

2015 Citizen Science Report

Crown of the Continent Research Learning Center

Glacier National Park



2015 Citizen Science Annual Report

Table of Contents

I. 2015 Citizen Science Summaries

- a. Citizen Science Program Overview
- b. Citizen Science Project Summaries
- c. 2015 Citizen Science Summary and Statistics
- d. Citizen Science Program History Summary
- e. 2015 Citizen Science Program Accomplishments

II. Citizen Science Projects

1. Mountain Goat and Bighorn Sheep Monitoring Report

Abstract

Introduction

Methods

Results

Discussion

Appendices

- i. Greater Yellowstone Area Mountain Ungulate Project collaboration
- ii. Example mountain ungulate survey site map
- iii. Mountain ungulate citizen science survey form and protocol
- iv. Mountain ungulate citizen science surveys
- v. Mountain ungulate citizen science observer involvement
- vi. Mountain goat high counts map
- vii. Mountain goat population summary
- viii. Detailed summary of mountain goat surveys
- ix. Bighorn sheep population summary
- x. Detailed summary of bighorn sheep surveys
- xi. Mountain goat and bighorn sheep locations maps for GYA collaboration
- xii. Mountain goat and bighorn sheep days (annual index count)

2. Pika Monitoring Report

Abstract

Introduction

Methods

Results

Discussion

Appendices

- i. Pika Inventory and Monitoring Program survey form and protocol
- ii. Example pika survey site map
- iii. Overview of pika I & M site selection for citizen scientists
- iv. Pika occupancy results 2015
- v. Pika citizen science surveys
- vi. Pika citizen science observer involvement
- vii. Pika occupancy maps 2013 - 2015

3. Invasive Plant Monitoring Report

Abstract
Introduction
Methods
Results
Discussion
Appendices

- i. Invasive plant survey form and protocol
- ii. Invasive Plant Citizen Science quick identification card
- iii. Annual Noxious Weed Blitz flyer
- iv. Invasive Plant Citizen Science survey results
- v. Invasive Plant Citizen Science observer involvement

4. Common Loon Citizen Science Report

Abstract
Introduction
Methods
Results
Discussion
Appendices

- i. Common loon survey form and protocols
- ii. Observing loon chicks and nursery areas protocol
- iii. Common Loon Citizen Science surveys
- iv. Common Loon Citizen Science observer involvement
- v. Loon days vs. season long population summary
- vi. Map of loon occupancy for 2015
- vii. Resident loon pairs map
- viii. Resident singles map
- ix. Lakes with no loons observed map
- x. Loon Days data (*internal report only*)
- xi. Loon Days summary with observer hours
- xii. Common loon trends (1988- present)
- xiii. Spring loon surveys data (*internal report only*)
- xiv. Loon nesting pairs map
- xv. Loon nesting summary (*internal report only*)
- xvi. 2015 Priority Lake list
- xvii. 2016 Priority Lake list

5. Raptor Migration Report

Introduction
Results
Discussion
Appendices

- i. Generic data observation form
- ii. Observation form instructions
- iii. Flight and weather form

III. Training and Outreach

6. Internships, VIP's, Citizen Scientists and Training

- a. Citizen Science quotes
- b. VIP and outreach volunteer hours
- c. Observer involvement
- d. Training and outreach sessions
- e. Glacier Youth Conservation Corps survey results

Report written by: Josh Martin, Jami Belt

Program funding: Glacier National Park Conservancy

Citizen Science in Glacier National Park

- Citizen science in Glacier National Park (GNP) engages park visitors and students from a wide range of backgrounds in research, in turn fostering science literacy and resource stewardship.
- Primary goal is to provide reliable baseline data about wildlife and plant species identified as priorities, and to aid with early detection of ecosystem changes.
- Citizen science enables us to begin to address the growing list of research/ monitoring needs in spite of funding constraints.



Accomplishments:

- The program has grown from a 6-week pilot effort focused on Common Loons to an almost year-round program that monitors many wildlife and plant species.
- We have trained over 1,320 citizen scientists. Since 2008, An average of 206 citizen scientists participates in field surveys each year.
- We have engaged over 700 students in citizen science data collection since 2010.
- Citizen scientists have contributed over 45,000 hours (in-kind contribution of \$900,000 at standard volunteer rate) and conducted over 4,100 surveys.
- Our program is one of the National Park Service's first citizen science programs and has served as a model for other parks and agencies.
- This program addresses many of the Call to Action initiatives.
- Our research indicates that large datasets from citizen scientists can yield statistically similar population and distribution estimates to those of biologists/ aerial surveys.

Projects:

Common Loon Monitoring

- A volunteer-based annual loon survey began in 1988, which indicated that GNP hosts 20% of state's loon population and that reproductive rates were low (five chicks/ year).
- The citizen science program started in 2005, the first in Glacier and one of the first in national parks, to increase monitoring of this sensitive species.
- We have established significant baseline data on loon population status, nesting areas, chick hatch and migration dates, and areas of concern for human disturbance.
- Our goal is to continue this long-term record to provide management recommendations about issues that may affect loon nesting success and habitat, an indicator of lake ecosystem health.

High Country Citizen Science

- This program was created in 2008 to address the need for research on mountain goats, bighorn sheep and pikas- priority species due to their vulnerability to climate change impacts.

Mountain goat and bighorn sheep monitoring

- We have established baseline data on mountain goat population density and distribution.
- Our goals are to continue monitoring mountain goat and bighorn sheep population status, to detect changes in distribution, long-term trends, and climate change impacts.

Pika monitoring

- We have established baseline data on pika distribution and persistence.

- In 2012 we implemented Inventory & Monitoring protocols at 47 sites to test the viability of using citizen scientists for long-term Vital Signs monitoring.



Invasive Plant Citizen Science

- This program was created in 2008 to help detect five target invasive plants in the backcountry.
- Citizen scientists assist Invasive Plant Management Team with early detection/rapid response.
- In addition to season-long monitoring we host an annual Weed Blitz (~ 50 participants annually).
- We have launched an on-line training to engage short-term visitors and schools.
- We will pilot-test a smart phone app that has been developed for the National Park Service.

Education and Outreach

- We have engaged over 700 students in citizen science data collection.
- Annually we provide outreach to 150- 250 participants from visiting school groups, universities and community colleges, teachers groups, and other learning groups.
- We developed Youth Exploring Science (Y.E.S!) an innovative curriculum-based program for high school/ middle school groups - an underrepresented group for education in parks- and have implemented this in-depth program with over 200 local students. During classroom instruction and field trips students develop research questions, collect and analyze field data. We aim to empower students to put the scientific method into action to answer their own questions about the ecosystem.



Program support and needs:

- Long-term monitoring of our target species is necessary to ensure that their populations are stable and to make sure their populations remain stable in the face of climate change.
- Each year we are asked to monitor additional species with citizen science, and we regularly add new species to keep the program diverse and meet additional research needs. However, we are at capacity with staff resources.
- The program is funded year-to year by the Glacier National Park Conservancy, which provides support for one coordinator position (term 8 months with furlough).
- Additional grant support is sought each year from various sources for 2-4 interns to assist with coordinating citizen scientists during the busy field season, but the instability of funding sources limits our ability to attract returning staff members who can help advance the program.
- We need to establish secure funding to sustain current gains, maintain staff consistency, increase the participant to staff ratio and meet additional monitoring requests.

2015 Glacier National Park Citizen Science Project Summaries

High Country Citizen Science Project

Citizen Science Pika Monitoring

The American Pika could be negatively impacted by climate change, due to their dependence on alpine habitat and physiological sensitivity to warm temperatures and early snowmelt. In 2012, Glacier National Park joined a network of parks to collect baseline information about pikas for the National Park Service Inventory and Monitoring Program's initiative. In 2012, 47 pika survey sites were established by research technicians. The summer of 2013 was the first field season that the Glacier National Park Citizen Science Program coordinated all surveys of pika monitoring sites, and pika monitoring continued during the summers of 2014 and 2015. In 2015, 89 citizen scientists and staff contributed 1041 hours to complete pika surveys. Observers completed 67 pika surveys and visited 38 official sites. Of the 9 official sites not visited, one was considered unsafe to send volunteers to, and several others were inaccessible for most of the survey season due to fire-related area closures. Of the 38 sites surveyed, 25 (66%) were recorded as "currently occupied," meaning that fresh sign or a pika was observed during the 2015 field season (Table 1). Four sites were classified as formerly occupied and 7 sites were unoccupied. The rate of occupancy at surveyed sites was 0.66, slightly below the average of 0.70 over the four years of data (Figure 1). We will continue monitoring during 2016 to attain a fourth year of baseline data and enable us to evaluate trend in pika occupancy and determine detection rates for planning long-term monitoring.

Year	Currently Occupied	Formerly Occupied	Unoccupied	Not Surveyed	Currently Occupied /Total Surveyed
2012*	38	1	8	0	0.81
2013	31	6	6	4	0.72
2014	28	7	10	2	0.62
2015	25	4	5	9	0.66

*Surveys were completed by research technicians who established survey sites, not citizen scientists.

Table 1. Summary of pika occupancy surveys completed at 47 Inventory and Monitoring official monitoring sites in Glacier National Park from 2012 to 2015. Currently occupied sites had fresh sign or pika observed during the current field season. A site was considered formerly occupied if only old scat or old haypiles were detected. After three surveys, a site that was not confirmed as currently occupied or formerly occupied was considered unoccupied.

