

# STATUS OF MOUNTAIN GOATS IN WASHINGTON

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**Abstract:** Based on aerial surveys (2004–2007, adjusted for sightability) and subjective estimates for unsurveyed areas, I developed an estimate of the total number of mountain goats (*Oreamnos americanus*) in Washington State, USA. Mountain goat populations were estimated for 56 units, 40 areas, and 21 zones, yielding a total 2,815 (2,401–3,184) mountain goats. Of the units/areas/zones identified, about 60% have been monitored with aerial surveys. For the remaining areas, the estimate for Lake Chelan was based on ground counts and the rest subjectively estimated. Additional aerial surveys around Mount Adams, for Mount Rainier National Park, the North Wenatchee Mountains, and the Chiwawa River area would enhance our knowledge of mountain goat populations in Washington.

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**Key words:** population, *Oreamnos*, survey.

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This is the first estimate of mountain goat (*Oreamnos americanus*) populations for the entire state of Washington. The most recent prior attempt to produce such an estimate was in 1961 (Wadkins 1962). His total of 8,555 did not include the Olympic Mountains, Mount Rainier National Park, or mountain goats on Yakama Indian lands, and was based on the extrapolation of ground counts. Although the Washington Department of Fish and Wildlife (WDFW) has conducted helicopter surveys of mountain goats for a number of years, between 2004–2007 they developed a sightability model for mountain goats that has facilitated consistent estimation of mountain goat populations (Rice et al. 2009). These surveys, combined with those conducted in the Olympic Mountains (Happe et al. 2004), provided the foundation for the current estimate. Nevertheless, WDFW surveys are typically limited to mountain goat populations in areas where hunting is permitted and substantial amounts of mountain goat habitat were not surveyed. In unsurveyed areas, I relied on expert opinion for estimating mountain goat numbers.

## STUDY AREA

I estimated mountain goat numbers in the Cascade and Olympic Mountains within Washington State. Occasionally, mountain goats have been reported in the northeastern (Selkirk) and southeastern (Blue Mountains) portions of the

state, but these areas were not included in this estimate.

## METHODS

I developed an estimate of the number of mountain goats in Washington based on a combination of aerial surveys conducted during July and September of 2004–2007 and expert opinion for those areas not surveyed. To determine geographic units for estimation I started with 2007 WDFW hunting units, added areas not covered in 2007 units from 2002 units (which were more numerous and extensive), and then added ad hoc polygons for areas not included by either. For surveys, I adjusted counts and calculated 90% confidence intervals based on our sightability model (Rice et al. 2009) and averaged across years for units with multiple surveys. For non-surveyed locales, I solicited expert opinion as to best subjective estimate, likely minimum and likely maximum for designated ad hoc units.

In some cases units were partially surveyed. In these cases, I generally added the survey estimates and the expert opinion estimates for the remaining portions of those units. However, sometimes the expert opinion estimates included the areas surveyed, and I used the expert opinion estimates for each unit instead. For the total estimate ranges, I took the simple expedient of adding the upper and lower confidence bounds from the surveys to

