (Kellert 1979, Witter and Sheriff 1987, Rudzits and Johansen 1991). Understanding public attitudes and

values is one tool that will aid resource agencies to address public desires, avoid litigation, identify potential sources of funding, and identify additional needs in the area of public education and awareness (Kellert 1979, Lyons 1987). The complexities of managing wilderness and wildlife in urban settings are exemplified in Pusch Ridge Wilderness (PRW), in southeastern Arizona.

The presence of desert bighorn sheep was a significant consideration in the designation of PRW (Krausman and Shaw 1979) and one of its major goals is to protect bighorn habitat (Krausman et al. 1995). Urbanization and increased recreation in PRW is adversely affecting wildlife populations, including, white-tailed deer (*Odocoileus virginianus*), and collared peccary (*Pecari tajacu*), but desert bighorn sheep have been the most adversely affected (J. R. Heffelfinger, Arizona Game and Fish Department, personal communication.). The Arizona Game and Fish Department estimated there were 70 – 100 bighorn sheep in PRW in 1978 (Cockling 1978 cited in Krausman et al. 1979), but recent estimates indicate there are <10 sheep remaining (J. R. Heffelfinger, personal communication) making recovery unlikely without human intervention. Several recent studies have tried to ascertain the risk of extinction faced by small populations of bighorn sheep (Berger 1990, Krausman et al. 1993, Goodson 1994, Berger 1999, Wehausen 1999). Despite different findings researchers agree small populations of desert bighorn sheep are vital to the future conservation of the species (Krausman and Leopold 1986, Berger 1990, Bleich et al. 1990, Berger 1999, Wehausen 1999). Concern over the decline of bighorn sheep in PRW has prompted the completion of biological and human dimension studies relative to bighorn management. These studies have concluded the bighorn decline

in PRW is due to a combination of urbanization, fire suppression, and increased recreation (Krausman et al. 1979, Purdy 1981, Harris et al. 1995, Krausman et al. 1995, Krausman 1997).

Development adjacent to PRW has isolated the population (Krausman 1997), prevented genetic interchange, altered traditional feeding grounds, and altered bighorn distribution (Krausman and Shaw 1979). Additionally, development has indirectly impacted bighorn sheep by altering the natural fire regime of PRW. Political pressure to suppress fire and restrict the use of prescribed burns may have contributed to the increase in dense, woody vegetation (Krausman et al. 1996a). Desert bighorn sheep prefer open, grassy areas adjacent to rocky terrain (McCarty and Bailey 1994, Etchberger et al. 1990) and may abandon areas where fire has been suppressed (Etchberger et al. 1989). Fire could be an important tool for restoring and conserving bighorn sheep in PRW (Krausman et al. 1996b). Seip and Bunnell (1985) found Stone's sheep (*Ovis dalli stonei*) with access to burned sites had lower counts of lungworm larvae (*Protostrongylus* spp.), higher lamb production, and greater horn growth in yearling rams compared to sheep without access to burned sites.

Several studies have concluded recreational pressures are also contributing to the decline of bighorn in PRW (Purdy 1981, Purdy and Shaw 1981, Krausman et al. 1979, Harris et al. 1995, Krausman 1997). Though some research shows bighorn sheep can habituate to recreation (Hicks and Elder 1979), most of the literature suggests recreation causes changes in behavior (DeForge 1976, Miller and Smith 1985, King and Workman 1986, McCarty and Bailey 1994), and increases stress (DeForge 1976, MacArthur et al.

1982). An estimated 34,000 recreationists and 3,300 dogs used PRW per year with the majority using Pima and Romero Canyons (Harris et al. 1995). Recreationists traveling off-trail or accompanied with dogs cause the greatest disturbance to bighorn sheep (MacArthur et al. 1982). Schoenecker (1997) found 18% of trail users in PRW hiked off-trail, and a dog accompanied 8% of the off-trail hikers.

Recreational horseback riding is another activity that may cause stress to bighorn sheep and degrade habitat. Currently 2 horseback outfitters (Pusch Ridge Stables and Walking Winds Stables) operate in Catalina State Park on the northwestern border of PRW. Neither outfitter is permitted to operate in PRW, but there are reports that one outfitter guides trips into lower portions of the wilderness. Presently, horse trails are degraded and are not being maintained (D. Bieber, U. S. Forest Service personal communication).

Desert bighorn sheep in PRW are a significant resource to residents of Tucson, and visitors to PRW (Harris et al. 1995). The annual economic value of bighorn in PRW in 1986 was estimated to be \$2,000,000-\$4,000,000 dollars (Burgarsky 1986). Property owners adjacent to PRW and recreationists support banning dogs completely from the wilderness, using prescribed fire to improve habitat, and sacrificing personal activities in the wilderness to benefit bighorn sheep (Harris and Shaw 1993, Harris et al. 1995). However, recreationists continue to hike off-trail and bring dogs into the wilderness (Schoenecker 1997).

### **Objectives**

To date, regulatory solutions have been ineffective in resolving many wildlife conservation issues. Regulatory solutions may only resolve problems temporarily (Geist 1978) unless combined with programs designed to increase support and cooperation from the public (Daoutopoulos and Pyrovetsi 1990). Developing a successful management plan for bighorn sheep in PRW requires opening lines of communication between Coronado National Forest and the public, developing a method of surveying different populations to determine the need for and desirability of an education program, and the establishment of education programs (University of Arizona 1978). My goal was to evaluate the contributions of incorporating public attitudes in developing wildlife management goals, objectives and programs. My objectives were to evaluate support for re-establishing desert bighorn sheep in PRW, identify preferred recreational management policies in relation to desert bighorn sheep conservation, evaluate support for fire management activities to improve habitat conditions for desert bighorn sheep, identify needs in public education to facilitate bighorn conservation, and evaluate differences towards these objectives based on group membership, residency, and visitation history, and age.

### **Study area**

The PRW was established on 24 February 1978 under the Endangered American Wilderness Act and is comprised of 22,572 ha in the southwest corner of the Santa Catalina Mountains. Deep canyons, eroded granite cliffs, and granite outcroppings characterize PRW. The dominant vegetative communities are Sonoran Desert scrub, semi-desert grassland, and Madrean evergreen woodland (Etchberger et al. 1989). Pusch

Ridge Wilderness is bounded by the Tucson metropolitan area (TMA) on the southern and western boundaries, and will become an isolated reserve as urban expansion continues (Harris 1992). Pusch Ridge Wilderness provides a multitude of recreational opportunities, including hiking, hunting, wildlife viewing, rock climbing, camping, and dog walking. Recreationists are attracted to PRW for its aesthetic qualities, psychological benefits, and physical challenges (Purdy 1981).

The Tucson metropolitan area is located in Pima County in southeastern Arizona, and has an estimated population of 767,873 (U.S. Bureau of Census 1998). Since 1990, the Tucson metropolitan area has experienced a 15.1% growth rate (U.S. Bureau of Census 1998). Tucson is anticipated to be the thirteenth fastest growing metropolitan area in the United States in the early part of the next century because of its strong economy, employment opportunities, and natural setting (Tucson Planning Department 1997).

La Reserve is a planned residential, recreational, and commercial community located on the boundary of PRW, north of Tucson. "Wilderness Estates" adjacent to the PRW boundary were developed to provide a low density buffer, and minimize the affects of development on the wilderness. "Wilderness Estates" have restrictions requiring houses be built away from the wilderness boundary with much of each lot left in natural conditions. In addition, the Homeowners Association of La Reserve has entered into an agreement with The University of Arizona Wildlife and Fisheries Sciences Program to support research in the ecology and management of wildlife in PRW.

## **Methods**

### **Survey administration**

I conducted a mail survey (Appendix A) following the Total Design Method (Dillman 1978, Salant and Dillman 1994) on 5 PRW user-groups: the Access Fund (TAF), La Reserve Homeowners (LRH), Pusch Ridge Stables Outfitters, the Southern Arizona Hiking Club (SAHC), and white-tailed deer hunters (WTH) of the Arizona Game and Fish Department's Game Management Unit 33. Pusch Ridge Wilderness is located in the southern portion of Game Management Unit 33. These groups were identified as important stakeholders because of their historic involvement in PRW, political influence, and diverse backgrounds.

I obtained a random sample for each user-group (except for Pusch Ridge Stables employees) using current (1998) membership lists obtained with the consent of executive officers from each group. I selected 200 respondents from each user-group using random numbers generated in Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA). I used an additional random number list to select between spouses for members of SAHC, and LRH. All Access Fund members residing in Arizona were selected due to the small membership ( $n = 245$ ). The Arizona Department of Game and Fish provided a random sample ( $n = 200$ ) of the 550 of WTH awarded hunt tags for October 1998 in Game Management Unit 33. All employees of Pusch Ridge Stables were surveyed ( $n = 5$ ).

The survey consisted of a participation request letter, an introductory letter, a questionnaire with cover letter, a reminder/thank you postcard, and a second questionnaire

(Appendix A). The participation request letter was mailed to organization officers in August 1999 and explained the purpose of the study, why their organization was selected, and the benefits of the study. The introductory letter was mailed on 19 November 1998 and explained the purpose of the survey, its benefits, importance of individual responses to the success of the study, and ensured confidentiality. The questionnaire with introductory cover letter was mailed on 30 November 1998 with a postage-paid business reply envelope. The reminder/thank you postcard was mailed 1 week after the questionnaire. A second survey was mailed on 14 January 1999 to all non-respondents. The second survey was postponed until after the holiday season to increase response rate. I conducted a pre-test in October 1998 on a non-random sample of 20 students in the School of Renewable Natural Resources (non-wildlife majors) ranging in ages from 23 – 45 years of age to detect problems with wording, survey format, and administration on

### **Statistical analysis**

I used descriptive statistics to evaluate public participation and satisfaction with wildlife and recreation management in PRW and Pearson's chi square test to evaluate attitudinal differences between user-groups, visitors and non-visitors, and place of residency regarding bighorn sheep management in PRW and educational needs. I used logistic regression to investigate the effect of age on attitudes. I used the methodology of Ramsey and Schafer (1997) for interpreting and reporting statistical tests. This methodology entails reporting effect sizes and interpreting P-values on a continuum without applying an arbitrary alpha level. This methodology provides more information

than the traditional method of pre-selecting an alpha level for significance, which can provide misleading conclusions and management implications (Ramsey and Schafer 1997, Johnson 1999).

## **Results**

I mailed 850 questionnaires and received 441 completed surveys (51%). Twenty-six surveys (3%) were returned as undeliverable, for a response rate of 54% (441/850-26). Response rates for individual groups were 52% for TAF, 54% for LRH, 58% for SAHC, and 41% for WTH. I did not include Pusch Ridge Stable employees in the analysis because of the small sample size. Efforts were made to obtain a more representative sample of the horseback outfitters, but one business declined to participate and Pusch Ridge Stables did not hire additional employees as anticipated. Sixty-four percent of the respondents were male, 34% were female, and 2% did not indicate their gender. The average age was 47.6 years ( $\pm 0.73$  SE). Age failed to explain differences in public attitudes toward wildlife, recreation and habitat management ( $r^2$  values  $<0.047$ ). The majority (57%) of respondents were TMA residents, 33% were not, and 10% failed to disclose their place of residency. Sixty-seven percent of respondents were members of  $\geq 1$  environmental organization. The 3 most popular organizations (excluding TAF and SAHC) were the Nature Conservancy, Rocky Mountain Elk Foundation, and the Sierra Club.