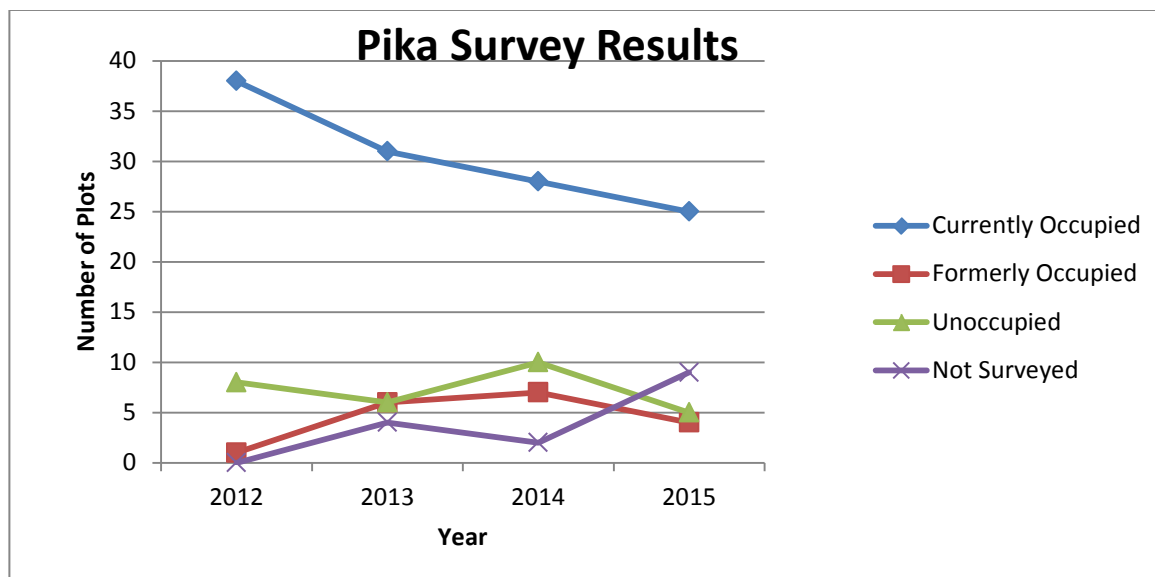


Figure 1. Pika occupancy surveys completed at 47 Inventory and Monitoring official monitoring sites in Glacier National Park from 2012 to 2015.

Citizen Science Mountain Goat and Bighorn Sheep Monitoring

Due to their dependence on high country habitat, mountain goats and bighorn sheep could serve as indicators of how warming temperatures impact alpine communities. In spring 2008, Glacier National Park (GNP) established the High Country Citizen Science program to train volunteers to gather baseline data on population and distribution of mountain goats. Monitoring of bighorn sheep was added to the program in 2013. In 2015, 125 citizen scientists contributed 2381 volunteer hours and completed 172 mountain ungulate surveys. Of the 37 official mountain goat sites, three (Grinnell Lake, Siyeh Pass, Swiftcurrent Lookout) received one survey, four (Fifty Mountain, Otokomi Lake, Pitimakin Pass, Triple Divide Pass) received two surveys, and the remaining 30 sites were surveyed at least three times each. Three additional un-official sites also received surveys. 267 mountain goats and 133 bighorn sheep were observed during surveys. In addition, UTM's were captured for 18 bighorn sheep and 82 mountain goat locations. During the Mountain Goat Days event, 46 surveys were completed, with 26 out of 37 official sites surveyed (Table 2). In total, 96 ungulates (33 goats and 18 sheep at survey sites during official survey periods and 34 goats and 11 sheep outside of survey sites or outside of survey periods) were recorded (Figure 2). By analyzing six years of count data collected since the initial baseline population estimate was completed in 2009, the citizen science program plans to determine the population trend of mountain goats in Glacier NP. The project will continue during the summer of 2016

Year	Number of Official Sites Surveyed	Total Goats Observed in Surveys	Volunteers	Hours
2015	26	67	28	496
2014	33	84	35	522
2013	34	36	33	478
2012	34	102	27	414
2011	33	80	20	336
2010	35	99	31	585
2009	35	138	34	548
2008	33	88	46	414

Table 2. Mountain Goat Days results from 2008-2015, including the number of survey sites visited, the total number of goats observed, the number of volunteers involved, and the number of volunteer hours accrued. These index counts represent a snapshot of the population at representative sites from year to year, but do not represent a park-wide population estimate.

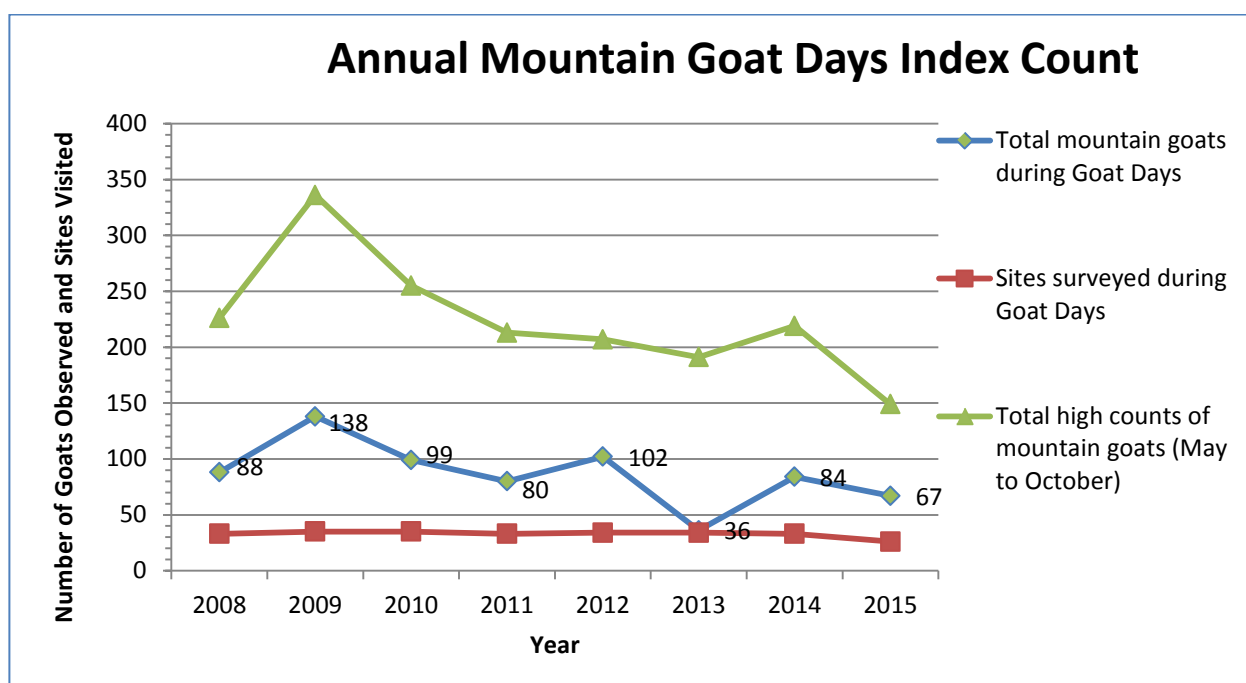


Figure 2. A summary of citizen science survey results from Mountain Goat Days from 2008 to 2015.

Common Loon Citizen Science Project

The Common Loon (*Gavia immer*) is considered a Species of Special Concern by Montana Fish Wildlife and Parks, due to the species' sensitivity to disturbance during nesting season and its low reproductive and recruitment rates. In 2006, GNP established the Common Loon Citizen Science project to train volunteers and GNP staff to gather baseline data on population and distribution of common loons, to improve accuracy during an annual Loon Day count, and to increase survey coverage of lakes with loons. In 2015, 129 citizen scientists contributed 3298 hours and completed 314 loon surveys. Forty-four of the 45 priority lakes were surveyed at least three times including all priority 1, 2 and 3 lakes. The season-long loon population estimate was 54 resident adults (14 pairs and 26 singles) and 5 chicks in 4 successful broods on 4 lakes. During loon days, 45 adults (11 pairs and 23 singles) and 5 chicks in 4 successful broods on 4 lakes were observed. Chick production was below average this year, with 5 chicks detected (Table 3). The long-term trend indicates that the number of common loons detected in GNP is increasing, but it is unclear whether that is a result of increased chick production or better detection of chicks (Figure 3). The fecundity rate of GNP's loon population (0.47) is slightly below the rate of 0.48 chicks fledged per territorial pair needed to maintain a stable population and is lower than the fecundity rate of Montana's common loon population as a whole. Chick hatch dates were pinpointed at three of four lakes with successful nesting, providing an invaluable resource for managers aiming to prevent nest disturbance. More frequent monitoring is needed to refine chick hatch dates and find both successful and unsuccessful nests. This information will allow us to better detect disturbance patterns and to track changes that may occur with life cycle timing due to climate changes. The project will continue during the summer of 2016.

2005 - 2015 Common Loon Citizen Science Project												
Resident vs. Loon Day Population												
	Resident					Loon Day					Fecundity - Chicks per Resident Pair	Fecundity - Chicks per 2 Resident Adults
	Pairs	Chicks	Broods	Singles	Adults	Pairs	Chicks	Broods	Singles	Adults		
2005	n/a	n/a	n/a	n/a	n/a	14	4	3	11	39		
2006	16	5	3	13	45	9	4	3	18	36	0.31	0.22
2007	20	10	6	6	46	10	6	5	23	43	0.50	0.43
2008	14	7	6	19	47	12	4	4	5	29	0.50	0.30
2009	16	11	6	9	41	12	9	7	11	35	0.69	0.54
2010	18	5	3	5	41	8	5	3	10	26	0.28	0.24
2011	17	8	5	11	45	11	3	3	12	35	0.47	0.36
2012	14	6	4	8	36	15	7	5	10	40	0.43	0.33
2013	17	8	6	13	47	10	8	6	14	30	0.47	0.34
2014	18	12	9	15	51	17	11	8	16	50	0.67	0.47
2015	14	5	5	26	54	11	5	4	23	45	0.36	0.19
Mean	16.4	7.7	5.3	12.5	45.3	11.7	6.0	4.6	13.9	37.1	0.47	0.34
Min	14	5	3	5	36	8	3	3	5	26		
Max	20	12	9	26	54	17	11	8	23	50		

Table 3. Season-long and Loon Day results from 2005-2015, including the number of loon pairs, singles, chicks and broods observed season-long and during July Loon Days.