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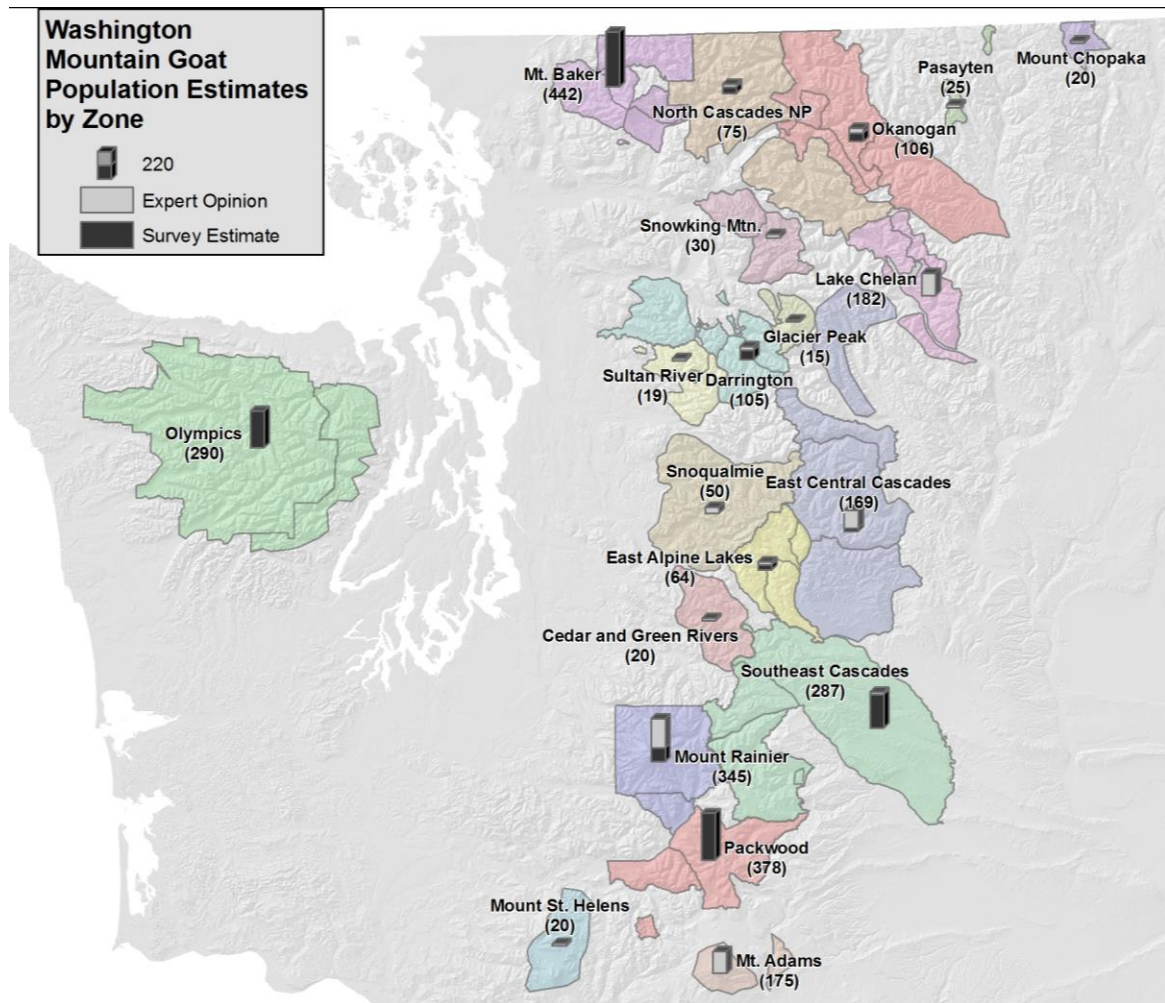


Fig. 1. Estimated number of mountain goats in Washington by Zone. The legend shows the height of an estimate of 220, with the proportion of each estimate that is based on expert opinion in light gray and that based on surveys in dark gray.

the likely minimum and likely maximum expert opinion estimates.

I summarized unit level estimates by two hierarchical groupings: Area and Zone. Survey estimates and expert opinion estimates were added separately within each Area and Zone. For surveys, I summed the variances (Pitman 1993:193) and recalculated confidence intervals based on the total variance. For expert opinion estimates, I summed the expert opinions for minimum and maximum. Hence, relative precision increased with broad scale estimates for surveys, but not for expert opinion estimates.

## Special Cases

### Lake Chelan

WDFW's few surveys of Lake Chelan were limited in scope, few, and lower than the Chelan Public Utility District (PUD) estimates. For the North and South shores of Lake Chelan I took the 2004–2006 PUD estimates, assigned the minimum to the likely minimum expert opinion, the maximum to the likely maximum expert opinion and the intermediate PUD estimate to the best guess.

### Olympics

Olympic National Park staff estimated the mountain goat population for the Olympic Peninsula from random stratified surveys in 2004

(Happe et al. 2004). Based on a few observations, I estimated that 17 (13–25) of these were in the Olympic National Forest.

### ***Okanogan***

Mountain goats visiting Hancock Ridge (Methow unit) appeared to spend the majority of their time on Mount Ballard and Majestic Mountain (East Ross Lake unit). Consequently, I used survey results from Hancock Ridge as a basis for the estimate for East Ross Lake. I also included peripheral areas surveyed with the Methow unit (near Washington Pass) in the Methow estimate.