### **Public participation and satisfaction**

A majority of members from each user-group have visited PRW, except TAF: 78% of SACH, 71% LRH, 60% WTH, and 48% TAF. Respondents who had not previously

visited PRW were classified as non-visitors. A majority of TAF (73%), SAHC (69%), and WTH (60%) reported they valued wildlife conservation and recreational opportunities in PRW equally. A majority (51%) of LRH reported wildlife conservation was the most important aspect in PRW. Respondents spent more days viewing wildlife than any other activity ( $\bar{x} = 22.6$  days  $\pm 4.6$  SE, 95% C.I. = 13.5 – 31.7). A minority of TAF (10%), LRH (10%), SAHC (12%), and WTH (25%) indicated they had conflicts with other recreationists in or around PRW. Similarly, a minority of TAF (14%), LRH (11%), SAHC (11%), and WTH (28%) had seen a law enforcement officer in PRW in the last 12 months. Of the respondents who indicated seeing a law enforcement officer, 44% (14/34) had seen a United States Forest Service (USFS) officer, and 24% (8/34) had seen an Arizona Game and Fish Department (AGFD) officer.

In Contrast to the high visitation rate to PRW, only 15% of respondents had ever attended a public meeting or participated in a survey conducted by the USFS or AGFD. Respondents were asked, “Do you feel natural resource agencies responsible for managing PRW and its wildlife are truly concerned or interested in the opinions of the public when making management decisions?” A plurality of TAF (42%), LRH (50%), and a majority SAHC (53%) were not sure if the managing agencies were concerned with public opinions when making management decisions. A plurality of WTH (47%) felt managing agencies are concerned with public opinions. Respondents were then asked to rate natural resource agencies involved in PRW management for incorporating public concerns in management decisions. A majority of TAF (66%) and LRH (53%) rated PRW management as fair. Pluralities of SAHC (43%) and WTH (45%) also rated management as fair for

incorporating public concerns in management decisions. Using the same scale, respondents were asked to rate PRW management for providing recreational opportunities and protecting wildlife. A majority of TAF (59%), LRH (60%), SAHC (60%), and WTH (67%) rated PRW management as very good for providing recreational opportunities. A plurality of TAF (47%), LRH (43%), SAHC (44%), and WTH (40%) rated PRW management as fair for protecting wildlife.

### **Bighorn sheep management**

Knowledge of the current status of bighorns in PRW differed between user-groups (Pearson's  $\chi^2 = 52.7$ , 423 df,  $P < 0.0001$ ), by residency ( $\chi^2 = 78.9$ , 391 df,  $P < 0.0001$ ), and between visitors and non-visitors (Pearson's  $\chi^2 = 39.8$ , 424 df,  $P < 0.0001$ ) (Table 1). A majority of LRH (74%), SAHC (68%), and WTH (58%) reported bighorn sheep were declining or extirpated in PRW. A majority of TAF (63%) reported they did not know the current status of bighorn sheep. Respondents ( $n = 249$ ) that reported bighorns as extirpated or declining were asked to select from a list, which factors contributed to the decline or extirpation and which single factor was the most responsible (Table 2). Respondents reported participating in wildlife viewing more than any other activity in PRW, but only 16% reported ever seeing desert bighorn sheep. Support for translocating sheep differed between user- groups ( $\chi^2 = 27.4$ , 416 df,  $P < 0.0006$ ) (Table 3). White-tailed deer hunters were the most supportive, and SAHC members were the least supportive. Support also differed by residency ( $\chi^2 = 18.8$ , 388 df,  $P < 0.0001$ ) (Table 3). Non-TMA residents were more supportive of transplants than TMA residents. Non-

Table 1. Stakeholder knowledge of current desert bighorn sheep status in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholders	<i>n</i>	Status		
		Declining/extirpated	Stable/increasing	Do not know
		(%)	(%)	(%)
<b>User-group</b>				
The Access Fund	123	34	3	63
La Reserve Homeowner Association	106	74	1	25
Southern Arizona Hiking Club	116	68	0	32
White-tailed deer hunters	80	58	6	36
<b>Visitation</b>				
Visitors	274	69	2	29
Non-visitors <sup>1</sup>	152	38	3	59
<b>Residency</b>				
Tucson area residents	250	74	2	24
Non-Tucson area residents	143	28	3	69
<b>Total</b>	<b>427</b>	<b>58</b>	<b>2</b>	<b>40</b>

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 2. Presumed causes of desert bighorn decline or extirpation in Pusch Ridge Wilderness, Arizona reported by 249 survey respondents, 1998.

Causes	Yes (%)	Most important (%)
Urbanization	84	73
Recreational disturbances	46	11
Predation	28	7
Disease	18	3
Fire suppression	14	3
Hunting	12	1
Do not know	8	1
Other	4	1

Table 3. Stakeholder attitudes toward translocating desert bighorn into Pusch Ridge Wilderness, Arizona, 1998.

Stakeholders	<i>n</i>	Opinion		
		Support (%)	Oppose (%)	Do not know (%)
User-group				
The Access Fund	121	69	12	19
La Reserve Homeowner Association	104	72	17	11
Southern Arizona Hiking Club	116	59	32	9
White-tailed deer hunters	80	80	14	6
Visitation				
Visitors	274	64	24	12
Non-visitors <sup>1</sup>	148	80	11	9
Residency				
Tucson metropolitan area Residents	248	66	26	8
Non-Tucson area residents	142	74	10	16
Total	421	69	19	12

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

visitors were more supportive (80%) of transplanting sheep into PRW than visitors (64%) ( $\chi^2 = 12.6$ , 420 df,  $P < 0.002$ ) (Table 3).

There is suggestive evidence that support for using prescribed burns in PRW “to reduce wildfire hazards and improve wildlife habitat” differed between user-groups ( $\chi^2 = 22.0$ , 418 df,  $P = 0.0375$ ) (Table 4). La Reserve Homeowners were the least supportive, though the majority of homeowners (60%) supported or strongly supported using prescribed fires. There is also suggestive evidence that support for using prescribed burns differed by residency ( $\chi^2 = 11.12$ , 389 df,  $P = 0.049$ ) (Table 4). Support did not differ by visitation ( $\chi^2 = 4.9$ , 419 df,  $P = 0.303$ ) (Table 4).

There was suggestive evidence that support for using planned burns “to improve habitat” differed among user-groups ( $\chi^2 = 22.0$ , 418 df,  $P = 0.0375$ ) and by residency ( $\chi^2 = 11.1$ , 389 df,  $P = 0.049$ ) (Table 5). Non-TMA residents (61%) and TMA residents (58%) endorsed the use of planned burns to improve wildlife habitat (Table 5). Attitudes toward planned burns did not differ between visitors and non-visitors ( $\chi^2 = 4.85$ , 419 df,  $P = 0.30$ ) (Table 5).

Support for allowing natural fires to burn in PRW “to improve wildlife habitat” differed among user-groups ( $\chi^2 = 36.35$ , 25 df,  $P = 0.0003$ ) (Table 6). A plurality of LRH was neutral in their feelings toward natural fires, whereas majorities of the other user-groups were supportive of allowing natural fires to burn. Attitudes toward letting natural fires burn in PRW did not differ by residency ( $\chi^2 = 4.77$ , 382 df,  $P = 0.312$ ) (Table 6) or by visitation ( $\chi^2 = 6.52$ , 416 df,  $P = 0.164$ ) (Table 6).

Table 4. Stakeholder attitudes toward using prescribed fires to “reduce wildfire hazards and improve wildlife habitat” in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Prescribed fire				
		Strongly opposed (%)	Opposed (%)	Neutral (%)	Support (%)	Strongly support (%)
User-group						
The Access Fund	124	2	5	19	45	29
La Reserve Homeowners Association	105	6	7	27	38	22
Southern Arizona Hiking Club	116	4	4	20	49	23
White-tailed deer hunters	78	8	10	10	31	41
Visitation						
Visitors	274	6	5	19	43	27
Non-visitors <sup>1</sup>	150	2	8	20	41	29
Residency						
Tucson area residents	248	5	4	21	41	29
Non-Tucson area residents	142	3	9	16	44	28
Total	423	5	6	19	42	28

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 5. Stakeholder attitudes toward using planned burns to "improve wildlife habitat" in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Planned burns				
		Strongly opposed (%)	Opposed (%)	Neutral (%)	Support (%)	Strongly support (%)
User-group						
The Access Fund	124	5	6	23	36	30
La Reserve Homeowners Association	105	9	6	35	19	31
Southern Arizona Hiking Club	115	8	3	31	28	30
White-tailed deer hunters	78	10	9	18	19	44
Visitation						
Visitors	273	8	5	26	25	36
Non-visitors <sup>1</sup>	150	6	7	30	29	28
Residency						
Tucson area residents	247	8	5	29	21	37
Non-Tucson area residents	142	6	8	25	34	27
Total	422	8	6	27	26	33

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 6. Stakeholder attitudes toward allowing natural fires burn to "improve wildlife habitat" in Pusch Ridge Wilderness, Arizona, 1998.

		Natural fire				
Stakeholder	<i>n</i>	Strongly opposed (%)	Opposed (%)	Neutral (%)	Support (%)	Strongly support (%)
User-group						
The Access Fund	123	0	11	26	25	38
La Reserve Homeowners Association	106	16	9	40	16	19
Southern Arizona Hiking Club	114	7	6	30	24	33
White-tailed deer hunters	76	12	9	30	15	34
Visitation						
Visitors	270	8	9	29	18	36
Non-visitors <sup>1</sup>	150	9	9	34	24	24
Residency						
Tucson area residents	246	8	7	31	20	34
Non-Tucson area residents	140	6	13	31	21	29
Total	419	8	9	31	21	31

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

I used 2 sets of questions to evaluate public sentiment concerning recreational policies in relation to bighorn conservation (Appendix A). Question 18 evaluated support for prohibiting various recreational activities to protect and benefit wildlife in PRW. Questions 24 – 27 asked respondents to select a preferred management policy regarding dogs in the wilderness, horseback riding, rock climbing, and hiking to protect and benefit bighorn in PRW.

Attitudes toward a dog policy in PRW differed between user-groups ( $\chi^2 = 38.98$ , 416 df,  $P < 0.0001$ ) and residency ( $\chi^2 = 31.1$ , 382 df,  $P < 0.0001$ ) (Table 7). Despite statistical differences TAF, LRH, SAHC, WTH, and TMA residents preferred banning dogs from PRW to alternative policies. Non-Tucson Metropolitan area residents supported allowing dogs on leashes into the wilderness. Majorities of visitors (63%) and non-visitors (61%) endorsed prohibiting dogs from the wilderness ( $\chi^2 = 0.153$ , 417 df,  $P = 0.927$ ) (Table 7).

Support for a horseback policy differed among user-groups ( $\chi^2 = 39.2$ , 415 df,  $P = 0.0006$ ) (Table 8). All groups, except LRH favored seasonal closures over the alternative policies. There was moderate evidence of difference by residency ( $\chi^2 = 14.78$ , 382 df,  $P = 0.01$ ) (Table 8). Pluralities of TMA residents (42%) and non-TMA residents (39%) favored seasonal closures, but differed in their support for prohibition and no restrictions. Visitors (42%) and non-visitors (39%) favored seasonal closures over alternative policies ( $\chi^2 = 1.92$ , 416 df,  $P = 0.360$ ) (Table 8).