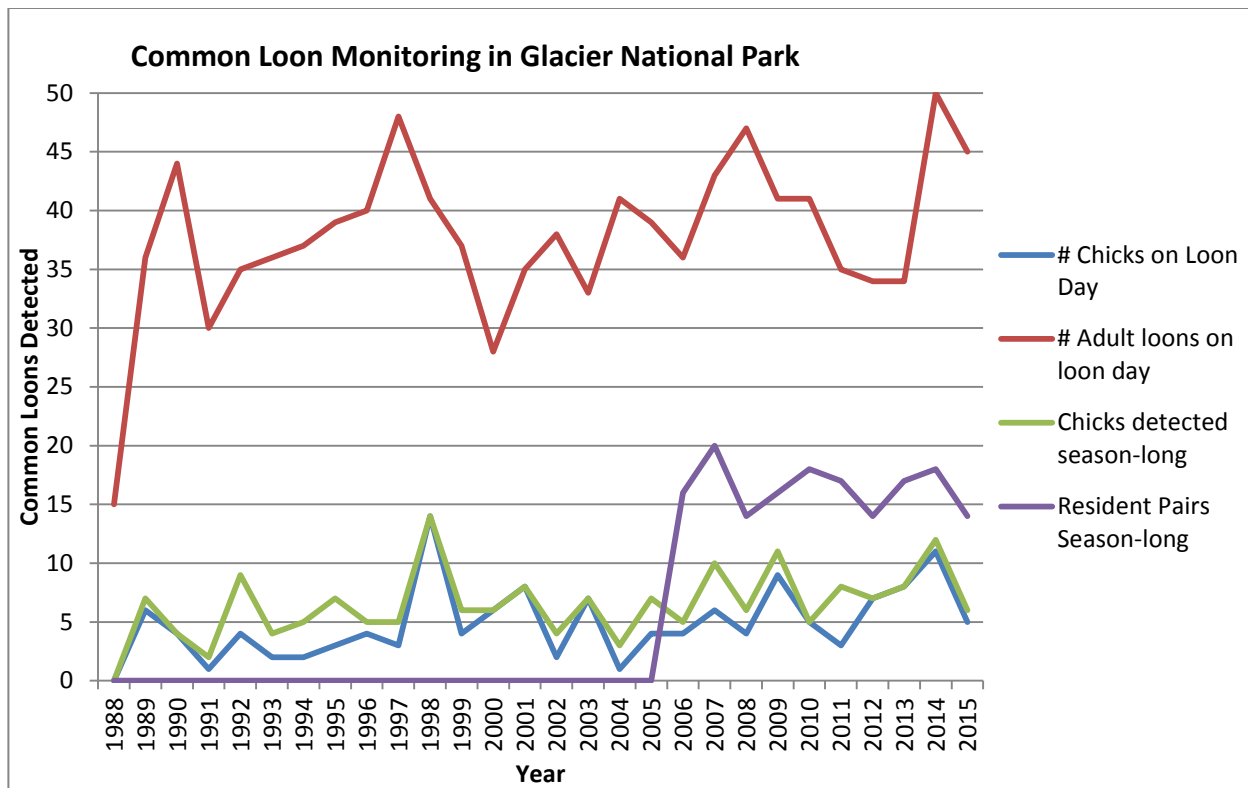


Figure 3: Common loon chicks and adults detected in Glacier National Park, 1988 - 2015. Records from 1988- 2004 were collected prior to establishment of the Common Loon Citizen Science Project.

Invasive Plant Citizen Science Project

Invasive plants are one of the greatest challenges facing land managers in the Crown of the Continent Ecosystem. Early detection of new invasive plants in GNP's backcountry is a high priority to ensure persistence of native plant communities. In 2008, Glacier National Park (GNP) established the Invasive Plant Citizen Science project. The primary goal is for citizen scientists to assist Glacier's Invasive Plant Management Team with early detection/rapid response by documenting invasive plants in locations that park staff cannot regularly survey. The Invasive Plant Citizen Science Project trains members of the public to detect and report the locations of target invasive plants in the backcountry and assists park managers with early detection of these plants in new locations. In 2015, Invasive Plant citizen scientists contributed 437 hours while conducting 32 invasive plant surveys in 23 areas throughout GNP. A total of 38 citizen scientists (including 30 Noxious Weed Blitz attendees) participated in surveying 208 miles of backcountry trails and hiking over 349 miles. Invasive plant species were reported in 19 of the 23 areas surveyed. Four of the five target species (spotted knapweed, Saint John's wort, oxeye daisy, and yellow toadflax) and two watch list species (orange hawkweed and an unconfirmed report of yellow starthistle), and two additional species (Canada thistle and meadow hawkweed) were detected with a total area of approximately 201,783 square feet (4.6 acres) (Table 4). Citizen science programs in Glacier successfully provided educational outreach for park visitors and local communities, as well as collected baseline information. The Invasive Plant Citizen Science Project was successful in educating participants about the issue of invasive plants and how to identify them. The project also contributed valuable information through detection of new infestations of invasive plants in GNP's backcountry and documentation of spread in infestations that were known from previous years.

2015 Invasive Plant Surveys																								
Trail Name or Site	Surveys	Target weeds found	Survey Hours	Group Size	Total Hours	Miles	Total Miles	HYPPER	Area (ft^2)	CENMAC	Area (ft^2)	CHRLU	Area (ft^2)	CENSOL	Area (ft^2)	LINVUL	Area (ft^2)	HEIAUR	Area (ft^2)	CIRARV	Area (ft^2)	HIECEA	Area (ft^2)	
Granite Park Loop	1	TRUE	6	1	6	4	4	TRUE	500											TRUE	3600			
Trout Lake to Arrow Lake	1	FALSE	10	1	10	4.6	4.6															TRUE	300	
Elizabeth, Cosley, Mokowanis Lake Trails	2	TRUE	24	1	24	34	34											TRUE	150	TRUE	38531			
Logging Lake Trail	1	TRUE	11.5	1	11.5	26.4	26.4											TRUE	24	TRUE	500			
Jackson Overlook to Lake McDonald	1	FALSE	40	1	40	20	20													TRUE	64000			
Pitamakin Pass	1	FALSE	8	1	8	7	7																	
Boundary Trail	2	TRUE	8	1	8	12	12	TRUE	6150			TRUE	1010	TRUE	1						TRUE	150		
Huckleberry Trail	1	TRUE	3.5	1	3.5	6	6					TRUE	3100											
Lake McDonald Trail	1	TRUE	5.25	1	5.25	4	4	TRUE	300	TRUE	300	TRUE	1											
Rocky Point Trail	2	FALSE	1	1	1	1.9	1.9																	
Sperry from McDonald Lodge to Fish Lake	1	TRUE	6	1	6	6	6	TRUE	100	TRUE	500	TRUE	400								TRUE	100		
Avalanche Trail	2	TRUE	8	2	16	10	20					TRUE	1901					TRUE	625	TRUE	2300			
Upper McDonald Creek	1	TRUE	6	1	6	5	5	TRUE	1500			TRUE	100							TRUE	100			
Apgar Lookout	2	TRUE	15	1	15	10	10	TRUE	10200			TRUE	6597					TRUE	185					
Running Eagle Falls Trail	1	FALSE	4	1	4	1	1																	
Rocky Point & Mdconald Lake	1	TRUE	3	1	3	8	8									TRUE								
Iceberg Lake Trail	2	TRUE	14.3	2	28.6	19.4	38.8			TRUE	2600	TRUE	1			TRUE	145							
Apikuni Falls Trail	1	TRUE	3.7	2	7.4	4	8			TRUE	2550													
Preston Park	1	TRUE	9.25	2	18.5	7	14					TRUE				TRUE	750							
Grinnel Lake Trail	1	TRUE	9.25	2	18.5	6.8	13.6			TRUE	12	TRUE	30											
Flattop Mountain Trail	1	TRUE	5.5	2	11	4.5	9	TRUE	4046	TRUE	300	TRUE	5087					TRUE	215	TRUE	29001			
Weed Blitz Sites	4	TRUE	6	30	180	3	90																	
North Fork Rd and Howe Ridge	1	TRUE	6	1	6	6	6	TRUE	100			TRUE	10622								TRUE	3100		
Totals	32				437.3	211	349																	
Sites with Target Weed								8		6		12		1		3		5		10		1		
Total Area Each Weed									22,896		6,262		28,849		1		895		1,199		141,382		300	
Toral Area All Weeds	201,784																							

Table 4: Invasive plants survey results summary at each trail/ location.

2015 Citizen Science Summary

Overview of citizen science efforts

- In 2015, 248 citizen scientists, including 111 individual citizen scientists and 137 members of outreach groups, were active in one or more of our projects, completing at least one survey during the 2015 season. Of these, 141 people completed at least three surveys.
- We trained 184 citizen scientists, of whom 171 were new participants, including 137 outreach group participants.
- Our annual Noxious Weed Blitz was attended by 30 participants.
- We trained 96 students (61 high school and middle school students and 35 university students) and 15 Glacier Youth Conservation Corps members and engaged them in data collection.
- Citizen scientists completed 595 surveys (316 loon surveys, 172 mountain goat/ bighorn sheep surveys, 67 pika surveys, 32 invasive plant surveys, and 8 raptor surveys).
- Citizen scientists contributed 7150 hours of survey effort. This is an in-kind contribution of \$143,000 analogous to 9 full-time (GS-5) employees for 20 week field season (May- September).

Internships

- We mentored three outstanding interns: one MSU graduate student with a major in wildlife biology, one recent Concordia University graduate, with a major in biology, one Blackfeet Community College student.
- We supervised 16 long-term VIP's who completed 2110 volunteer hours.

Outreach and education

- We conducted numerous educational outreach programs, training the participants about the ecology and concerns of the wildlife and plant species we are monitoring, and engaging them in data collection whenever possible. Approximately 130 individuals were educated during outreach presentations including 96 students and 3 teachers.
- Flathead High School International Baccalaureate class: 14 students, 1 instructor. Conducted classroom sessions and field trips for students to do ungulate and pika surveys, and shared data from our ungulate and pika databases.
- University of Montana volunteer group: 11 students, 1 instructor. Gordon Luikart from the Flathead Lake Biological Station led a group of students who participated in a loon training session and did a survey.
- Glacier Youth Conservation Corps (Montana Conservation Corps): two crews, 15 people total. Attended High Country training and conducted loon, pika, and ungulate surveys.
- Boy Scouts troop from Pittsburgh: 11 Boy Scouts and 1 leader. Attended the Weed Blitz.
- University of Montana Wildlife Society: 25 students. Attended High country training and conducted goat and pika surveys.
- The Woods Project (Chicago and Houston students): 36 students, 3 leaders. Attended loon training and conducted surveys.
- Glacier Conservancy Master Naturalists: 13 attendees and 1 instructor. Received loon training and program overview.
- Sierra Club: 11 members, 1 leader. Attended high country training and conducted goat and pika surveys.