### ***Glacier Peak***

Mountain goats visiting Gamma Ridge all appeared to be from the east side of the Cascades coming to visit the mineral licks on Gamma Ridge (Rice 2010). Therefore I used the Gamma Ridge surveys as a basis for estimation in the Chiwawa River ad hoc unit, and used expert opinion for the number of residents in the rest of the Glacier Peak unit.

## **RESULTS**

Estimates for surveyed areas were based on a total of 1,139 goat groups containing 4,799 individuals that were observed over 4 years (2004–2007).

Mountain goat populations were estimated for 56 units, 40 areas, and 21 zones (Table 1, Figs. 1 and 2), yielding an estimated total of 2,815 (2,401–3,184) mountain goats for Washington.

Of the total units/areas/zones, about 60% were monitored with aerial surveys; the estimate of goat numbers for other areas was based on expert opinion, with the exception of Lake Chelan where routine ground counts were performed. About 25% of Washington's mountain goats were in National Parks. About 35% of Washington mountain goats were in the seven units for which hunting permits were issued in 2009. Overall, 47% of mountain goats outside of national parks were in areas for which goat hunting permits were issued from 2004–2007.

## **DISCUSSION**

Aerial survey coverage of Mt. Adams (primarily on Yakama tribal lands), Mount Rainier National Park, the North Wenatchee Mountains, and the

Chiwawa River area would improve our knowledge of the status of mountain goats in Washington. Subsequent to this report, the Muckleshoot Tribe surveyed most of the Snoqualmie area, resulting in an estimated population of 49 mountain goats (Vales 2009), compared with my subjective estimate of 50.

There is a large degree of uncertainty about mountain goat populations in unsurveyed areas (total 703–1,402 goats). However, the costs of completely surveying all these areas would be prohibitive. A random stratified survey design (e.g., Happe et al. 2004) would probably be called for should this be attempted.

My total estimate of 2,815 mountain goats in Washington was substantially less than the estimate of 8,555 goats from 1961. My estimate for the areas included for the 1961 estimate was 2,007 goats. It is difficult to say how much of this difference is due to declines in mountain goat populations, and how much is due to differing methods. It is clear that there have been large declines in some areas. For instance, the Snoqualmie area was thought to contain 450 mountain goats in 1961 (Wadkins 1962), while the current estimate was 50. Similarly the Bumping River area population was estimated at 475 in 1961 and my estimate was 67. Excessive harvest is thought to be the primary cause of such declines (Rice and Gay 2010). In contrast, Mount Rainier National Park was thought to hold 374–500 mountain goats in 1983 (Michalovic 1984), which was similar to my current estimate of 231–385. Similarly, the Packwood area population was estimated at 450 in 1961, compared to the current estimate of 378. Clearly, declines have been uneven across the landscape.

Table 1. Estimated number of mountain goats by Zone, Area, and Unit, based on survey, expert opinion, and combined with 90% confidence intervals (CI) and estimate range. MGU = mountain goat unit (2002 and 2007). Table continued on next page.