Table 7. Stakeholder attitudes toward alternative dog policies in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholders	n	Opinion (%)		
		No dogs allowed	Dogs on leashes	No restrictions
User-group				
The Access Fund	119	50	49	1
La Reserve Homeowner Association	106	70	26	4
Southern Arizona Hiking Club	113	79	21	0
White-tailed deer hunters	80	48	45	7
Visitation				
Visitors	272	63	34	3
Non-visitors <sup>1</sup>	147	61	36	3
Residency				
Tucson area residents	247	72	26	2
Non-Tucson area residents	139	44	50	6
Total	418	62	35	3

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 8. Stakeholder support for alternative horseback policies in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Policy (%)					
		Ban	Seasonal	Permit	No	Seasonal	Other
			closures	system	restrictions	closures/ permits	
<b>User-group</b>							
The Access Fund	121	26	42	21	3	7	1
La Reserve	106	33	32	18	8	8	1
<b>Homeowners Association</b>							
Southern Arizona	112	31	49	6	5	6	3
<b>Hiking Club</b>							
White-tailed deer	81	20	39	12	19	10	0
<b>Hunters</b>							
<b>Visitation</b>							
Visitors	271	29	42	13	7	8	1
Non-visitors <sup>1</sup>	150	27	39	17	9	7	1
<b>Residency</b>							
Tucson area	246	33	42	11	5	8	1
<b>Residents</b>							
Non-Tucson area	141	21	39	21	11	6	2
<b>Residents</b>							
Total	420	28	41	14	8	8	1

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Support for rock climbing policies differed among user-groups ( $\chi^2 = 55.29$ , 417 df,  $P < 0.0001$ ) (Table 9). All groups except LRH favored seasonal closures (Table 9).

Support also differed by residency ( $\chi^2 = 21.7$ , 384 df,  $P = 0.0006$ ) (Table 9) though a majority of non-TMA residents (57%) and a plurality of TMA (47%) residents preferred seasonal closures. Seasonal closures were preferred by visitors and non-visitors ( $\chi^2 = 5.91$ , 418 df,  $P = 0.315$ ) (Table 9).

Support for a hiking policy in PRW differed among user-groups ( $\chi^2 = 38.57$ , 417 df,  $P = 0.0007$ ) (Table 10). Southern Arizona Hiking Club was the most supportive (64%) of seasonal closures, whereas only pluralities of the remaining groups favored this option. There is moderate evidence of a difference by residency ( $\chi^2 = 15.92$ , 384 df,  $P < 0.007$ ) (Table 10). Tucson metropolitan residents, and non-TMA residents favored seasonal closures over the alternative policies, but Tucson residents were more agreeable to prohibiting hiking, and less supportive of removing all restrictions than non-residents (Table 10). Visitors and non-visitors preferred seasonal closures ( $\chi^2 = 8.43$ , 418 df,  $P < 0.134$ ) (Table 10).

I used 2 questions to evaluate support for seasonal and area closures for all recreational activities to reduce stress to desert bighorn sheep. Attitudes toward seasonal closures differ by group-membership ( $\chi^2 = 45.19$ , 418 df,  $P < 0.0001$ ) (Table 11).

Majorities of TAF, LRH, and SAHC endorsed the implementation of seasonal closures,

Table 9. Stakeholder support for alternative rock climbing policies in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Policy (%)					
		Ban	Seasonal	Permit	No	Seasonal	Other
			closures		restrictions	closures/ permits	
<b>User-group</b>							
The Access Fund	121	2	66	18	7	6	1
La Reserve	106	33	31	18	8	8	2
<b>Homeowners Association</b>							
Southern Arizona	112	20	57	12	4	6	1
<b>Hiking Club</b>							
White-tailed deer	81	17	46	15	11	11	0
<b>Hunters</b>							
<b>Visitation</b>							
Visitors	273	19	51	13	9	7	1
Non-visitors <sup>1</sup>	150	15	50	20	5	9	1
<b>Residency</b>							
Tucson area	246	24	47	14	6	8	1
<b>Residents</b>							
Non-Tucson	141	6	57	18	11	7	1
<b>area residents</b>							
Total	422	17	51	16	7	8	1

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 10. Stakeholder attitudes toward alternative hiking policies in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Policy (%)					
		Ban	Seasonal	Permit	No	Seasonal	Other
			closures	system	restrictions	closures/ permits	
<b>User-group</b>							
The Access Fund	122	2	48	29	10	10	1
La Reserve	106	15	43	18	8	15	1
<b>Homeowners</b>							
<b>Association</b>							
Southern Arizona	113	6	64	14	9	6	1
<b>Hiking Club</b>							
White-tailed deer	81	8	46	15	20	11	0
<b>Hunters</b>							
<b>Visitation</b>							
Visitors	273	9	53	16	12	9	1
Non-visitors <sup>1</sup>	150	6	46	25	9	13	1
<b>Residency</b>							
<b>Tucson area</b>							
Tucson area	248	11	54	17	8	9	1
<b>Residents</b>							
Non-Tucson area	141	3	44	24	17	11	1
<b>Residents</b>							
Total	424	8	50	19	11	11	1

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 11. Stakeholder attitudes toward seasonal closures to reduce stress to bighorn sheep during critical periods (e.g., lambing season) in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Natural fire				
		Strongly opposed (%)	Opposed (%)	Neutral (%)	Support (%)	Strongly support (%)
User-group						
The Access Fund	123	16	17	14	36	17
La Reserve Homeowners Association	106	15	5	14	17	49
Southern Arizona Hiking Club	113	15	11	18	22	34
White-tailed deer hunters	80	26	14	19	19	22
Visitation						
Visitors	272	19	14	13	21	33
Non-visitors <sup>1</sup>	151	15	6	21	31	27
Residency						
Tucson area residents	246	17	11	15	19	38
Non-Tucson area residents	143	19	13	18	32	18
Total	422	17	12	16	24	31

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

whereas only a plurality of WTH endorsed the policy (Table 11). Tucson residents were more supportive of seasonal closures than non-residents ( $\chi^2 = 18.81$ , 385 df,  $P = 0.0009$ ) (Table 11). Attitudes toward seasonal closures differed by visitation ( $\chi^2 = 15.12$ , 419 df,  $P = 0.005$ ) (Table 11). Visitors were more opposed to seasonal closures than non-visitors, but majorities of both endorsed the policy.

Attitudes toward area closures differed between user-groups ( $\chi^2 = 36.22$ , 412 df,  $P = 0.0003$ ) (Table 12). Among white-tailed deer hunters there was more opposition (45%) to the use of area closures than supported (39%). Majorities of the other user-groups supported area closures. Tucson metropolitan residents were more supportive of seasonal closures than non-TMA residents ( $\chi^2 = 12.49$ , 379 df,  $P = 0.014$ ). Visitors (55%) and non-visitors (55%) endorsed area closures ( $\chi^2 = 8.52$ , 413 df,  $P < 0.074$ ) (Table 12).

### **Educational needs**

Forty-one percent of LRH reported hiking does have negative effects on wildlife, whereas 49% of AFM, 43% of SAHC, and 50% of WTH reported hiking does not have negative effects on wildlife (Table 13). There is suggestive evidence that attitudes about the effects of hiking on wildlife differs by residency ( $\chi^2 = 5.49$ , 391 df,  $P = 0.064$ ) (Table 13). Non-TMA residents were more likely to think hiking does not have negative effects on wildlife than local residents do. More visitors (48%) than non-visitors (37%) reported hiking does not negatively impact wildlife ( $\chi^2 = 13.93$ , 425 df,  $P = 0.0009$ ) (Table 13).

Table 12. Attitudes toward area closures to reduce stress to wildlife during lambing season in Pusch Ridge Wilderness, Arizona, 1988.

Stakeholder	<i>n</i>	Natural fire				
		Strongly opposed (%)	Opposed (%)	Neutral (%)	Support (%)	Strongly support (%)
User-group						
The Access Fund	120	12	19	19	31	19
La Reserve Homeowners Association	104	13	9	14	20	44
Southern Arizona Hiking Club	113	14	7	17	27	35
White-tailed deer hunters	79	24	21	16	16	23
Visitation						
Visitors	268	15	16	14	22	33
Non-visitors <sup>1</sup>	149	15	9	21	29	26
Residency						
Tucson area residents	242	14	11	16	22	37
Non-Tucson area residents	141	18	18	18	25	21
Total	416	15	14	16	25	30

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 13. Respondents' perceptions of the effects of human activities on wildlife in Pusch Ridge  
Wilderness, Arizona, 1998.

Activity	Group (%)				Visitation (%)		Residency (%)	
	TAF <sup>1</sup>	LRH <sup>2</sup>	SAHC <sup>3</sup>	WTH <sup>4</sup>	Visitors	Non- visitors <sup>5</sup>	TMA <sup>6</sup>	Non-TMA <sup>7</sup>
Hiking	(n = 123)	(n = 106)	(n = 116)	(n = 80)	(n = 275)	(n = 151)	(n = 250)	(n = 143)
Yes	33	41	37	38	34	39	41	30
No	49	35	43	50	37	48	40	52
Do not know	18	24	20	12	29	13	19	18
Horseback riding	(n = 123)	(n = 106)	(n = 117)	(n = 80)	(n = 276)	(n = 151)	(n = 251)	(n = 143)
Yes	47	34	37	27	39	37	38	36
No	23	28	29	59	26	36	31	36
Do not know	30	38	34	14	35	27	31	28

Table 13. Respondents' perceptions of the effects of human activities on wildlife in Pusch Ridge

Wilderness, Arizona, 1998, continued.

Activity	Group				Visitation		Residency	
	TAF <sup>1</sup>	LRH <sup>2</sup>	SAHC <sup>3</sup>	WTH <sup>4</sup>	Visitors	Non-visitors <sup>5</sup>	TMA <sup>6</sup>	Non-TMA <sup>7</sup>
Rock climbing	(n = 123)	(n = 106)	(n = 117)	(n = 80)	(n = 276)	(n = 151)	(n = 251)	(n = 143)
Yes	30	37	38	28	32	34	37	25
No	51	25	24	58	35	39	30	53
Do not Know	19	38	39	14	33	27	33	52
Hunting	(n = 123)	(n = 106)	(n = 117)	(n = 80)	(n = 268)	(n = 149)	(n = 251)	(n = 143)
Yes	42	37	26	38	30	39	34	36
No	28	25	26	58	40	28	31	35
Do not Know	30	38	48	4	30	33	35	29

Table 13. Respondents' perceptions of the effects of human activities on wildlife in Pusch Ridge  
Wilderness, Arizona, 1998, continued.

Activity	Group				Visitation		Residency	
	TAF <sup>1</sup>	LRH <sup>2</sup>	SAHC <sup>3</sup>	WTH <sup>4</sup>	Visitors	Non-visitors <sup>5</sup>	TMA <sup>6</sup>	Non-TMA <sup>7</sup>
Urbanization	(n = 124)	(n = 105)	(n = 116)	(n = 79)	(n = 274)	(n = 151)	(n = 247)	(n = 144)
Yes	89	85	85	86	83	88	88	87
No	2	4	3	9	3	4	4	5
Do not Know	9	11	12	5	14	8	8	8

<sup>1</sup> The Access Fund.

<sup>2</sup> La Reserve Homeowners Association.

<sup>3</sup> Southern Arizona Hiking Club.

<sup>4</sup> White-tailed deer hunters.

<sup>5</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

<sup>6</sup> Respondents residing in the Tucson Metro area.

<sup>7</sup> Respondents residing outside the Tucson Metro area.