Citizen Science Program History Summary

Citizen Science Programs:

<http://www.nps.gov/glac/naturescience/ccrlc-citizen-science.htm>

Common Loon Citizen Science Project

Year	Participants	New Recruits	Surveys	Hours	Resident Adults	Resident Pairs	Chicks
2015	129	65	316	3298	54	14	5
2014	118	69	257	3485	51	18	12
2013	112	48	238	3003	47	17	8
2012	75	35	215	2522	34	14	7
2011	112	31	158	>220	45	17	8
2010	105	33	220	>1840	41	18	5
2009	132			1592	41	16	11
2008	120			1800	47	14	7
2007	156			>2600	43	10	6
2006	77			2903	45	16	4
2005	46			1948	45	19	7

High Country Citizen Science Project

Year	Participants	New Recruits	Surveys	Hours	Ungulate Surveys	Ungulates on Goat Days	Pika Surveys
2015	125	83	239	3422	172	96	67
2014	91	103	233	4804	160	128	73
2013	134	59	255	4386	176	35	79
2012	123	71	181	2769	153	118	28
2011	178	113	210	3534	172	78	38
2010	143	73	213	2900	169	155	44
2009	88	44	330	3009	272	134	58
2008	86		232	1392	186		46

Invasive Plants Citizen Science

Year	Participants	New Recruits	Surveys	Hours	Trails with Weeds Detected
2015	38	23	32	437	19
2014	87	65	47	1060	19
2013	69	67	44	453	23
2012	90	82	58	1088	25
2011	94	59	82	802	30
2010	54	27	57	400	27
2009	25	17			
2008	28	396	81		

All Projects Combined

Year	Active Citizen Scientists	Active Outreach Group Members	New Citizen Scientists	New Outreach Group Members	Hours	Surveys	VIP Hours
2015	247	127	171	130	7150	594	2110
2014	259	135	215	161	9385	537	4522
2013	216	85	159		7842	537	3170
2012	212	113	197		6380		
2011	191	83			6500	450	2530
2010	180	89			5100	490	3640
2009	108				4600		3189
2008	234				3588	463	
2007	156				2600		
2006	77				2903		
2005	46				1984		

Funding

Citizen Science – Loons, High Country & Invasive Plants

2015 Glacier National Park Conservancy: \$55,000, FLREA: \$15,000, NPS Base: \$10,000
2014 Glacier National Park Conservancy- \$69,000 (\$24k unrestricted; \$45k special donor)
2013 Glacier National Park Conservancy- \$35,000
2012 Glacier National Park Fund - \$52,000 (includes \$7,000 for on-line program)
2012 NPS Youth in Parks - \$15,840
2011 Glacier National Park Fund- \$50,000
2010 Glacier National Park Fund - \$25,000

High Country Citizen Science

2013 FLREA- \$14,000
2011 George M. Wright Internship ~ \$6,200
2009 Glacier National Park Fund- \$25,000
2008 Glacier National Park Fund- \$22,000

Invasive Plant Citizen Science

2011 Unilever Foundation - \$10,000
2008 NPS Parks as Classrooms- \$25,000

Citizen Science for Common Loons

2013 Rocky Mountain CESU grant- \$7,000- Common Loon Citizen Science Internship
2008 Glacier National Park Associates- \$5,000- Citizen Science for Common Loons Internship
2007 Glacier National Park Fund- \$19,000- Note: Another \$16,000 in this account was for the Invasive Plant Field guide.
2007 Glacier National Park Associates- \$5,000- Citizen Science for Common Loons Internship
2006 Glacier National Park Fund- \$16,000
2005 Rocky Mountain CESU grant- \$5,000- Citizen Science for Common Loons pilot year (training GNP staff and participants)

2015 Citizen Science Program Accomplishments

Citizen Science program coordination

- Trained 171 new citizen scientists for all 3 projects, including 137 participants trained during outreach programs listed under “Outreach and Education.”
- 247 citizen scientists including 137 outreach participants were active in one or more project(s), completing at least one survey. 141 participants completed at least 3 surveys.
- Trained 96 students (61 high school and middle school students and 35 university students) and 15 Glacier Youth Conservation Corps members and engaged them in data collection
- Trained 15 Glacier Youth Conservation Corps members in 2 sessions

Leadership and supervision

- Supervised 2 outstanding interns.
- Supervised and mentored Blackfeet Community College intern for Montana Loon Society.
- Supervised 16 VIPs who completed 2110 hours in FY 2015.
- Radio and backcountry protocol training for new VIPs
- Volunteer appreciation- issued certificates to all participants who conducted at least one survey, and recognition items (tee shirts) to VIP’s who completed 80 hour commitment.
- Held bi-monthly staff meetings with interns to provide and solicit feedback.

Recruiting, engagement and new audiences

- Conducted trainings in Headquarters area, Glacier Park Lodge, Big Creek, Glacier Institute Field Camp, and at Flathead HS.
- Solicited volunteer feedback during appreciation potluck.
- Facebook group for citizen science members- expanded size of group to 93 members.
- Made posts of survey needs, project results, media stories, related science articles, hiking partner requests, etc.
- Entered Citizen Science projects on Commons Lab Database of federal crowdsourcing and citizen science projects

Collaboration/ funding/ partnerships

- Blackfeet Reservation intern- supervised student intern in collaboration with Montana Loon Society, Biodiversity Research Institute and Common Loon Working Group.

Data Collection

- Citizen scientists completed 594 surveys and 7,150 hours of survey effort. This is an in-kind contribution of over \$143,000 equivalent to 9 full-time (GS-5) employees for 20 week field season (May- September)
- Completed 316 loon surveys- at least 3 surveys at 44 of the 45 priority lakes, including all priority 1, 2, and 3 lakes, and 25 surveys on lakes not on the priority list.
- Completed 172 mountain goat/ bighorn sheep surveys - Of the 37 official mountain goat sites, three (Grinnell Lake, Siyeh Pass, Swiftcurrent Lookout) received one survey, four (Fifty Mountain, Otokomi Lake, Pitimakin Pass, Triple Divide Pass) received two surveys, and the remaining 30 sites were surveyed at least three times each
- Completed 68 pika surveys - 38 of 47 sites surveyed. Several sites were unreachable for safety reasons or fire-related area closures
- Completed 32 invasive plants surveys, detecting 4.3 acres of invasives
- Coordinated Loon Day (38 participants, 47 lakes observed) and Spring Loon Days (39 lakes observed).
- Coordinated Noxious Weed Blitz (30 participants).
- Coordinated Goat Days with of 46 surveys at 26 out of 37 official sites despite multiple fire closures and

heavy smoke.

- Raptor migration- Conducted weekly surveys to count migrating raptors with help from 5 volunteers who contributed over 150 hours.
- Christmas Bird Count- in 2014, 28 observers on 10 field routes and one feeder site recorded 689 birds of 40 species. CBC will occur again in winter 2015.
- WORF and BIMS- verified and submitted data on wildlife and bear sightings.

Collaboration with other researchers on citizen science target species

- Greater Yellowstone Mountain Ungulate Project- continued collaboration with Montana State University to compare goat and sheep population monitoring and habitat selection.
- Shared loon survey data with Montana Department of Fish, Wildlife, and Parks and the Montana Common Loon working Group.
- Coordinated the observation of 47 lakes in and near the park for Montana Department of Fish, Wildlife, and Parks Loon Day
- Completed 68 pika surveys for the Inventory and Monitoring Vital Signs Monitoring program

Training and data collection quality control

- Trained all new and several returning volunteers in how to fill out data sheets properly
- Revised loon and ungulate survey forms by adding fillable fields so volunteers could fill out forms electronically

Logistical needs and volunteer/staff relations

- Maintained excellent relations with backcountry permit staff, subdistrict rangers, dispatch office, etc. to ensure their continued help with survey logistical needs
- Replaced damaged or missing tags at 4 pika sites

Data Management

Data entry and quality assurance

- All 2015 loon, pika, and goat data reviewed for QA/QC by coordinator and/or loon intern
- Archived 2015 datasheets for loons, pika, ungulates, by site and date, and weeds and observer contact forms and photo releases by name
- Completed all data entry for 2015.
- Updated SOP for loon data entry and wrote SOP for observer data entry.

File organization and project information accessibility

- Completely re-did the loon citizen science intern manual, most of which had not been updated since 2007.
- Continued to organize photos in citizen science photo file. Removed duplicates and placed uncategorized files into folders.
- Observer database- fixed all undeliverable email and mailing addresses.
- Began organizing literature into binders and created indices for them.

GIS

- Created maps of 2015 mountain goat/ bighorn sheep count data
- Created maps of 2015 pika occupancy data.
- Created maps of 2015 loon season-long and loon day occupancy.

Database management

- Observer database - Built new queries for improved reporting of volunteer participation
- Loon database – created new queries for QA/QC to ensure loon numbers, chick presence/size, and nesting status fields and volunteer names/numbers are filled out consistently, and to improve reporting of volunteer hours
- Ungulates database – Created new queries to improve volunteer participation reporting and fixed tab order on the data entry forms.
- Pika database - Created new queries to improve volunteer participation reporting, fixed tab order on the data entry forms, and corrected some errors in the volunteer list.

Reporting and Outreach

Annual summary reports

- Completed final report.
- Submitted all report documents as merged .pdf for IRMA.
- Loon nesting history- updated spreadsheet with all 2013-2015 nesting locations, and hatch dates.