Zone	Area	Unit	MGU	Survey		Expert opinion		Combined		
				Est	CI	Est	Range	Est	Range	
Mt Baker	Ruth Creek	Ruth Creek	4-1	58	50-66			58	50-66	
	Mt Baker	Lincoln Creek	4-4	53	49-56			53	49-56	
		Chowder Ridge	4-3	97	92-103			97	92-103	
		Avalanche Gorge	4-7	222	207-237			222	207-237	
		Dillard Creek	4-6			0	0-0	0	0-0	
		All		372	356-388	0	0-0	372	356-388	
		Loomis Mtn	Loomis Mtn		12	9-15			12	9-15
	All		442	424-461	0	0-0	442	424-461		
North Cascades NP	North Cascades NP	North Cascades NP		50	41-59	25	20-40	75	61-99	
Okanogan	East Ross Lake	East Ross Lake	4-8			30	25-35	30	25-35	
	Jack Mtn	Jack Mtn	4-9			10	5-15	10	5-15	
	Majestic Mtn	Majestic Mtn	4-10			0	0-0	0	0-0	
	Okanogan	Methow	2-2	66	61-70			66	61-70	
	All			66	61-70	40	30-50	106	91-120	
Pasayten	Eastern Pasayten	Central Pasayten				10	5-15	10	5-15	
		Eastern Pasayten			15	11-20	15	11-20		
		All			25	16-35	25	16-35		
		Mt Chopaka	Mt Chopaka	2-1			20	10-30	20	10-30
Linton Mtn	Linton Mtn				0	0-0	0	0-0		
Snowking Mtn	Mt Tommy	Thompson	4-12			5	0-10	5	0-10	
		Thompson								
		Mt Buckindy	4-14			25	20-30	25	20-30	
		All			30	20-40	30	20-40		
Darrington	Boulder River	Liberty Mtn	4-21	55	47-63			55	47-63	
		North Lake		0	0-0			0	0-0	
		Twin Peak	4-23	8	5-11			8	5-11	
		All		63	54-71			63	54-71	
	E of Sauk R	White Chuck		7	5-10			7	5-10	
		Mt Pugh		0	0-1			0	0-1	
		Sauk River	4-18	2	1-3			2	1-3	
		Sloan Peak	4-24	2	1-3	30	20-50	30	20-50	
		All		10	7-13	30	20-50	40	27-63	
		All		75	66-84	30	20-50	105	86-134	
Glacier Peak	Glacier Peak	Glacier Peak	4-16	53	44-62	10	0-20	10	0-20	
		Lime Ridge			5	0-10	5	0-10		
		All			15	0-30	15	0-30		
East Central Cascades	Chiwawa River	Chiwawa River				75	50-100	75	50-100	
		Nason Ridge	East Stevens Pass	3-1	24	15-34			24	15-34
	Wenatchee Mts	North	3-2			60	50-75	60	50-75	
		Wenatchee Mts								
		Cle Elum	3-5			10	5-15	10	5-15	
	Lake Chelan	All	All		24	15-34	145	105-190	169	120-224
			Stehekin	Stehekin			20	15-30	20	15-30
East Sawtooth Ridge		East Sawtooth Ridge			15	10-20	15	10-20		
Chelan North		Chelan North	2-1	41	35-47	90	75-115	90	75-115	
Chelan South		Chelan South		21	17-25	57	50-100	57	50-100	
	All				182	150-265	182	150-265		

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Zone	Area	Unit	MGU	Survey		Expert opinion		Combined		
				Est	CI	Est	Range	Est	Range	
<i>Table 1 continued from previous page</i>										
Olympics	Sultan River	Mt Pilchuck				6	8-10	6	8-10	
		Vesper Peak	4-25			10	5-25	10	5-25	
		Mt Stickney				3	1-5	3	1-5	
		All				19	14-40	19	14-40	
		Olympic NP	Olympic NP			273	251-291	273	251-291	
Snoqualmie	East Olympics	East Olympics				17	13-25	17	13-25	
		All		290	264-316			290	264-316	
East Alpine Lakes	Snoqualmie Kachess Ridge	Snoqualmie				50	24-75	50	24-75	
		Chikamin Ridge				10	5-15	10	5-15	
		Goat & Davis Mts	3-3			15	10-20	15	10-20	
		Kachess Ridge	3-11	39	33-46			39	33-46	
		All		39	33-46	25	15-35	64	48-81	
Cedar & Green Rivers	Cedar & Green Rivers	Cedar & Green Rivers				20	16-28	20	16-28	
		Southeast Cascades	Blazed Ridge	Blazed Ridge	3-10	92	84-99		92	84-99
Packwood	Naches Pass	Naches/Corral Passes	3-6	101	91-112			101	91-112	
		Bumping River	Bumping River	3-7	67	63-71			67	63-71
			Timberwolf Mtn		8	5-10	20	8-25	20	8-25
			All		72	64-81	20	8-25	87	71-96
		Mt Rainier	Mt Rainier NP	Mt Rainier NP		267	254-281	20	8-25	287
Packwood	Tatoosh	Tatoosh	5-2	111	101-121	224	130-164	335	231-285	
		All		111	101-121	234	135-179	345	236-300	
Mt St Helens Mt Adams	Goat Rocks	Goat Rocks/ Tieton R	5-4	282	273-292			282	273-292	
		Smith Creek	5-3	32	25-38			32	25-38	
		Dark Divide		64	56-71			64	56-71	
		All		378	364-391			378	364-391	
		Mt St Helens	Mt St Helens			20	15-25	20	15-25	
Mt Adams	Klickitat River	Mt Adams				150	90-225	150	90-225	
		Klickitat River				25	15-40	25	15-40	
		All				175	105-265	175	105-265	
All				1740	1698- 1782	1075	703- 1402	281	2401- 3184	