Opinions concerning the effects of horseback riding on wildlife differs between user-groups ( $\chi^2 = 37.77$ , 424 df,  $P < 0.0001$ ) (Table 13). Pluralities of TAF, LRH, and SAHC reported horseback riding does have negative effects on wildlife. Opinions did not differ by residency ( $\chi^2 = 1.36$ , 392 df,  $P < 0.508$ ) (Table 13). Visitors (37%) and non-visitors (39%) reported horseback riding does have negative effects on wildlife ( $\chi^2 = 4.00$ , 425 df,  $P = 0.14$ ) (Table 13).

Opinions concerning the effects of rock climbing on PRW wildlife differed by user-group ( $\chi^2 = 45.62$ , 424 df,  $P < 0.0001$ ) (Table 13). Members of TAF and WTH were more likely to report rock climbing does not affect wildlife, but LRH and SAHC were not sure. Opinions also differed by residency ( $\chi^2 = 20.12$ , 392 df,  $P < 0.0001$ ) (Table 13). Perceptions of the effects of rock climbing on wildlife did not differ between visitors and non-visitors ( $\chi^2 = 2.39$ , 425 df,  $P = 0.304$ ) (Table 13).

Opinions concerning the effects of hunting differed between user-groups ( $\chi^2 = 56.36$ , 424 df,  $P < 0.0001$ ). Opinions concerning the effects of hunting did not differ by residency ( $\chi^2 = 31.88$ , 382 df,  $P = 0.391$ ) (Table 13). A greater percentage of non-visitors (40%) reported hunting does not have long-term effects on wildlife than visitors (28%) ( $\chi^2 = 6.48$ , 415 df,  $P = 0.039$ ). Of the respondents who reported hunting has long-term effects on wildlife ( $n = 104$ ), 45% reported hunting as beneficial affects including revenue generation, maintaining populations, and improving sex and age ratios. Negative effects mentioned were stress, displacement, disturbance, and poaching.

Perceptions of the effects of urbanization on wildlife did not differ between user-groups ( $\chi^2 = 9.00$ , 422 df,  $P = 0.174$ ), or residency ( $\chi^2 = 0.344$ , 389 df,  $P = 0.8420$ ) (Table 13). There is suggestive evidence that perceptions of the effects of urbanization on wildlife differed between visitors and non-visitors ( $\chi^2 = 5.03$ , 423 df,  $P = 0.081$ ) (Table 13). Twice as many non-visitors (14%) than visitors (7%) stated they did not know if urbanization has negative affects on wildlife. Of those respondents who reported urban expansion does have negative affects on wildlife ( $n = 277$ ), habitat loss and fragmentation was cited most often (77%), followed by displacement (13%) and disturbance (13%). Other affects listed included noise, overuse, stress, habitat degradation, introduction of exotics, pollution, and fire suppression.

There is suggestive evidence that attitudes toward the effects of natural fires in PRW differed between user-groups ( $\chi^2 = 16.44$ , 418 df,  $P = 0.058$ ) (Table 14). Majorities of every user-group, except LRH reported natural fires are beneficial. Attitudes did not differ by residency ( $\chi^2 = 4.31$ , 385 df,  $P = 0.230$ ) (Table 14). Pluralities of Tucson residents (49%) and non-residents (45%) reported natural fires are beneficial. A majority of visitors (52%) and plurality of non-visitors (43%) reported natural fires are beneficial ( $\chi^2 = 4.00$ , 419 df,  $P = 0.262$ ) (Table 14).

Knowledge of which agencies are responsible for managing wildlife populations in PRW differed between user-groups ( $\chi^2 = 70.57$ , 417 df,  $P < 0.0001$ ) (Table 15). White-tailed deer hunters had the highest percentage of correct answers (55%) and LRH had the lowest (10%). Knowledge of agency responsibility related to managing wildlife

Table 14. Stakeholder attitudes concerning the effects of natural fires in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Natural fire			
		Harmful (%)	Beneficial (%)	Depends (%)	Do not know (%)
User-group					
The Access Fund	123	3	51	30	16
La Reserve Homeowners Association	104	10	38	30	22
Southern Arizona Hiking Club	115	3	53	27	17
White-tailed deer hunters	79	5	53	34	8
Visitation					
Visitors	273	4	52	28	16
Non-visitors <sup>1</sup>	149	7	43	33	17
Residency					
Tucson area residents	244	5	49	27	19
Non-Tucson area residents	149	5	45	37	13
Total	421	5	49	30	16

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

Table 15. Stakeholder knowledge of agency responsibility in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	Managing wildlife populations			Enforcing recreational restrictions		
		Correct	Incorrect	Do not	Correct	Incorrect	Do not
		(%)	(%)	know (%)	(%)	(%)	know (%)
User-group							
The Access Fund	123	18	51	31	48	24	28
La Reserve	105	9	44	47	12	39	49
Homeowners							
Association							
Southern Arizona	114	19	55	26	46	21	30
Hiking Club							
White-tailed deer hunters	77	54	38	8	34	47	20
Visitation							
Visitors	268	24	57	19	41	37	22
Non-visitors <sup>1</sup>	150	22	31	47	25	25	50
Residency							
Tucson area residents	244	21	50	29	33	33	34
Non-Tucson area residents	143	26	45	29	38	32	30

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

populations did not differ by residency ( $\chi^2 = 0.90$ , 384 df,  $P = 0.639$ ) or visitation ( $\chi^2 = 0.1$ , 419 df,  $P = 0.755$ ) (Table 15).

Knowledge of which agency is responsible for recreational law enforcement differed among user-groups ( $\chi^2 = 50.64$ , 416 df,  $P < 0.0001$ , 416) (Table 15).

Knowledge did not differ by residency ( $\chi^2 = 0.896$ , 384 df,  $P = 0.639$ ) (Table 15), with a minority of residents and non-residents correctly answered the question. Knowledge of agency responsibility for enforcing recreational restrictions differed between visitors and non-visitors ( $\chi^2 = 10.67$ , 418 df,  $P = 0.001$ ) (Table 15) with more non-TMA residents correctly answering the question. Knowledge of current recreational restrictions differed among user-groups ( $\chi^2 = 49.59$ , 416 df,  $P < 0.0001$ ), residency ( $\chi^2 = 30.49$ , 384 df,  $P < 0.0001$ ) and between visitors and non-visitors ( $\chi^2 = 79.46$ , 417 df,  $P < 0.0001$ ) (Table 16). Minorities of all stakeholder groups were aware of any current recreational restrictions in PRW (Table 16). Respondents who were aware of current restrictions ( $n = 136$ ) cited seasonal restrictions (50%), restrictions on off-trail hiking (18%), dog restrictions (35%), fire restrictions (.07%), party size limit (2%), rock climbing bolt ban (4%), a ban on vehicles in the wilderness (15%).

## **Discussion**

### **Public participation and satisfaction**

Wilderness areas must be managed for the dual and sometimes conflicting purposes of protecting natural resources and providing recreational opportunities (Coggins and Glicksman 1990). If natural resource professionals are to fulfill these goals

Table 16. Stakeholder knowledge of the presence of any current recreational restrictions in Pusch Ridge Wilderness, Arizona, 1998.

Stakeholder	<i>n</i>	No (%)	Yes (%)
User-group			
The Access Fund	121	67	33
La Reserve Homeowners Association	105	81	19
Southern Arizona Hiking Club	112	41	59
White-tailed deer hunters	79	81	19
Visitation			
Visitors	270	51	49
Non-visitors <sup>1</sup>	148	94	6
Residency			
Tucson area residents	246	57	43
Non-Tucson area residents	139	78	22

<sup>1</sup> Non-visitors defined as any respondent that has not visited Pusch Ridge Wilderness.

they must stay abreast of and incorporate public values and desires with the most current biological and economic information (Shaw and Zube 1980, Witter 1987, Rudzits and Johansen 1991).

Public satisfaction with PRW recreational opportunities is high. The majority of respondents had visited PRW at least once, and 61% of respondents rated the wilderness as “good” in terms of providing recreational opportunities. A similar study found 83% of trail-users had previously visited PRW and the presence of the wilderness was important to recreationists (Harris et al. 1995). Despite the high volume of use and diversity of activities pursued, only 13% of respondents reported ever having conflicts with other recreationists in or around the wilderness.

I found respondents participate in wildlife viewing more than any other activity in PRW. Visitors are attracted to PRW for its aesthetic, psychological, and physical benefits (Purdy 1981) and wildlife appears to be a significant aspect to each of these benefits. Similarly, Harris et al. (1995) found the primary reason for visiting PRW for 79% percent of trail-users was wildlife viewing (excluding birds), and 26% reported bird watching as the primary reason. Clearly the presence of wildlife in PRW contributes to the recreational experience and public satisfaction, but is not indicative that the public is satisfied with wildlife conservation in PRW. The public is not as satisfied with wildlife conservation as with recreational opportunities in PRW. Since 1981, public satisfaction with wildlife conservation in PRW has been about 33% (Purdy 1981).

A minority of respondents rated PRW as “good” in terms of incorporating public concerns. There is ample opportunity to increase public satisfaction considering 44%

were undecided when asked to rate PRW for incorporating public concerns, and few had ever attended or participated in public meetings or surveys administered by the USFS or AGFD. Increasing opportunities or awareness of opportunities for citizens to voice their opinions could improve public satisfaction.

### **Bighorn sheep management**

The decline of bighorn sheep is reflected in the low occurrence of sightings by recreationists. Only 16% of respondents had ever seen bighorn in PRW, with the latest sighting reported in 1993. Harris et al. (1995) reported similar sighting rates. Overall knowledge of bighorn status was poor. Respondents either are not concerned with, or are not exposed to information detailing the status of bighorn sheep. Findings from 1 other survey support the latter explanation. Sixty percent of the general public reported having no information on bighorns in PRW (Purdy 1981). Yet, since 1975 there as been  $\geq 50$  newspaper articles printed in 2 Tucson newspapers concerning bighorn conservation in PRW. Also, informational signs explaining the plight of bighorn sheep in PRW, and the reasons behind recreational restriction have been constructed at Pima and Romero Canyon trail heads. The number of non-Tucson residents (34%), and non-visitors (35%) in my sample may partially explain the lack of awareness. Harris et al. (1995) reported 93% of trail-users in PRW were aware of the presence of bighorns. Similarly, the majority of non-TMA residents did not know the current status of bighorn sheep whereas the majority of Tucson residents were aware of the decline. Visitors to PRW were also more aware of

the decline than non-visitors indicating information is available and used by local residents and recreationists.

In PRW, conservation of these desert bighorn sheep will require a variety of management activities including translocations, recreational restrictions and habitat management. Respondents supported translocating sheep in PRW. Reintroductions have been effective in restoring dwindling wildlife populations including elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*), turkey (*Meleagris gallopavo*) bighorn sheep, and endangered species including the gray wolf (*Canis lupus*) (Fritts et al. 1995). Most reintroductions have been used to establish wildlife populations in areas where endemic populations have been extirpated, usually after the original decimating factor(s) has been removed. Conversely, translocations usually are used to augment existing populations. In PRW urbanization, recreation, and fire suppression are suspected to have caused the decline of bighorn sheep and may still pose significant threats to bighorn sheep in PRW and render any translocation unsuccessful. Prior to translocating sheep into PRW managers should address recreational disturbances, evaluate habitat conditions, and where necessary implement habitat modification activities.