Communicating Citizen Science Results

- Shared results during mid-season potluck.
- Emailed loon day and season-long results and maps, mountain goat day and season-long results, and pika occupancy results, to all citizen scientists
- Posted mid-season results and end of season results on Facebook.
- Shared ungulate and pika data with Flathead HS International Baccalaureate class
- Shared loon data with Common Loon Working Group and Montana Fish Wildlife and Parks

Science communication, Outreach and education

- Conducted numerous educational outreach programs, training the participants about the ecology and concerns of the wildlife and plant species we are monitoring, and engaging them in data collection whenever possible. Approximately 137 individuals were educated during outreach presentations including 96 students and 3 teachers.
- Flathead High School International Baccalaureate class: 14 students, 1 instructor. Conducted classroom sessions and field trips for students to do ungulate and pika surveys, and shared data from our ungulate and pika databases.
- University of Montana volunteer group: 11 students, 1 instructor. Gordon Luikart from the Flathead Lake Biological Station led a group of students who participated in a loon training session and did a survey.
- Glacier Youth Conservation Corps (Montana Conservation Corps): two crews, 15 people total. Attended High Country training and conducted loon, pika, and ungulate surveys
- Boy Scouts troop from Pittsburgh: 11 Boy Scouts and 1 leader. Attended the Weed Blitz
- University of Montana Wildlife Society: 25 students. Attended High country training and conducted goat and pika surveys.
- The Woods Project (Chicago and Houston students): 36 students, 3 leaders. Attended loon training and conducted surveys.
- Glacier Conservancy Master Naturalists: 13 attendees and 1 instructor. Received loon training and program overview.
- Sierra Club: 11 members, 1 leader. Attended high country training and conducted goat and pika surveys.
- Updated loon, pika, and mountain ungulate training presentations.

High Country Citizen Science Project: 2015

Mountain Goats and Bighorn Sheep

Abstract

Due to their dependence on high country habitat, mountain goats and bighorn sheep could serve as indicators of how warming temperatures impact alpine communities. In spring 2008, Glacier National Park (GNP) established the High Country Citizen Science program to train volunteers to gather baseline data on population and distribution of mountain goats. Monitoring of bighorn sheep was added to the program in 2013. In 2015, 125 citizen scientists contributed 2381 volunteer hours and completed 172 mountain ungulate surveys. Of the 37 official mountain goat sites, three (Grinnell Lake, Siyeh Pass, Swiftcurrent Lookout) received one survey, four (Fifty Mountain, Otokomi Lake, Pitimakin Pass, Triple Divide Pass) received two surveys, and the remaining 30 sites were surveyed at least three times each. Three additional un-official sites also received surveys. 267 mountain goats and 133 bighorn sheep were observed during surveys. In addition, UTMs were captured for 18 bighorn sheep and 82 mountain goat locations. During the Mountain Goat Days event, 46 surveys were completed, with 26 out of 37 official sites surveyed. In total, 96 ungulates (33 goats and 18 sheep at survey sites during official survey periods and 34 goats and 11 sheep outside of survey sites or outside of survey periods) were recorded. By analyzing six years of count data collected since the initial baseline population estimate was completed in 2009, the citizen science program plans to determine the population trend of mountain goats in Glacier NP. The project will continue during the summer of 2016.

Introduction

Glacier National Park is an excellent study system to examine conservation and wildlife monitoring in the context of climate change. Due to their dependence on high country habitat, mountain goats and bighorn sheep could serve as indicators of how warming temperatures impact alpine communities. These species are also highly visible and popular with visitors, providing an opportunity for the general public to become involved in conservation monitoring and the scientific process.

Research and monitoring that relies on volunteers to collect data without direct supervision is called citizen science (Trumbull et al. 2000). As ecosystem-level disturbances (e.g., global climate change; Morissette et al. 2009) proliferate, as funding for ecological monitoring declines (Pilz et al. 2005), and as demand for public participation in resource management increases (Yung 2007), many organizations are developing citizen science programs to address the need for cost-effective monitoring that covers large geographic areas. Careful training and sampling design may allow citizen science programs to yield results that are as reliable as those from professional monitoring programs (Hochachka et al. 2000, Yoccoz et al. 2003, Gouveia et al. 2004). Citizen science data are often collected on spatial scales beyond the reach of most research budgets (Cooper et al. 2007, Greenwood 2007, Cohn 2008), and they may also be conducted over a longer term than professional monitoring programs with larger funding needs (Danielsen et al. 2005).

To monitor species of interest using citizen science, managers at Glacier National Park established citizen science projects focused on monitoring common loons, mountain goats, bighorn sheep, pikas, and invasive plants, based in the Crown of the Continent Research Learning Center. The High Country Citizen Science Project was established in 2008 and continues to engage volunteers to monitor mountain ungulates (mountain goats and bighorn sheep) in Glacier. Declines in goat numbers at a prominent mineral lick in GNP (S. Gniadek, Glacier National Park, unpublished data) and throughout the neighboring Bob Marshall Wilderness (Koeth 2008), and uncertainty about mountain goat response to climate change (Pettorelli et al. 2007), generated concern about the stability of mountain goat populations in GNP. Broad-scale abundance estimates of mountain goats in GNP are needed for future monitoring. Due to the sensitivity of mountain goats to trapping (Côté et al. 1998) and the costs, safety concerns, and

potential impacts to visitor experience associated with traditional mark–recapture methods, the National Park Service suggested citizen science as a noninvasive monitoring approach.

Aerial survey by helicopter is the primary noninvasive technique used to census mountain goats (Shackleton 1997), but the high cost of this method means that coverage or replication is often sacrificed. A combination of aerial surveys and observational ground counts may improve precision of population estimates (Festa-Bianchet and Côté 2008). Mountain goats are an ideal candidate species for ground counts due to the high visibility of their exposed habitats (Veitch et al. 2002). Ground counts are rarely conducted, however, because they are not typically cost-efficient due to the rugged and remote places inhabited by mountain goats (Festa-Bianchet and Côté 2008). Studies using the number of ungulates seen per day by hunters and outfitters as an estimate of ungulate density (Ericsson and Wallin 1999, Veitch et al. 2002, Pettorelli et al. 2007) have reported promise as viable long-term monitoring techniques. The large number of visitors to GNP (approx. 2 million/year) similarly provides a potentially useful resource for monitoring mountain goat populations.

In spring 2008, GNP created the High Country Citizen Science program to train volunteers to conduct observational surveys of mountain goats. These surveys take place on a park-wide scale and focus on data collection at backcountry locations. Using citizen science data collected in 2009, a baseline density of 1.23 ± 0.195 mountain goats/km² was estimated, and using data collected by biologists, a baseline density of 1.56 ± 0.42 mountain goats/km² was estimated (Belt & Krausman 2012). The biologist-produced estimate was higher but had more variability. In addition, the citizen scientist estimate was most similar to the estimate produced by aerial surveys. Therefore, citizen science was determined to be an effective tool to monitor mountain goat trends into the future (Belt & Krausman 2012).

In 2013, the GNP Citizen Science Program formed a partnership with the Greater Yellowstone Area Mountain Ungulate Project (Appendix 1). Mountain goats are considered a non-native species in the Greater Yellowstone Area, and their spread in distribution across the region has raised concerns regarding their potential impacts on native bighorn sheep. In contrast, Glacier National Park contains native populations of both bighorn sheep and mountain goats. Glacier National Park's setting provides an excellent opportunity to study natural distribution and sympatry of mountain ungulate species. Comparison of mountain ungulate location data between native mountain goat range (Glacier National Park) and non-native range (Greater Yellowstone Area) could lead to significant ecological insight regarding mountain goat ecology and interaction with bighorn sheep in different settings.

Therefore, in 2015 the objectives of the mountain ungulate monitoring program were to:

- Enlist the help of volunteers and GNP staff to collect baseline information about mountain goats and bighorn sheep;
- Monitor how the population size of each species changes over time by analyzing population trends;
- Map parkwide distribution of mountain ungulates;
- Conduct the annual Mountain Goat Days event.

Study Area

Glacier NP contained 4,081 km² of federally protected land and was situated in the northern Rocky Mountains, Montana, USA. For a description of the study area, see Chadwick (1977). Glacier NP provided habitat to an un hunted native population of mountain goats of undetermined size. Earlier studies yielded density estimates of 1.16 mountain goats/km² in a 310-km² central portion of GNP (Chadwick 1977) and 2.9 mountain goats/km² in a 32.7-km² area (Singer and Doherty 1985). Glacier NP maintains an extensive network of >1,127 km of hiking trails. Our study area included all portions of the Livingston and Lewis mountain ranges that had slope angles $\geq 25^\circ$ and were within 3.2 km of a trail (Fig. 1). Surveys were conducted at 37 official survey sites, and 32 sites with an area of 1,311 km² (32.1% of GNP) were used for trend analysis.

Methods

Survey site selection

Thirty-seven mountain ungulate survey sites were originally selected throughout the park for monitoring efforts, based on criteria that included potential mountain goat habitat, proximity to trails, and average mountain goat home range size. Proximity to escape terrain (i.e., precipitous terrain used to evade predators, with cliffs, rocky ledges, and slope angles $\geq 25^\circ$) is a strong determinant of habitat use by mountain goats (See Belt and Krausman 2012 for references). A model based solely on distance to escape terrain with slope angles $\geq 33^\circ$ correctly predicted occurrence in 87% of mountain goat observations from a study in Colorado, USA (Gross et al. 2002). Therefore, we identified escape terrain from a 30-m digital-elevation model using slope-angle classifications of $25\text{--}32^\circ$, $33\text{--}39^\circ$, and $40\text{--}90^\circ$ (Gross et al. 2002). The area of GNP with slope angles $\geq 25^\circ$ was $1,653 \text{ km}^2$ (40.5% of GNP). We then created $8\text{-km} \times 11\text{-km}$ grid cells over the escape terrain to systematically locate observation sites. The grid-cell size was large enough to encompass the maximum home-range size of a mountain goat (Rideout 1977), to minimize the likelihood that mountain goats would move from one grid cell to another.

Most (76.6%) of the escape terrain used by mountain goats in GNP exceeded 40° (Chadwick 1977). Therefore, we identified all grid cells with $\geq 40^\circ$ escape terrain $\leq 3.2 \text{ km}$ from a hiking trail for observation sites. The distance of 3.2 km is the maximum line-of-sight distance for reliable detection and identification of mountain goats (S. Gniadek, personal communication; D. Chadwick, National Geographic, personal communication), which we verified through field tests. We then divided each trail into 2-km segments, randomly selected 1 segment/cell, hiked each segment, and recorded Universal Transverse Mercator coordinates of all points from which slope features were visible. We then selected in each grid cell, from all points, the observation point (i.e., site) from which the largest area of escape terrain $\geq 25^\circ$ was visible. We selected 32 sites, but topographic features blocked portions of each site. We calculated the portion of each site that was visible from each observation point using the Spatial Analyst Viewshed function in ArcGIS. We used the Spatial Analyst Extract by Mask function in ArcGIS to calculate the area of escape terrain in the viewshed of each site.