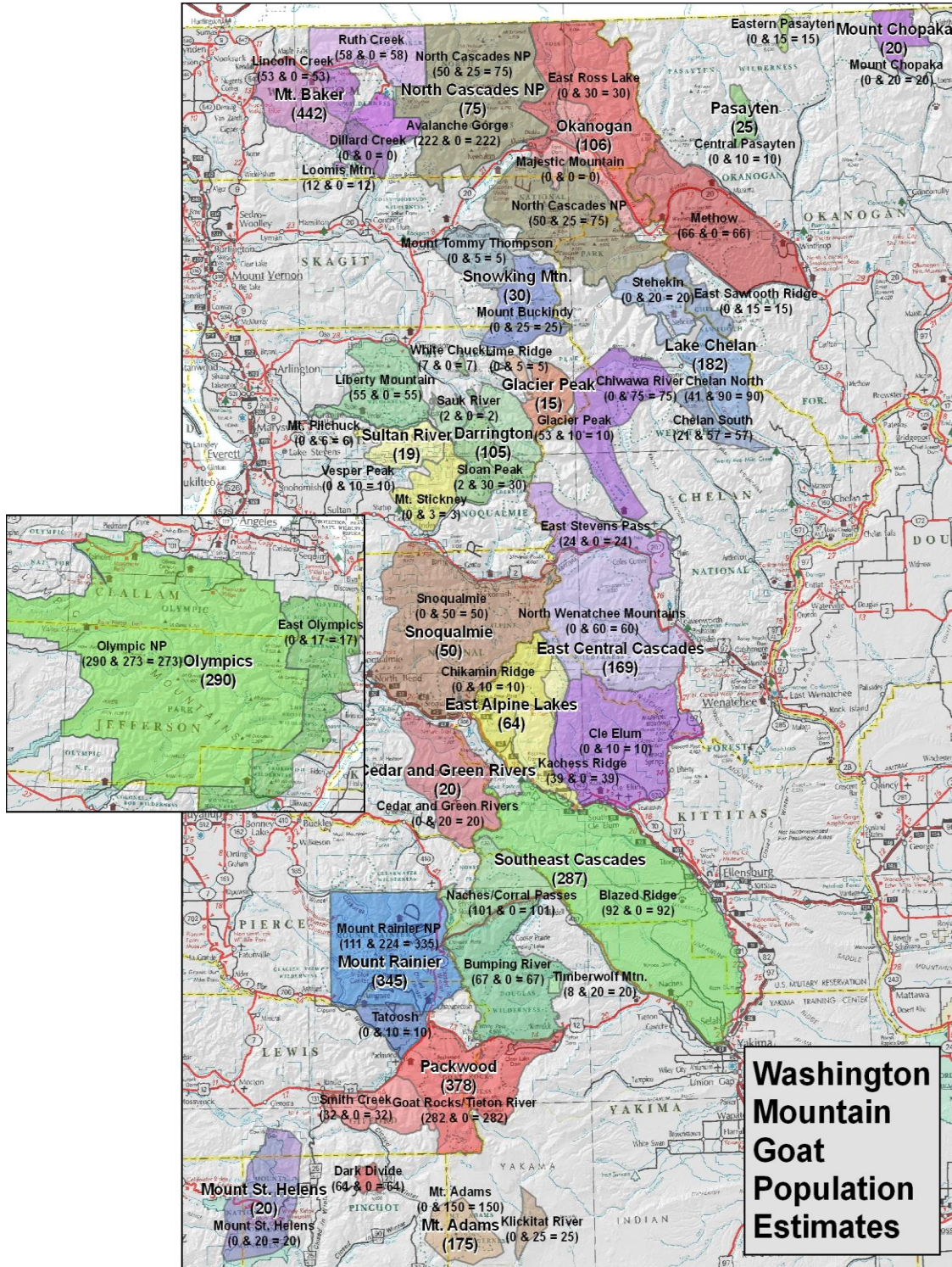


Fig. 2. Estimated number of mountain goats in Washington. Large font labels are for Zones with the combined estimates in parentheses. Smaller font labels are for units, with the survey estimate, expert opinion estimate, and combined estimate in parenthesis.

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