Recreational activities may have contributed to the decline of bighorn sheep in PRW (Harris et al. 1995, Krausman et al. 1997, Krausman 1997), consequently restoration of sheep in PRW will necessitate minimizing recreational disturbance. Public willingness to sacrifice recreational opportunities (i.e., hiking) to benefit the long-term survival of sheep is well-documented (Harris et al. 1995, Purdy 1981). Respondents favored implementing seasonal closures for hiking, rock climbing, and horseback riding.

Members of TAF and SAHC were the most supportive of seasonal closures on rock climbing and hiking respectively suggesting resource managers can expect cooperation with restrictions provided individual recreationists are aware of the regulations. There was overwhelming support for banning dogs from PRW entirely. Most respondents (except WTH) were also supportive of area closures to benefit wildlife. Logistically, seasonal closures are probably the most feasible alternative, and biologically the most advantageous to wildlife. The low rate of compliance with existing restrictions (Schonecker 1997) is believed to be partly a function of the lack of law enforcement. Concentrating the presence and visibility of law enforcement officers during seasonal closures or in closed areas may increase compliance without having to hire additional personnel. Similar plans have been successful in minimizing human disturbance in critical areas used by Rocky Mountain bighorn sheep in Rocky Mountain National Park, Colorado (Mary Cowan, National Park Service, personal communication).

Desert bighorn sheep prefer open, grassy areas with high visibility adjacent to escape cover (McCarthy and Bailey 1994). Fire suppression in PRW has allowed shrubs to increase thus decreasing visibility, forage availability, and habitat quality for bighorn sheep (Etchberger et al. 1990). Although some fires have occurred in PRW in recent years (Ron Olding, Arizona Game and Fish Department, personal communication) many resource professionals believe that prescribed fires are needed to improve habitat conditions prior to or concurrent with a sheep translocation. The use of prescribed burns or allowing natural fires to burn is a controversial because of risks to private property and short-term reduction in aesthetic quality of the area (Harris et al. 1995). Respondents in

my study strongly endorsed the use of prescribed fire to benefit bighorn sheep despite possible risks to property and short-term reduction of aesthetic quality and recreational activities. Respondents were not as supportive of allowing natural fires to burn. Support varied slightly between user-groups, though there was more support for allowing fires to burn than opposition. La Reserve Homeowners were the least supportive of fire management activities, and clearly would incur the greatest risk if prescribed fires were implemented or natural fires were allowed to burn. The varying support among the types of fire techniques and objectives indicate the public is sensitive to fire management, and that resource professionals should clearly demonstrate how management will reduce wildfire hazards to homeowners (Carpenter et al. 1986). Open lines of communication between interest groups, particularly adjacent property owners and agencies prior to implementation of prescribed fires should be effective in minimizing opposition during and after fire management activities (Carpenter et al. 1986).

### **Educational needs**

A primary goal of educational programs for natural resources agencies has been to increase public awareness of wildlife management issues and cooperation with technical solutions (Shepard and Speelman 1986, Westphal and Halverson 1986). An education program designed to inform the public about wildlife ecology, desert bighorn sheep management would contribute significantly to the successful management of bighorn in PRW. I identified several topics that should be incorporated into educational programs to facilitate bighorn recovery in PRW. The role of fire in natural communities has been well

established in the scientific literature, but the public retains misconceptions and fears about fire. Nearly half of respondents reported natural fires are beneficial in natural communities, and 30% reported the effect of natural fires depends on specific situation. This should be viewed as an opportunity for PRW managers to increase public support for active fire management, including allowing natural fires to burn. By developing and presenting a fire management plan that reduces wildfire hazards, improves wildlife habitat, and details risks, PRW managers can expect to gain additional support from the undecided populace (Carpenter et al. 1986). Fire management programs need to target a cross-section of adults and address specific topics, such as fire size, intensity, and objectives. Resource managers must clearly describe where and when natural fires would be allowed to burn and prescribed fires used (Carpenter et al. 1986).

The public is not aware of the possible negative effects of non-consumptive activities on wildlife populations. Most respondents did not report that recreational activities have negative effects on wildlife. Purdy (1981) found most recreationists believed their own activities were not harmful to wildlife, but that the activities of others were detrimental to wildlife. Increasing public understanding of possible effects of non-consumptive activities should increase adherence with recreational restrictions.

The public is keenly aware of the effects of urbanization on wildlife. A vast majority of respondents felt urbanization negatively affects wildlife, but knowledge does not always translate into appropriate action. Urban expansion is believed to be the primary contributor to the decline of bighorn sheep in PRW (Krausman et al. 1979, Harris et al. 1995, Krausman 1997). It has created a barrier around 3 sides of the wilderness,

restricted movement, and destroyed traditional feeding grounds (Krausman 1997).

Currently the only existing corridor allowing inter-mountain travel by bighorn sheep is to the north. On 22 April 1999, the City Commissioners for Pinal County voted to allow the development of 5,600 homes over the next 5 years in Oracle located to the north of PRW, which will effectively complete the isolation of PRW. This situation highlights the need for extensive education campaigns covering large geographic areas surrounding protected lands.

Implementation of new management plans often results in public opposition in the form of editorials, verbal and written complaints, legal recourse (i.e., law suites, public referenda), and dissatisfaction with management agencies. Public knowledge of agency responsibility was poor. Agency jurisdiction of public lands and resources varies considerably and may contribute to public opposition and dissatisfaction by impeding communication between citizens and agencies prior to implementation of management plans. The lack of knowledge regarding agency responsibility indicates the USFS and AGFD are not as visible to the public as they should be (Gilbert 1982).

Current compliance with existing regulations is poor (Schoenecker 1997). To exacerbate the problem, the greatest use of bighorn habitat by off-trail hikers occurs in January-June, during lambing season (Harris et al. 1995). Poor compliance with restrictions is probably due to the lack of knowledge of restrictions and law enforcement. To counteract this PRW managers have suggested developing inter-agency jurisdiction so AGFD officers could enforce USFS regulations in PRW (Arizona Game and Fish Department 1985). Law enforcement officers, regardless of jurisdiction can provide

information about recreational restrictions and considering the lack of knowledge of agency jurisdiction may increase compliance with regulations.

### **Management implications**

The success of an integrated resource management plan in PRW, including bighorn sheep restoration and recreation management will hinge on an active and well-publicized public outreach program. The program should target 3 specific segments of the public: special interest groups (i.e., SAHC, TAF, LRH, WTH), independent recreationists, and the general public. Managers should first identify special interest groups active in PRW and develop ways of maintaining communication with them. Managers should provide them with information on upcoming or new management activities and allow them a chance to express their opinions. This type of proactive approach should increase support and cooperation with management activities, and improve public perceptions of and satisfaction with management agencies.

Second, managers need to be more visible and accessible to independent visitors to PRW. This could be accomplished with volunteers representing the USFS along trails. Volunteers could be trained to communicate with recreationists and provide information about management objectives and regulations. Efforts should also be made to increase the presence of law enforcement officers along trails. Patrolling trails on peak days and or periods would maximize the number of contacts by law enforcement officers without sacrificing responsibilities in other areas of Coronado National Forest.

Efforts should be made to increase the general public's knowledge of PRW management activities. Most people obtain their information of wildlife conservation from

television (Gilbert 1982) and are most interested in mammals and other culturally important species (Kellert 1987). Pusch Ridge managers could develop a monthly news segment in cooperation with local television news programs to inform the public of management activities and progress. The program should gain the public's attention by highlighting large mammals, particularly desert bighorn sheep, but should also strive to increase public knowledge and interest in all wildlife. Additionally, managers should inform television news station and radio stations about prescribed fires and annual seasonal closures.

Managers must continually evaluate and revise management activities to meet their objectives. Studies designed to evaluate survival, productivity, mortality, and habitat use need to be conducted to evaluate the success of bighorn sheep translocations. Recreational restrictions can be evaluated with the aid of student interns, and repeating studies by Purdy (1981), Harris (1992) and Schoenecker (1997). Information gathered by repeating these studies would provide a comparison of public attitudes and behavior before and after the recovery of desert bighorn sheep and implementation of seasonal closures. This information would provide PRW managers, and other natural resource professionals with increased insight into the management of wilderness and wildlife threatened with urbanization and increased recreational use.

### **Post Script**

On 6 June 1999 representatives from the AGFD, USFS, and University of Arizona met to discuss the future of sheep conservation in PRW. Considering the results of this study and similar findings by Harris (1992) and Purdy (1981) the AGFD presented a plan

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to translocate an experimental herd of  $\approx 30$  sheep into PRW. This proposal was contingent on a verbal commitment by the USFS to incorporate prescribed fires and natural fires into their forest management plan. The USFS expressed interest in restoring fire to PRW and agreed to incorporate prescribed fires and natural fire into their revised forest management plan that is currently being written. A subcommittee was formed with representatives from the AFGD, USFS, and University of Arizona to proceed with the proposed plan to reestablish desert bighorn sheep in PRW.

**APPENDIX A**

**USER-GROUPS ATTITUDES RELATED TO PUSCH RIDGE WILDERNESS**

**MANAGEMENT MAIL SURVEY INSTRUMENT**

**User-group participation request letter mailed to organization officers.**

Patrick Devers  
Research Assistant  
104 Biosciences East Building  
The University of Arizona,  
Tucson, Arizona 85721  
15 August, 1999

Tom Matthews  
Arizona Regional Representative  
The Access Fund  
4610 East Catalina Dr.  
Phoenix, AZ 85018

Dear Mr. Matthews,

I am conducting a survey on public attitudes and beliefs with regards to wildlife management and recreation in the Pusch Ridge Wilderness. Tucson, Arizona. This survey is a part of a study at the University of Arizona, School of Renewable Natural Resources. The goal of the study is to provide natural resource managers with a better understanding of the opinions and activities of people with an interest in the resources of Pusch Ridge Wilderness. Your organization has an obvious interest in the management of Pusch Ridge Wilderness, and I request your participation in this effort. This study offers members of the Access Fund an opportunity to let their opinions be known and contribute to the management of Pusch Ridge Wilderness.

I propose to mail a short survey, in the fall (early October) to Access Members residing in the Tucson Metropolitan Area. The survey will be completely confidential, and the respondents' names will not be used for any other purposes. Results of the survey will be the basis of a Master's Thesis, and will be made available to resource managers and the public.

I ask the Access Fund to participate in this study by providing a current list of members and their addresses in the Tucson Metropolitan Area. Please consider this request and I will contact you in the next week. If you have any questions you can reach me at (520) 621-3361, or (520) 903-1765. My email address is [pkd@ag.arizona.edu](mailto:pkd@ag.arizona.edu). Thank you for your time.

Sincerely,

Patrick Devers  
Research Assistant

**Pre-survey informational letter distributed on 19 November 1998.**

Patrick Devers  
Research Assistant  
104 Biosciences East Building  
The University of Arizona,  
Tucson, Arizona 85721  
15 August, 1999

Dear \_\_\_\_\_,

Tucson is a unique area, surrounded by numerous public lands, such as Pusch Ridge Wilderness, established to protect wildlife and wilderness, and provide recreational opportunities. It is essential that the opinions, desires, and beliefs of the public are considered when creating management plans for public lands and wildlife. You have been selected to receive a survey about wildlife conservation and recreational opportunities in Pusch Ridge Wilderness because of your affiliation with the Southern Arizona Hiking Club. This survey is part of a study being conducted by the University of Arizona, School of Renewable Natural Resources. Our goal is to provide natural resource managers with a better understanding of the opinions and beliefs of the people who have an interest in the resources of Pusch Ridge Wilderness. You will receive the survey in the next few days, please take the time to complete the survey and participate in the management of your natural resources. Thank you for your help.