Citizen scientist involvement

Citizen science is an effective tool for monitoring mountain goat population trends (Belt & Krausman 2012). Therefore, volunteers were recruited and coordinated to complete mountain ungulate surveys throughout Glacier National Park. To ensure accurate data collection, volunteers were asked to attend a full-day citizen science training session. Citizen science staff provided background information through a PowerPoint presentation and showed the protocol to participants in the field by conducting an actual survey.

Mountain ungulate population trend monitoring

Once trained, volunteers conducted surveys at selected sites based on their schedule, hiking ability, and preference. Volunteers navigated to each site using a GPS unit and site map (Appendix 2). Photos of the observation point and the views due north and due south were provided to ensure that volunteers could locate the correct site despite GPS error ($\pm 10 \text{ m}$). Volunteers conducted a one-hour survey using magnifying optics and located groups of mountain goats and bighorn sheep within the visible survey area. For every bighorn sheep and mountain goat observation (incidental or during formal surveys), volunteers recorded total number, sex, age (young of year, yearling, or adult), predominant behavior upon detection (sitting, standing, feeding, walking, or other), and predominant landscape feature (snow/ice, ledge, loose rock, meadow, shrub/krummholz, forest, road, or trail). Volunteers were asked to take photos of each group of mountain goats with a digital camera through a spotting scope, and to submit photos for verification purposes. Volunteers also recorded the power and field of view of their optical equipment, temperature, cloud cover, weather, and time of day. The survey form and accompanying protocol are in Appendix 3. Our goal was to survey each site at least three times per season; ideally once during Mountain Goat Days in mid-August, once beforehand and once afterward. After data forms were

submitted, citizen science staff worked to ensure data quality by double-checking data sheets were completed correctly, verifying correct species identification in photos, and contacting volunteers with any questions regarding questionable observations. Staff entered all data into a Microsoft Access relational database and data entry was double-checked for quality control.

Mountain ungulate spatial distribution

Mountain ungulate location data (UTM coordinates) were recorded when possible to support spatial data collection and the project's collaboration with the GYA Mountain Ungulate Project. Recording accurate mountain ungulate locations can be challenging for volunteers, as it requires effective use of topographical maps and/or aerial photos. We asked only volunteers who had previous experience and a high comfort level with reading topographic maps to record mountain ungulate locations. Volunteers and staff accomplished this task through the use of hand-held GPS units, mobile mapping applications, the digital Glacier Wildlife Tracking map, and paper maps of survey sites (approximately 1:45,000 scale). UTM's were manually entered into the Access database or locations were captured using ArcGIS.

Mountain Goat Days event

Every year the Citizen Science Program works to coordinate a Mountain Goat Days event, in which a survey is conducted at every site in the park during one weekend. This event provides an opportunity to gain a snapshot of the mountain ungulate population, as well as an avenue to facilitate volunteer participation and engagement. Mountain Goat Days has taken place every August since the project's inception in 2008.

Results

Citizen scientist involvement

In 2015, High Country citizen scientists contributed 2381 hours for mountain goat/bighorn sheep surveys. A total of 125 citizen scientists conducted mountain ungulate surveys. Citizen scientists completed 172 mountain ungulate surveys and nine of these surveys were at unofficial sites (Appendices 4 and 5). We conducted seven training sessions (including outreach groups who conducted surveys) with 89 citizen scientist participants and of these 83 were new and outreach attendees. Outreach groups included two Glacier Youth Conservation Corps crews, Flathead High School International Baccalaureate class, the Sierra Club, and the University of Montana Wildlife Society (See Internships, VIPs, Citizen Scientists and Training section for details).

Mountain ungulate population trend monitoring

From May through October 2015, citizen scientists and park staff completed a total of 172 mountain ungulate surveys. Of the 37 official mountain goat sites, three (Grinnell Lake, Siyeh Pass, Swiftcurrent Lookout) received one survey, four (Fifty Mountain, Otokomi Lake, Pitimakin Pass, Triple Divide Pass) received two surveys, and the remaining 30 sites were surveyed at least three times each. Three additional un-official sites also received surveys.

The total of the high counts at every survey site was 149 mountain goats and 114 bighorn sheep. 267 mountain goats (Appendices 7 and 8) and 133 bighorn sheep (Appendices 9 and 10) were observed during formal surveys. In addition, incidental observations of 75 mountain goat groups and 14 bighorn sheep groups were recorded, including 204 mountain goat and 58 bighorn sheep.

Mountain ungulate spatial distribution

Of the 249 total mountain ungulate groups observed (160 groups observed during surveys and 89 incidental observations), UTM locations were recorded for 100 records (40%) (Appendix 11). UTM's were captured for 18 bighorn sheep and 82 mountain goat locations. When the location data for 2013 through 2015 are compiled, the citizen science program collected a total of 391 location records, including 69 bighorn sheep and 322 mountain goat locations.

Mountain Goat Days event

With 28 volunteers and park staff who contributed 496 hours, citizen scientists conducted an index count at representative sites throughout the entire park between August 11st and 18st, 2015 (Appendix 12). In total, 96 ungulates (33 goats and 18 sheep at survey sites during official survey periods and 34 goats and 11 sheep outside of survey sites or outside of survey periods) were recorded. (Table 1, Figure 1). A total of 46 surveys were completed, with 26 out of 37 official sites surveyed. The coverage of sites was negatively impacted by multiple fire-related area closures and heavy smoke during the Goat Days weekend. These index counts represent a snapshot of the population at representative sites from year to year, but do not represent a park-wide population estimate.

Year	Number of Official Sites Surveyed	Total Goats Observed in Surveys	Volunteers	Hours
2015	26	67	28	496
2014	33	84	35	522
2013	34	36	33	478
2012	34	102	27	414
2011	33	80	20	336
2010	35	99	31	585
2009	35	138	34	548
2008	33	88	46	414

Table 1. Mountain Goat Days results from 2008-2015, including the number of survey sites visited, the total number of goats observed, the number of volunteers involved, and the number of volunteer hours accrued.

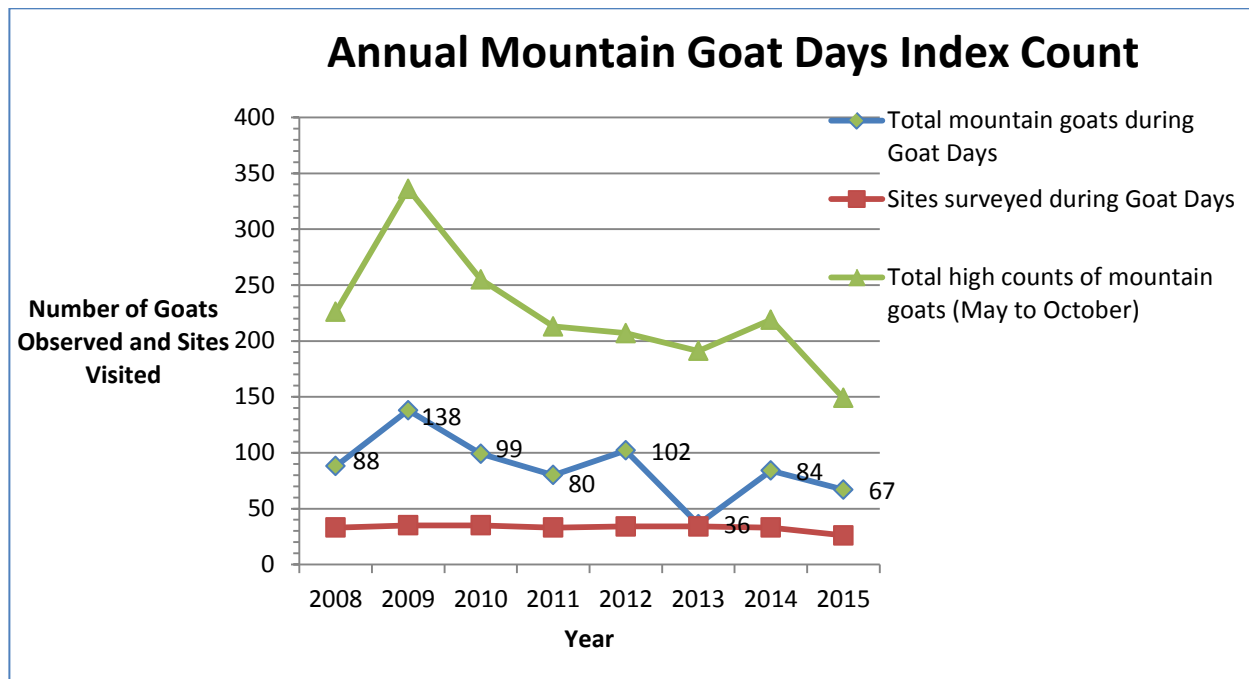


Figure 1. A summary of citizen science survey results from Mountain Goat Days from 2008 to 2015.

Discussion

Citizen science programs in Glacier successfully provided educational outreach for park visitors and local communities, as well as collected baseline information regarding species of interest. Specifically, the High Country citizen science project was successful in collecting baseline counts regarding mountain goats and bighorn sheep. When comparing the trend of minimum mountain goat count data for Goat Days and total high counts over the past eight years, the trend lines are similar. Further analysis is necessary to account for detection probability and accurately determine population dynamics. By analyzing six years of count data collected since the initial baseline population estimate was completed in

2009, the citizen science program will be able to determine the population trend of mountain goats in Glacier NP. In addition, the program plans to address potential violation of closure within the study area by using information on home range use garnered from telemetry data collected by mountain goat radio-collars deployed in the Logan Pass area from 2013-2014. We will incorporate this information to adapt our study design to ensure that our survey sites are widely spaced enough to prevent overlap of home ranges over multiple sites and the resulting potential for double counting of mountain ungulates.

The long-term goal of our mountain ungulate monitoring is to detect trends in mountain goat populations. A power analysis was conducted in 2009 to determine whether the levels of precision in N-mixture model population estimates (λ) and standard error of λ from estimates by volunteers and biologists were adequate to detect a population decline (Belt and Krausman 2012). The International Union for Conservation of Nature criteria for upgrading mountain goats from their current status as least concern to vulnerable include a 30% level of reduction in population size over three generations, or ten years (Shackleton 1997). Our results suggested that statistical power of estimates by volunteers were not sufficient to detect a decline of this magnitude over ten years. Optimization of our survey design may increase the power to detect mountain goat population trends. To attain power of 0.8 (80% likelihood of detecting a decline) while maintaining the current level of survey effort, the standard error for volunteer estimates of abundance would need to decrease to 1.502. This may be attainable with a greater number of volunteers across more sites. Recruiting more volunteers may be an option for increasing sample size but would require additional funds for volunteer coordination. Alternatively, greater precision and higher power could be achieved by reducing the number of sites and increasing surveys/site (MacKenzie and Royle 2005). This could be particularly effective when probability of occupancy is high but detection probability low (MacKenzie and Royle 2005), as is the case with common but wide-ranging species.

The capacity for citizen science programs to continue monitoring over a long period of time could be harnessed as an additional means of increasing power. Funding for monitoring of species that are not in imminent danger of extinction is often limited. When resources are scarce and population declines may not be evident immediately, the long-term nature of citizen science is particularly advantageous. If monitoring at the current spatial and temporal scale continues for 30 years, citizen science volunteers will have an 80% likelihood ($\alpha = 0.1$) of detecting a 30% decline in mountain goat populations. For species that do not require management action over the short-term, 30 years may represent a suitable time frame for conservation. When properly designed by incorporating detection probability by volunteers, citizen science programs can contribute to long term population monitoring.

Our trend analysis will determine how to best optimize the survey design to potentially shorten the time required for detection of important trends, or to increase the precision of population estimates if monitoring continues over the long-term (30 years). To inform management about population resilience or vulnerabilities, future conservation planning must also account for landscape connectivity and genetic diversity.

The Glacier Citizen Science Program was able to capture additional mountain ungulate data to facilitate collaboration with the Greater Yellowstone Area Mountain Ungulate Project, including bighorn sheep observations and mountain ungulate location data. Continuation of the new data collection methods will serve to further increase our understanding of mountain ungulates in Glacier National Park. For example, fine-scale occupancy analyses could be performed in the future, since presence data are captured by citizen scientists and absence data could be extrapolated through viewshed analyses of official survey sites. In addition, with the assistance of the Greater Yellowstone Area Mountain Ungulate Project, we would like to evaluate the potential to compare these data with mountain ungulate survey data collected in the Greater Yellowstone Area.

Literature Cited

- Belt, J.J. and P.R. Krausman. 2012. Evaluating population estimates of mountain goats based on citizen science. *Wildlife Society Bulletin* 36: 264-276.
- Chadwick, D. H. 1977. The influence of mountain goat social relationships on population size and distribution. *Proceedings of the International Mountain Goat Symposium* 1:74–91.
- Cohn, J. P. 2008. Citizen science: can volunteers do real research? *BioScience* 58:192–197.
- Cooper, C. B., J. Dickinson, T. Phillips, and R. Bonney. 2007. Citizen science as a tool for conservation in residential ecosystems. *Ecology and Society* 12:11.
- Côté, S. D., M. Festa-Bianchet, and F. Fournier. 1998. Life-history effects of chemical immobilization and radiocollars on mountain goats. *Journal of Wildlife Management* 62:745–52.
- Danielsen, F., N. D. Burgess, and A. Balmford. 2005. Monitoring matters: examining the potential of locally-based approaches. *Biodiversity and Conservation* 14:2507–2542.
- Ericsson, G., and K. Wallin. 1999. Hunter observations as an index of moose *Alces alces* population parameters. *Wildlife Biology* 5:177–185.
- Festa-Bianchet, M., and S. D. Côté. 2008. Mountain goats: ecology, behavior and conservation of an alpine ungulate. Island Press, Washington, D.C., USA.
- Gouveia, C., A. Fonseca, A. Câmara, and F. Ferreira. 2004. Promoting the use of environmental data collected by concerned citizens through information and communication technologies. *Journal of Environmental Management* 71:135–154.
- Greenwood, J. J. D. 2007. Citizens, science and bird conservation. *Journal of Ornithology* 148:77–124.
- Gross, J. E., M. C. Kneeland, D. F. Reed, and R. M. Reich. 2002. GIS-based habitat models for mountain goats. *Journal of Mammalogy* 83:218–228.
- Hochachka, W. M., K. Martin, F. Doyle, and C. J. Krebs. 2000. Monitoring vertebrate populations using observational data. *Canadian Journal of Zoology* 78:521–529.
- Koeth, C. 2008. Clinging to existence. *Montana Outdoors* (Mar–Apr):23–27.
- MacKenzie, D. I., and J. A. Royle. 2005. Designing occupancy studies: general advice and allocating survey effort. *Journal of Applied Ecology* 42:1105–1114.
- Morisette, J. T., A. D. Richardson, A. K. Knapp, J. I. Fisher, E. A. Graham, J. Abatzoglou, B. E. Wilson, D. D. Breshears, G. M. Henebry, J. M. Hanes, and L. Liang. 2009. Tracking the rhythm of the seasons in the face of global change: phenological research in the 21st century. *Frontiers in Ecology and the Environment* 7:253–260.
- Pettorelli, N., F. Pelletier, A. Von Hardenberg, M. Festa-Bianchet, and S. D. Côté. 2007. Early onset of vegetation growth vs. rapid green-up: impacts on juvenile mountain ungulates. *Ecology* 88:381–390.
- Pilz, D., H. Ballard, and E. T. Jones. 2005. Broadening participation in biological monitoring: guidelines for scientists and managers. Institute for Culture and Ecology, Portland, Oregon, USA.

Rideout, C. B. 1977. Mountain goat home ranges in the Sapphire Mountains of Montana. *Proceedings of the International Mountain Goat Symposium* 1:201–211.

Shackleton, D. M., editor. 1997. Wild sheep and goats and their relatives. Status survey and conservation action plan for Caprinae. International Union for Conservation of Nature/Status Survey and Conservation Caprinae Specialist Group, Gland, Switzerland and Cambridge, United Kingdom.

Singer, F. J., and J. L. Doherty. 1985. Movements and habitat use in an un hunted population of mountain goats, *Oreamnos americanus*. *Canadian Field-Naturalist* 99:205–17.

Trumbull, D. J., R. Bonney, D. Bascom, and A. Cabral. 2000. Thinking scientifically during participation in a citizen-science project. *Science Education* 84:265–275.

Veitch, A., E. Simmons, M. Promislow, D. Tate, M. Sallow, and R. Popko. 2002. The status of mountain goats in Canada's Northwest Territories. *Northern Wild Sheep and Goat Council* 13:49–62.

Yoccoz, N. G., J. D. Nichols, and T. Boulinier. 2003 Monitoring of biological diversity—a response to Danielsen et al. *Oryx* 37:412.

Yung, L. 2007. Citizen monitoring and restoration: volunteers and community involvement in wilderness stewardship. U.S. Department of Agriculture Forest Service Proceedings P-49, Rocky Mountain Research Station, Fort Collins, Colorado, USA.

Appendix 1:

Glacier National Park and Greater Yellowstone Area Mountain Ungulate Collaboration Report 2015

INTRODUCTION

In 2013 the Glacier National Park Citizen Science Project formed a partnership with the Greater Yellowstone Area Mountain Ungulate Project. The Greater Yellowstone Area Mountain Ungulate Project is a collaborative research effort that focuses on bighorn sheep and mountain goat ecology in the Yellowstone ecosystem. Mountain goats are considered a non-native species in the Greater Yellowstone Area, and their spread in distribution across the region has raised concerns regarding their potential impacts on native bighorn sheep. In contrast, Glacier National Park contains native populations of both bighorn sheep and mountain goats. Glacier National Park's setting provides an excellent opportunity to study natural distribution and sympatry of mountain ungulate species. Comparison of mountain ungulate data between native mountain goat range (Glacier National Park) and non-native range (Greater Yellowstone Area) could lead to significant ecological insight regarding mountain goat ecology and interaction with bighorn sheep in different settings.

The Glacier National Park High Country Citizen Science project has collected mountain goat demographic and population trend data through ground-based monitoring at official survey sites since 2008. The Citizen Science project uses trained volunteers to collect mountain goat observations at monitoring sites and estimate population trends of the native mountain goat population within the park. For this project volunteers travel to high country sites accessible from trails to conduct systematic surveys for mountain goats within areas that contain both species of mountain ungulates. The Greater Yellowstone Area Mountain Ungulate Project's occupancy research initiative also involves systematic ground surveys for mountain ungulates, but surveys are conducted by biological science technicians in off-trail locations. In addition to mountain goat presence, Greater Yellowstone Area observers record bighorn sheep presence and UTM locations of mountain ungulate groups that are seen.

Both Glacier National Park and the Greater Yellowstone Area use occupancy analysis and n-mixture models to determine population size and monitor trend. Due to these preexisting similarities in survey format and research interests between the two projects, the Glacier Citizen Science project could potentially collect additional data to facilitate a cooperative research effort with the Greater Yellowstone Area Mountain Ungulate Project. The summer of 2013 served as a pilot year for the cooperative effort to evaluate compatibility between these two research projects. Since the pilot year was successful, the collection of UTM location data of bighorn sheep and mountain goats continued during the summers of 2014 and 2015.

METHODS

Participants in Glacier National Park's High Country Citizen Science Project collected mountain ungulate data at 37 official survey sites that were visited by trained volunteers and park staff. (See Belt & Krausman 2012 for methods regarding site selection and survey protocol). Incidental mountain ungulate sightings along trails and roads were also recorded. Bighorn sheep were added to the survey protocol, data sheets, and new volunteer training. Returning citizen scientists were provided with resources regarding bighorn sheep identification, aging, and sexing in the field. For every bighorn sheep and mountain goat observation (incidental or during formal surveys), volunteers recorded total number, sex, age (young of year, yearling, or adult), predominant behavior upon detection (sitting, standing, feeding, walking, or other), and predominant landscape feature (snow/ice, ledge, loose rock, meadow,

shrub/krummholz, forest, road, or trail). The citizen science database was modified to accommodate bighorn sheep observations.