Sincerely,

Patrick Devers  
Research Assistant

**Cover letter and survey distributed on 30 November 1998.**

Patrick Devers  
Research Assistant  
104 Biosciences East Building  
The University of Arizona,  
Tucson, Arizona 85721

Dear \_\_\_\_\_,

Pusch Ridge Wilderness was established to protect wildlife and wilderness, and to provide recreational opportunities. It is essential that the opinions and desires of the public be considered when creating management plans for public and wildlife. As I mentioned in a previous letter, this survey is part of a study being conducted by the University of Arizona, School of Renewable Natural Resources. The purpose of this survey is to provide natural resource managers with a better understanding of the opinions and beliefs of people who have an interest in Pusch Ridge Wilderness. You have been selected to participate in this survey because of your membership in the Southern Arizona Hiking Club. It is important that you complete and return this survey, so that your views are considered in the management of Pusch Ridge Wilderness. If you wish to comment on any of the questions, or qualify any of your answers please feel free to use the space in the margins, or a separate sheet of paper. Your comments will be read and taken into account.

This questionnaire has an identification number so that we may check your name off our mailing list when you return your questionnaire. Your name will never be directly associated with your responses, or used for any other purpose. Thank you for your help.

Sincerely,

Patrick K. Devers

1. Have you ever visited Pusch Ridge Wilderness?

- |        |                    |               |
|--------|--------------------|---------------|
| 1. Yes |                    | 65% (n = 432) |
| 2. No  | → If no, go to # 8 | 35% (n = 153) |

2. Have you ever seen any of the following types of wildlife in Pusch Ridge Wilderness (PRW)? Please Circle the number(s) of all that apply.

- |                      |               |
|----------------------|---------------|
| 1. Deer              | 58% (n = 279) |
| 2. Coyotes           | 59% (n = 279) |
| 3. Bighorn sheep     | 14% (n = 277) |
| 4. Peregrine Falcons | 18% (n = 275) |
| 5. Desert Tortoises  | 20% (n = 279) |
| 6. Javelina          | 51% (n = 142) |
| 7. Gila Monsters     | 30% (n = 279) |
| 8. Other: _____      | 31% (n = 274) |

Other animals sighted included: bats, rabbits, mountain lions, snakes, hawks, red-tailed hawks, lizards, foxes, ringtail, bobcat, coati, raccoons, roadrunners, skunks, owls, dove, quail, ducks, squirrels, golden eagles, frogs, small mammals, raptors, hummingbirds, spotted owl.

3. Please estimate the number of days in the past 12 months you have engaged in each of the following activities in the Pusch Ridge Wilderness (PRW).

- |  |  |
|--|--|
| 1. Enjoyed views of PRW from outside the wilderness. (n = 250)   | $\bar{x} = 145 (\pm 10.1 \text{ SE.})$ |
| 2. Hiked on established trails in PRW. (n = 252)   | $\bar{x} = 8 (\pm 1.2 \text{ SE})$     |
| 3. Hiked off the trails in PRW. (n = 250)  | $\bar{x} = 4 (\pm 1.0 \text{ SE})$     |
| 4. Viewed wildlife in PRW. (n = 250)   | $\bar{x} = 22 (\pm 4.6 \text{ SE})$    |
| 5. Rock climbed in PRW. (n = 252)  | $\bar{x} = 1 (\pm 0.84 \text{ SE})$    |
| 6. Went horseback riding in PRW. (n = 252)   | $\bar{x} = 1 (\pm 0.08 \text{ SE})$    |
| 7. Hunted in PRW. (n = 252)  | $\bar{x} = 0.37 (\pm 0.01 \text{ SE})$ |
| 8. Participated in any other activities in PRW<br>(Please list the activity, and indicate the number of days). |  |
| Picnicking, camping, photography (n = 233)   | $\bar{x} = 0.01 (\pm 0.01 \text{ SE})$ |

4. Have you ever seen any bighorn sheep in Pusch Ridge Wilderness (PRW)? (n = 276)

- |        |                                     |     |
|--------|-------------------------------------|-----|
| 1. Yes | <input type="checkbox"/>            | 16% |
| 2. No  | <input checked="" type="checkbox"/> | 84% |

If yes, where did you last see bighorn sheep in PRW? (n = 41)

- |  |     |
|--|-----|
| A. On or near Pima Canyon Trail        | 44% |
| B. On or near Romero Canyon Trail      | 22% |
| C. On or near Finger Rock Canyon Trail | 12% |
| D. Other:                              | 22% |

Pusch Ridge, Wilderness Estates, Pusch Peak

When was the last time you saw bighorn sheep in PRW?

Please provide month and year.

1970, 72, 73, 83, 85, 87, 88, 89, 90, 92, 93

5. Have you ever seen peregrine falcons in Pusch Ridge Wilderness (PRW)? (n = 269)

- |        |                                     |     |
|--------|-------------------------------------|-----|
| 1. Yes | <input type="checkbox"/>            | 15% |
| 2. No  | <input checked="" type="checkbox"/> | 85% |

If yes, where did you last see peregrine falcons in PRW? (n = 47)

- |  |     |
|--|-----|
| A. On or near Pima Canyon Trail        | 36% |
| B. On or near Romero Canyon Trail      | 11% |
| C. On or near Finger Rock Canyon Trail | 11% |
| D. On or near Ventana Canyon Trail     | 9%  |
| E. Other:                              | 33% |

Pusch Ridge, Rappel Rock, Rooney wash, Mt. Kimball, Willow Canyon, Summit Crags Ravins

When was the last time you saw peregrine falcons in PRW?

Please provide month and year.

1988, 96, 97

6. Have you seen a law enforcement officer in Pusch Ridge Wilderness in the last 12 months? (n = 263)

1. Yes	15%
2. No	85%

To the best of your knowledge what agency did the officer represent? (n = 34)

A. Pima County Sheriff	27%
B. Arizona Game and Fish Department	24%
C. U. S. Forest Service	44%
D. U. S. Fish and Wildlife Service	3%
E. Other: _____	3%

7. Have you ever had any conflicts with other recreationists in or around PRW? (n = 272)

1. Yes	13%
2. No	87%

If yes, please explain any conflict you have had with other recreationists.

Interactions between hikers/4-wheel drive vehicles, hunters/anti-hunters, disruptive and loud recreationists, hikers/horseback riders, hikers/dogs on and off leashes, hikers/hunters, hunters/hunters, restricted access by homeowners.

8. Please indicate your current place of residence, and how long you have lived at your current location.

1. Tucson Metro Area (n = 252)	$\bar{x} = 14.7$ years ( $\pm 0.85$ s.e.)
2. Phoenix Metro Area (n = 101)	$\bar{x} = 16$ years ( $\pm 1.35$ s.e.)
3. Other (n = 46)	$\bar{x} = 13.1$ years ( $\pm 1.83$ s.e.)

9. Two important benefits of Pusch Ridge Wilderness (PRW) are, outdoor recreation and wildlife conservation. Which is more important to you? (Circle the number corresponding to your response) (n = 425)

1. Don't Know	2%
2. Recreation	6%
3. Wildlife conservation	30%
4. Recreation and wildlife conservation equally	62%

10. To the best of your knowledge what is the status of bighorn sheep in Pusch Ridge wilderness (PRW)? (n = 427)

- |                                    |     |
|------------------------------------|-----|
| 1. No bighorn sheep remain in PRW. | 17% |
| 2. The population is declining.    | 41% |
| 3. The population is stable.       | 2%  |
| 4. The population is increasing    | 1%  |
| 5. Don't know                      | 39% |

→ If you answered #1 or #2 above, what factors do you think are the causes of the decline or disappearance of bighorn sheep in PRW? (Circle all that apply). (n = 249)

- |  |      |
|--|------|
| A. Urban development                         | 84%  |
| B. Hunting                                   | 13%  |
| C. Predators                                 | 28%  |
| D. Disturbances from recreational activities | 46%  |
| E. Disease                                   | 18%  |
| F. Fire suppression                          | 8%   |
| G. Don't know                                | 14%  |
| H. Other:                                    | 4.4% |

Other factors cited: pollution, natural dispersal (immigration), dogs isolation, marginal habitat, natural cycle, noise, helicopters.

Please place an \* by the single factor on the list above that you feel is the most responsible for the decline of bighorns in Pusch Ridge Wilderness. (n = 249)

- |  |     |
|--|-----|
| A. Urban development                         | 73% |
| B. Hunting                                   | 1%  |
| C. Predators                                 | 7%  |
| D. Disturbances from recreational activities | 11% |
| E. Disease                                   | 3%  |
| F. Fire suppression                          | 3%  |
| G. Don't know                                | 1%  |
| H. Other:                                    | 1%  |

11. If you knew that bighorn sheep were declining or gone from Pusch Ridge Wilderness, would you support a plan to transplant more bighorn sheep into Pusch Ridge Wilderness? (n = 421)

1. Yes	69%
2. No	19%
3. Don't know	12%

→ If you answered #1 or #2 above, how strongly do you feel about your answer? (n = 284)

A. Very strong	49%
B. Somewhat strong	46%
C. Not strong at all.	5%

12. To the best of your knowledge, are peregrine falcons present in Pusch Ridge Wilderness? (n = 420)

1. Yes	22%
2. No	4%
3. Don't know	74%

13. Do you believe hiking has any negative affects on wildlife in PRW? (n = 425)

1. Yes	44%
2. No	37%
3. Not sure	19%

↓  
If yes, please explain.

Displacement, pollution, habitat degradation, stress, habituation, disturbance, habitat loss, minor, moderate, noise.

14. Do you believe horseback riding has any negative affects on wildlife in PRW? (n = 426)

1. Yes	37%
2. No	33%
3. Not sure	30%

↓  
If yes, please explain.

Competition for food, habitat degradation, trail degradation, pollution, displacement, disturbance, noise, stress, habituation, introduction of exotics, habitat loss, minor, moderate.

15. Do you believe rock climbing has any negative affects on wildlife in PRW? (n = 426)

1. Yes	33%
2. No	38%
3. Not sure	29%



If yes, please explain.

Habitat degradation, displacement, disturbance, noise, pollution, stress, habituation, habitat loss, minor

16. Do you believe urban expansion has any negative affects on wildlife in PRW? (n = 424)

1. Yes	86%
2. No	4%
3. Not sure	10%



If yes, please explain.

Displacement, habitat degradation, disturbance, habitat loss, noise, introduction of exotics, habitat fragmentation, pollution, overuse, major, minor, fire suppression, stress

17. Do you believe regulated hunting has any long-term affects on wildlife populations in Pusch Ridge Wilderness? (n = 416)

1. Yes	36%
2. No	33%
3. Not sure	31%



If yes, please explain.

Anti-hunting, beneficial, decreases populations, displacement, disturbance, noise, loss of habitat, minor, negative, poaching, pollution, stress

18. On a scale of 1 to 5 (1 = strongly opposed, 5 = strongly support, and 3 = neutral) how would you rate your feelings about the following actions that could be taken to protect and benefit wildlife in Pusch Ridge Wilderness (PRW)?

	1	2	3	4	5
1. Planned burns on portions of PRW to improve wildlife habitat. (n = 419)	8%	6%	27%	26%	33%
2. Letting natural fires burn in PRW to improve wildlife habitat. (n = 419)	8%	9%	31%	21%	31%
3. Prohibiting all dogs in PRW to reduce stress on wildlife. (n = 425)	14%	9%	18%	13%	46%
4. Prohibiting all horseback riding in PRW to reduce stress on wildlife. (n = 425)	19%	13%	31%	14%	23%
5. Prohibiting all rock climbing in PRW to reduce stress on wildlife. (n = 421)	37%	12%	26%	10%	15%
6. Prohibiting all hiking in PRW to reduce stress on wildlife. (n = 422)	52%	18%	15%	4%	11%
7. Prohibiting all recreational activities only during seasons critical to wildlife (i.e., lambing and nesting seasons) (n = 422)	17%	12%	16%	24%	31%
8. Prohibiting recreational activities only in areas critical to wildlife. (n = 418)	15%	13%	17%	25%	30%

19. In general, do you believe natural fires are harmful or beneficial in Pusch Ridge Wilderness? (n = 421)
- |               |     |
|---------------|-----|
| 1. Harmful    | 5%  |
| 2. Beneficial | 49% |
| 3. Depends    | 30% |
| 4. Don't know | 16% |
20. Sometimes natural resource agencies use prescribed burns (intentionally started and carefully controlled fires) to reduce wildfire hazards, and improve wildlife habitat. Please indicate the level of your support for using prescribed burns in Pusch Ridge Wilderness to reduce fire hazards, and improve wildlife habitat. (n = 423)
- |                     |     |
|---------------------|-----|
| 1. Strongly oppose  | 4%  |
| 2. Oppose           | 6%  |
| 3. Neutral          | 20% |
| 4. Support          | 42% |
| 5. Strongly support | 28% |
21. To the best of your knowledge list the government agency or agencies that are responsible for managing wildlife populations in Pusch Ridge Wilderness? (n = 419)
- |            |     |
|------------|-----|
| Correct    | 23% |
| Incorrect  | 48% |
| Don't know | 29% |
22. To the best of your knowledge list the government agency or agencies that are responsible for enforcing recreational restrictions in Pusch Ridge Wilderness, not including hunting regulations? (n = 418)
- |            |     |
|------------|-----|
| Correct    | 36% |
| Incorrect  | 32% |
| Don't know | 32% |
23. Are you aware of any current recreational restrictions in Pusch Ridge Wilderness? (n = 419)
- |        |     |
|--------|-----|
| 1. Yes | 34% |
| 2. No  | 66% |

If yes, please list those you are aware of.

No motorized vehicles, seasonal closures, bolt ban, dog restrictions, no off-trail hiking, party size limit, fire restrictions.

For each of the following 4 questions please indicate the policy you favor and the strength of your feeling about the policy. (Please circle the number and letter of your response)

24. If dogs were shown to cause stress or be detrimental to bighorn sheep in PRW, which of the following policies would you favor concerning dogs in PRW? (n = 418)

Policy

- |                               |     |
|-------------------------------|-----|
| 1. No dogs in the wilderness. | 62% |
| 2. Dogs must be on a leash.   | 35% |
| 3. No restrictions.           | 3%  |

Strength

- |                      |     |
|----------------------|-----|
| A. Very strong       | 74% |
| B. Somewhat strong   | 24% |
| C. Not strong at all | 2%  |

25. If hiking in PRW was shown to cause stress in or be detrimental to bighorn sheep or peregrine falcons in PRW, which of the following policies would you prefer in PRW? (n = 422)

Policy

- |   |     |
|---|-----|
| 1. Prohibit all hiking in the wilderness.                           | 8%  |
| 2. Seasonal closures during lambing and nesting season.             | 51% |
| 3. A permit system to limit the number of hikers in the wilderness. | 19% |
| 4. No restrictions.   | 11% |
| 5. Seasonal closures/permit system                                  | 11% |
| 6. Other  | >1% |

Strength

- |                      |     |
|----------------------|-----|
| A. Very strong       | 53% |
| B. Somewhat strong   | 42% |
| C. Not strong at all | 5%  |

26. If rock climbing was shown to cause stress in or be detrimental to bighorn sheep or peregrine falcons in PRW, which of the following policies would you prefer in PRW? (n = 422)

Policy

- |  |     |
|--|-----|
| 1. Prohibit all rock climbing in the wilderness.                         | 17% |
| 2. Seasonal closures during lambing and nesting season.                  | 51% |
| 3. A permit system to limit the number of<br>climbers in the wilderness. | 16% |
| 4. No restrictions.  | 7%  |
| 5. Seasonal closures/permit systems                                      | 8%  |
| 6. Other   | 1%  |

Strength

- |                      |     |
|----------------------|-----|
| A. Very strong       | 53% |
| B. Somewhat strong   | 42% |
| C. Not strong at all | 5%  |

27. If horseback riding was shown to cause stress in or be detrimental to bighorn sheep or peregrine falcons in PRW, which of the following policies would you prefer in PRW? (n = 420)

Policy

- |  |     |
|--|-----|
| 1. Prohibit all horseback riding in the wilderness.                    | 28% |
| 2. Seasonal closures during lambing<br>and nesting season.             | 41% |
| 3. A permit system to limit the number of<br>riders in the wilderness. | 14% |
| 4. No restrictions   | 8%  |
| 5. Seasonal closures/permit system                                     | 8%  |
| 6. Other   | 1%  |

Strength

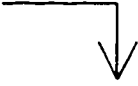
- |                      |     |
|----------------------|-----|
| A. Very strong       | 59% |
| B. Somewhat strong   | 36% |
| C. Not strong at all | 5%  |

28. Do you feel the agencies responsible for managing Pusch Ridge Wilderness and its wildlife are truly concerned or interested in the opinions of the public when making management (n = 417) decisions?

- |               |     |
|---------------|-----|
| 1. Yes        | 29% |
| 2. No         | 27% |
| 3. Don't know | 44% |

29. Have you ever attended any type of public meeting, or been asked to participate in a mail or telephone survey sponsored by the U. S. Forest Service, or Arizona Game and Fish Department concerning the management of any public lands or wildlife (not including this one)?  
(n = 421)

1. Yes	15%
2. No	85%



If yes, please explain. What was the meeting or survey about, who conducted it, and when was it?

Arizona Game and Fish Department hunt and fishing surveys and commission meetings, Aqua Caliente trailhead meeting, bolt and climbing bans on national forests, Environmental Assessments and Environmental Impact Statements for various national forests, meetings on Mexican wolf re-introduction in Arizona, Sabino Canyon and Mt. Lemmon highway fee proposals, Tucson Rod and Gun Club hearings, trailhead self surveys.

30. Please list any and all environmental or outdoor organization(s) you are a member of.

1 membership	24%
≥2 membership	43%
no memberships	33%

Organizations: Arizona Desert Bighorn Sheep Society, Arizona Antelope Federation, Ducks Unlimited, Anglers United, Trout Unlimited, Foundation of North American Wild Sheep, Safari Club International, Arizona Mule Deer Association, Arizona White-tailed Deer Club, National Wild Turkey Federation, National Rifle Association, Rocky Mountain Elk Foundation, Arizona Mountaineering Club, American Alpine Club, Sierra Club, Arizona Wildlife Federation, Nature Conservancy, Southwest Outdoor Club, Audubon Society, World Wildlife Federation, Colorado Mountain Club, Green Peace, Natural Resource Defense Fund Council, National Wildlife Federation, Southwest Center for Biological Diversity

31. On a scale of 1 to 5 (1 = Very Poor, 2 = Poor, 3 = Fair, 4 = Good, and 5 = Very Good) please rate the management of Pusch Ridge Wilderness, in terms of providing recreational opportunities, protecting wildlife and incorporation of public concerns. (Circle the number of your response)

	1	2	3	4	5
A. Providing recreational Opportunities (n = 302)	3%	3%	33%	43%	18%
B. Protecting wildlife (n = 302)	7%	13%	43%	27%	10%
C. Incorporating public Concerns (n = 282)	8%	14%	51%	20%	7%

32. What is your gender? (n = 420)

1. Female	35%
2. Male	65%

33. What is your age? (n = 408)

$\bar{x} = 47.2 (\pm 0.75 \text{ s.e.}, 95\% \text{ C.I.} = 45.7 - 48.7)$

34. Would you be interested in attending a public informational program developed by natural resource personnel concerning possible management actions that could be implemented to enhance wildlife conservation and recreational opportunities in Pusch Ridge Wilderness? (n = 410)

1. Yes	46%
2. No	54%

If yes, please provide your name, address, and telephone number so we may contact you with information about the programs.

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Please use the following space for any additional comments you have on any topic covered in this questionnaire. Feel free to attach additional sheets if necessary.

Your contribution to this effort is greatly appreciated. Your participation will help ensure that the integrity of Pusch Ridge Wilderness is maintained for all to enjoy. If you would like to receive a summary of these survey results, please print your name and address, and “copy of results” on the back of the return envelope (not on this questionnaire).

**Reminder/Thank you postcard mailed on 7 December 1998.**

Thank you for completing and returning the survey concerning Pusch Ridge Wilderness wildlife and recreation. Your participation was critical to the success of the study. If you have not yet completed the survey, please take a few minutes to fill it out and return it. If you have any questions related to the study please contact me at (520) 621-3361. Thank you for your time.

Sincerely,

Patrick K. Devers

Research Assistant

The University of Arizona

### Literature cited

- Anderson, S. H. 1995. Recreational disturbance and wildlife populations. Pages 157-168 *in* R. L. Knight and K. J. Gutzwiller, editors, Wildlife and recreationists: coexistence through management and research. Island Press, Washington D.C., USA.
- Arizona Game and Fish Department. 1985. Pusch Ridge bighorn sheep management plan and memorandum of understanding.
- Berger, J. 1990. Persistence of different sized populations: an empirical assessment of Rapid extinctions in bighorn sheep. *Conservation Biology* 4:91-98.
- Berger, J. 1999. Intervention and persistence in small populations of bighorn sheep. *Conservation Biology* 13:432-435.
- Bleich, V. C., J. D. Wehausen, and S. A. Holl. 1990. Desert dwelling mountain sheep: conservation implications of a naturally fragmented distribution. *Conservation Biology* 4:383-390.
- Boyles, S. A., and F. B. Samson. 1985. Effects of nonconsumptive recreation on wildlife: a review. *Wildlife Society Bulletin* 13:110-116.
- Burgarsky, D. J. 1986. The value of the Pusch Ridge bighorn sheep herd. Thesis, University of Arizona, Tucson, Arizona, USA.
- Carpenter, E. H., J. G. Taylor, H. J. Cortner, P. D. Gardner, M. J. Zwolinski, and T. C. Daniel. 1986. Targeting audiences and content for forest fire information programs. *Journal of Environmental Education* 17:33-41.

- Cocking, E. 1978. Draft: performance report on bighorn sheep in management unit 33. Arizona Game and Fish Department, Phoenix, USA.
- Coggins, G. C., and R. L. Glicksman. 1990. Public natural resource law, Volume 2. Clark, Boardman and Callahan Publishing, New York, New York USA.
- Daoutopoulos, G. A., and M. Pyrovetsi. 1990. Comparison of conservation attitudes Among fishermen in three protected lakes in Greece. *Journal of Environmental Management* 31:83-92.
- DeForge, J. R. 1976. Stress: is it limiting bighorn? *Desert Bighorn Council Transactions*. 16:30-31
- Dillman, D. A. 1978. Mail and telephone surveys: the total design method. John Wiley And Sons, New York, New York, USA.
- Doig, H. E. 1987. Applying wildlife values information in management planning and policy making. Pages 305-30 *in* D. J. Decker, and G. R. Goff editors. *Valuing wildlife: economic and social perspectives*. Westview Press, Boulder, Colorado, USA
- Duffus, D. A., and P. Dearden. 1990. Non-consumptive wildlife-oriented recreation; a conceptual framework. *Biological Conservation* 53:213-231.
- Duffus, D. A., and P. Dearden. 1990. Non-consumptive wildlife-oriented recreation, a conceptual framework. *Biological Conservation* 52:213-231.
- Etchberger, R. C., P. R. Krausman, and R. Mazaika. 1989. Mountain sheep habitat characteristics in Pusch Ridge Wilderness, Arizona. *Journal of Wildlife Management* 53:902-907.

- Etchberger, R. C., P. R. Krausman, and R. Mazaika. 1990. Effects of fire on desert bighorn sheep habitat. Pages 53-57 *in* P. R. Krausman and N. S. Smith, editors. Managing Wildlife in the Southwest Symposium. Arizona Chapter of the Wildlife Society, Phoenix, Arizona, USA.
- Flather, C. H., and H. C. Cordell. 1995. Outdoor recreation: historical and anticipated trends. Pages 3-16 *in* R. L. Knight and K. J. Gutzwiller, editors. Wildlife and recreationists: coexistence through management and research. Island Press, Washington D.C., USA.
- Fritts, S. H., E. E. Bangs, J. A. Fontaine, W. G. Brewster, and J. F. Gore. 1995. Restoring wolves to the Northern Rocky Mountains of the United States. Pages 107 – 126 *in* L. N. Carbyn, S. H. Fritts, and D. R. Seip, editors. Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Edmonton, Alberta, Canada.
- Geist, V. 1978. A philosophical look at recreational affects on wildlands. Pages 1-7 *in* Recreational affects on wildlands conference proceedings. United States Forest Service #R-6-001-1979.
- Gilbert, F. F. 1982. Public attitudes toward urban wildlife: a pilot study in Guelph, Ontario. Wildlife Society Bulletin 10:245-253.
- Giles, R. H. 1978. Wildlife management. W. H. Freeman and Company, San Francisco, USA.
- Goodson, N. J. 1994. Persistence and population size in mountain sheep: why the Different interpretations? Conservation Biology 8:617-621.

- Harris, L. D., and G. Silva-Lopez. 1992. Forest fragmentation and the conservation of biological diversity. Pages 197-237 *in* P. L. Fiedler and S. K. Jain editors. Conservation biology: the theory and practice on nature conservation, preservation and management. Chapman and Hall Publishers, New York, New York, USA.
- Harris, L. K. 1992. Recreation in mountain sheep habitat. Thesis, University of Arizona, Tucson, Arizona, USA.
- Harris, L. K., and W. W. Shaw. 1993. Conserving mountain sheep habitat near an urban environment. Desert Bighorn Council Transactions 37:16-19.
- Harris, L. K., P. R. Krausman, and W. W. Shaw. 1995. Human attitudes and mountain sheep in a wilderness setting. Wildlife Society Bulletin 23:66-72.
- Hicks, L. L., and J. M. Elder. 1979. Human disturbance of Sierra Nevada bighorn sheep. Journal of Wildlife Management 43:909-915
- Ishee, M. K. 1995. Roadless lands and wilderness planning: a history and overview. Pages 396 *in* R. L. Fink, editor. The natural resources law manual. American Bar Association, Chicago, Illinois, USA.
- Johnson, D. H. 1999. The insignificance of statistical significance testing. Journal of Wildlife Management 63:763-772.
- Kellert, S. R. 1979. Public attitudes toward critical wildlife and natural habitat issues. Phase I American attitudes, knowledge and behaviors toward wildlife and natural habitats. United States Fish and Wildlife Service, Washington, D. C., USA.
-

- Kellert, S. R. 1987. The contributions of wildlife to human quality of life. Pages 222-229 in D. J. Decker and G. R. Goff, editors. *Valuing wildlife: economic and social perspectives*. Westview Press, Boulder, Colorado, USA.
- King, M. M., and G. W. Workman. 1986. Response of desert bighorn sheep to human harassment; management implications. *Transactions of the North American Wildlife and Natural Resources Conference* 51:74-85.
- Knight, R. L., and D. N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. *Transactions of North American Wildlife and Natural Resources Conference* 56:238-247
- Knopf, F. L. 1986. Changing landscapes and the cosmopolitanism of the eastern Colorado avifauna. *Wildlife Society Bulletin* 14:132-142
- Knuth, B. A., and L. A. Nielsen. 1991. People, patches and politics: considering the Human dimensions in landscape management. Pages 83-96 in D. J. Decker, editor. *Challenges in the conservation of biological resources*. Westview Press, Boulder, Colorado, USA.
- Krausman, P. R. 1997. Human disturbance and the disappearance of bighorn sheep in Pusch Ridge Wilderness. *Caprina* 8:3-4.
- Krausman, P. R., and B. D. Leopold. 1986. The importance of small populations of desert bighorn sheep. *Transactions of the North American Wildlife and Natural Resources Conference* 51:52-61.

- Krausman, P. R., G. Long, and L. Tarango. 1996b. Desert bighorn sheep and fire, Santa Catalina Mountains, Arizona. Pages 162 – 168 *in* P. F. Ffolliott, L F. DeBano, M. B. Baker, G. J. Gottfried, G. Solis-Garza, C. B. Edminster, D. G. Neary, L. S. Allen, and R. H. Harme, technical coordinators. Effects of fire on Madrean Province ecosystems: a symposium proceedings. U.S. Forest Service, General Technical Report RM-GTR-289.
- Krausman, P. R., R. C. Etchberger, and R. M. Lee. 1993. Persistence of mountain sheep. *Conservation Biology* 7:219.
- Krausman, P. R., R. C. Etchberger, and R. M. Lee. 1996a. Persistence of mountain sheep populations in Arizona. *Southwestern Naturalist* 41:399-402.
- Krausman, P. R., and W. W. Shaw. 1979. Bighorn sheep in the Pusch Ridge Wilderness Area: current knowledge and research needs. Unpublished report prepared for the United States Department of Agriculture, United States Forest Service, Coronado National Forest, Arizona, USA.
- Krausman, P. R., W. W. Shaw, and J. L. Stair. 1979. Bighorn sheep in the Pusch Ridge Wilderness area, Arizona. *Desert Bighorn Council Transactions* 23:40-46

- Krausman, P. R., W. W. Shaw, R. C. Etchberger and L. K. Harris. 1995. The decline of bighorn sheep in Santa Catalina Mountains, Arizona. Pages 245-250 *in* L. F. DeBano, G. J. Gottfried, R. H. Hamre, C. B. Edminster, P. F. Ffolliott, and A. Ortega-Rubio, technical coordinators, Biodiversity and management of the Madrean archipelago: the sky islands of southwestern United States and Northwestern Mexico. United States Forest Service General Technical Report RM-GTR-264.
- Lyons, J. R. 1987. Basic and applied social research needs in wildlife management. Pages 285-295 *in* D. J. Decker, and G. R. Goeff, editors. Valuing wildlife: economic and social perspectives. Westview Press, Boulder, Colorado USA.
- Mankin, P. C., and R. E. Warner. 1997. Mammals of Illinois and the Midwest: ecological and conservation issues for human-dominated landscapes. Pages 135-153 *in* M. W. Schwartz, editor. Conservation in highly fragmented landscapes. International Thomson Publishing, New York, New York, USA.
- MacArthur, R. A., V. Geist, and R. H. Johnson. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. *Journal of Wildlife Management* 46:351-358.
- McCarty, C. W. and J. A. Bailey. 1994. Habitat requirements of desert bighorn sheep. Colorado Division of Wildlife, Special Report #69. Denver, Colorado, USA.
- Miller, G., and E. L. Smith. 1985. Human activity in bighorn sheep habitat: what disturbs sheep? *Desert Bighorn Council Transactions* 29:4-7.
-

- Parenteau, P. A., and D. C. Baur. 1995. An overview of federal wildlife law. Pages 255-277 in R. L. Fink, editor. The natural resources law manual. American Bar Association. Chicago, Illinois, USA.
- Pomerantz, G. A., D. J. Decker, G. R. Goeff, and K. G. Purdy. 1988. Assessing affects of recreation on wildlife: a classification scheme. Wildlife Society Bulletin 16:58-62.
- Purdy, K. G. 1981. Recreational use of desert bighorn sheep habitat in Pusch Ridge Wilderness. Thesis, University of Arizona, Tucson, Arizona, USA.
- Purdy, K. G., and W. W. Shaw. 1981. An analysis of recreational use patterns in desert bighorn habitat: the Pusch Ridge Wilderness case. Desert Bighorn Council Transactions 25:1-5.
- Ramsey, F. L., and D. W. Schafer. 1997. The statistical sleuth: a course in methods of data analysis. Duxbury Press, New York, New York, USA.
- Rudzits, G., and H. E. Johansen. 1991. How important is wilderness? results from a United States Survey. Environmental Management 15:227-233.
- Salant, P., and D. A. Dillman. 1994. How to conduct your own survey. John Wiley and Sons, Incorporated, New York, New York, USA.
- Seip, D. R., and F. L. Bunnell. 1985. Nutrition of Stone's sheep on burned and unburned ranges. Journal of Wildlife Management 49:397-405.
- Schoenecker, K. A. 1997. Human disturbance in bighorn sheep habitat, Pusch Ridge Wilderness, Arizona. Thesis, University of Arizona, Tucson, Arizona, USA.
-

- Shaw, W. W., and E. H. Zube. 1980. Wildlife values. University of Arizona Center for Assessment of Noncommodity Natural Resource Values, Institutional Series Report # 1, The University of Arizona, Tucson, Arizona, USA.
- Shepard, C. J., and L. R. Speelman. 1986. Affecting environmental attitudes through outdoor education. *Journal of Environmental Education* 17:20-23.
- Soulé, M. E. 1991. Conservation: tactics for a constant crisis. *Science* 253:744-750.
- Taft, J. B. 1997. Savanna and open woodland communities. Pages 24-44 *in* M. W. Schwartz, editor. Conservation in highly fragmented landscapes. Chapman and Hall Publishing, New York, New York, USA.
- Tucson Planning Department. 1997. Tucson update volume 12. December 1997. Tucson, Arizona, USA.
- United States Bureau of Census. 1998. State and metropolitan area data book 1997-98, 5<sup>th</sup> edition. Washington D.C. 1998.
- University of Arizona. 1978. Pusch Ridge Management Plan. School of Renewable Natural Resources, The University of Arizona, Tucson, Arizona, USA.
- Westphal, J. M., and W. F. Halverson. 1986. Assessing the long-term effects of an environmental education program: a pragmatic approach. *Journal of Environmental Education* 17:26-30.
- White, P. S., and J. Harrod. 1997. Disturbance and diversity in a landscape context. Pages 128-159 *in* J. A. Bissonette, editor. Wildlife and landscape ecology, effects of pattern and scale. Springer Verlag publishing, New York, New York, USA.

- Wehausen, J. D. 1999. Rapid extinction of mountain sheep populations revisited. *Conservation Biology* 13:378-384.
- Wiens, J. A. 1996. Wildlife in patchy environments: metapopulations, mosaics and management. Pages 53-84 *in* D. R. McCullough, editor. *Metapopulations and wildlife conservation*. Island Press, Washington D. C., USA.
- Witter, D. J. and S. L. Sheriff. 1987. Wildlife policy and monitoring public values. Pages 255-263 *in* D. J. Decker, and G. R. Goff editors. *Valuing wildlife: economic and social perspectives*. Westview Press, Boulder, Colorado, USA.