In addition to adding bighorn sheep to the monitoring protocol, mountain ungulate location data (UTM coordinates) were recorded when possible. Recording accurate mountain ungulate locations can be challenging for volunteers, as it requires effective use of topographical maps and/or aerial photos. We asked only volunteers that had previous experience and a high comfort level with reading topographic maps to record mountain ungulate locations. Volunteers and staff accomplished this task through the use of hand-held GPS units, mobile mapping applications, the digital Glacier Wildlife Tracking map, and paper maps of survey sites (approximately 1:45,000 scale). The citizen science database was modified to accommodate UTM location data, and UTMs recorded by volunteers as digits were entered manually during data entry. Locations recorded on paper maps were digitized in ArcGIS and imported into the citizen science database. We entered and mapped only mountain ungulate location data that had fine spatial accuracy and were recorded by observers comfortable with topographic maps.



Citizen scientists surveying for mountain ungulates at Avalanche Lake, Glacier National Park (NPS Photo).

RESULTS

From May through October 2015, citizen scientists and park staff completed a total of 172 mountain ungulate surveys. Of the 37 official mountain goat sites, three (Grinnell Lake, Siyeh Pass, Swiftcurrent Lookout) received one survey, four (Fifty Mountain, Otokomi Lake, Pitimakin Pass, Triple Divide Pass) received two surveys, and the remaining 30 sites were surveyed at least three times each. Three additional un-official sites also received surveys. The total of the high counts at every survey site was 149 mountain goats and 114 bighorn sheep. 267 mountain goats (Appendices 7 and 8) and 133 bighorn sheep (Appendices 9 and 10) were observed during formal surveys. In addition, incidental observations of 75 mountain goat groups and 14 bighorn sheep groups were recorded, including 204 mountain goat and 58 bighorn sheep.

Of the 249 total mountain ungulate groups observed (160 groups observed during surveys and 89 incidental observations), UTM locations were recorded for 100 records (40%) (Appendix 11). UTMs were captured for 18 bighorn sheep and 82 mountain goat locations. When the location data for 2013 through 2015 are compiled, the citizen science program collected a total of 391 location records, including 69 bighorn sheep and 322 mountain goat locations.

DISCUSSION

The Glacier Citizen Science project was able to capture additional mountain ungulate data to facilitate collaboration with the Greater Yellowstone Area Mountain Ungulate Project, including bighorn sheep observations and mountain ungulate location data. Continuation of the new data collection methods will serve to further increase our understanding of mountain ungulates in Glacier National Park. For example, fine-scale occupancy analyses could potentially be performed in the future, since presence data are captured by citizen scientists and absence data could be extrapolated through viewshed analyses of

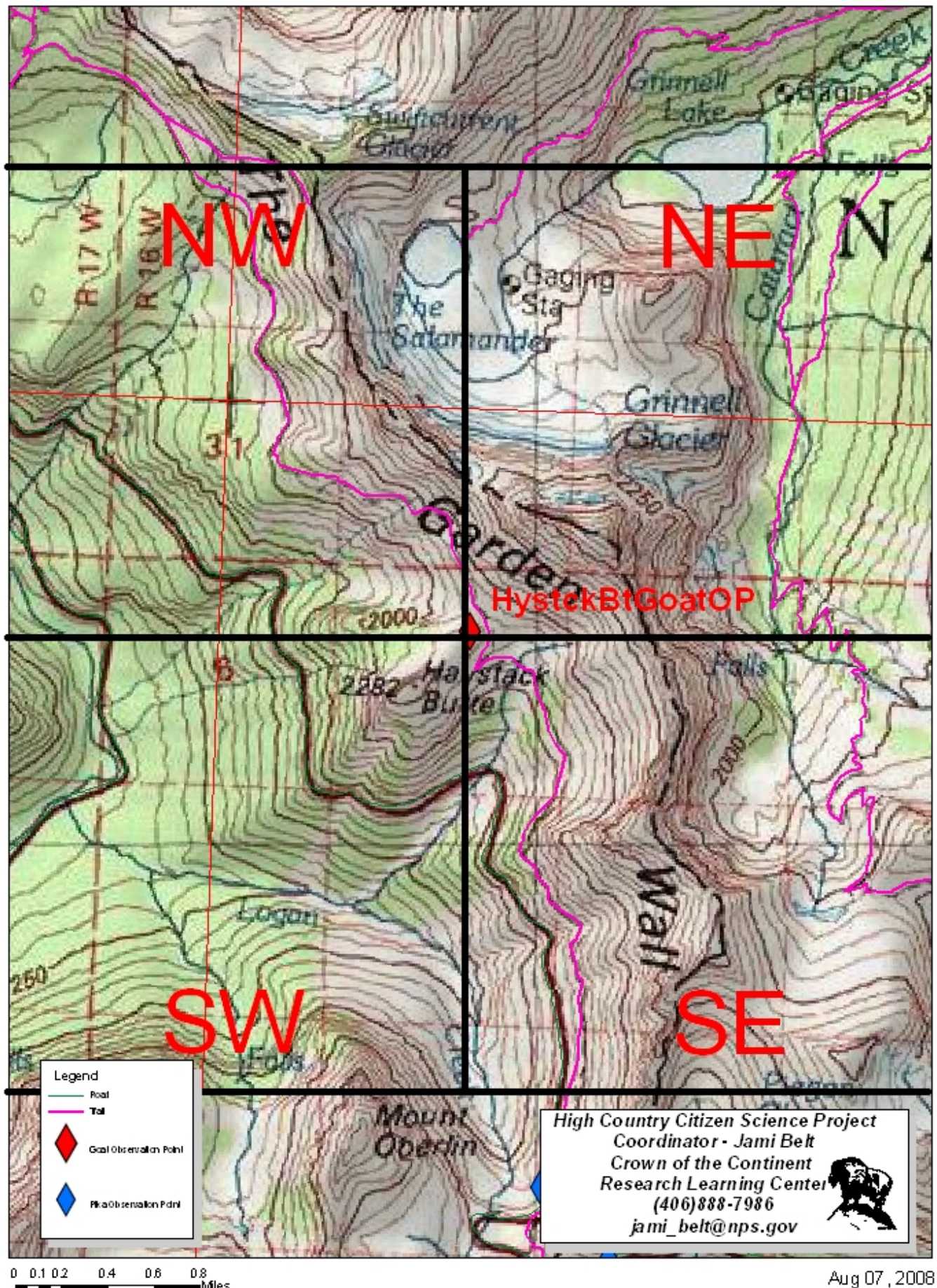
official survey sites. The size of survey plots used in Glacier National Park is much larger than those used in the Greater Yellowstone Area, but we have discussed the possibility of merging grids in the GYA to make them comparable. In addition, with the assistance of the Greater Yellowstone Area Mountain Ungulate Project, we would like to evaluate the potential to compare these data with mountain ungulate survey data collected in the Greater Yellowstone Area.

WORKS CITED

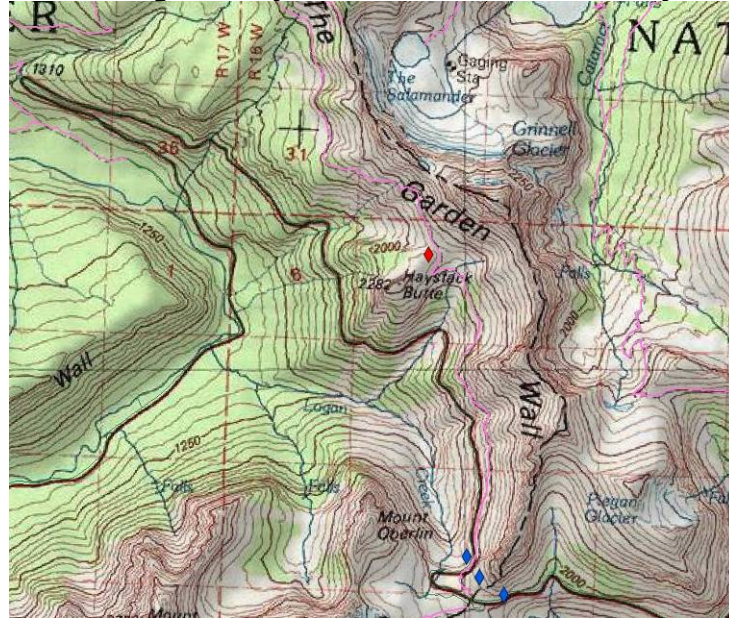
Belt, J.J. and P.R. Krausman. 2012. Evaluating population estimates of mountain goats based on citizen science. *Wildlife Society Bulletin* 36: 264-276.

O'Reilly, M. Using Occupancy Surveys to Assess Summer Resource Selection of Sympatric Bighorn Sheep and Mountain Goats in Northern Yellowstone. Greater Yellowstone Mountain Ungulate Project website, accessed 11/1/2013.

Haystack Butte



Route Map to Haystack Butte Goat Survey Site



To reach Haystack Butte Goat Survey Site:

1. Head down the Highline Trail from Logan Pass towards the pass next to Haystack Butte.
2. At the highest point on this section of trail, where you are directly between Haystack Butte and the Garden Wall leave the trail at the point pictured to the right, following a faint trail heading up towards Haystack Butte.
3. The survey site is on the second small ledge (set of rock outcroppings) about 150 yards from the Highline Trail.

Haystack Butte Goat Observation Point
(*HystckBtGoatOP*)
GPS point 12U 0299480; 5401696 (NAD 83)



Point at which you leave Highline Trail



Looking up towards OP from Highline
OP is at the top of this photo



View of OP on ledge as seen approaching
from below (brown rock ledge in center)



Closer view of observation point



View looking north from Haystack Butte OP



View looking south from Haystack Butte OP

GLACIER NATIONAL PARK HIGH COUNTRY CITIZEN SCIENCE MOUNTAIN GOAT AND BIGHORN SHEEP SURVEY FORM

Site Name or Description _____ Date _____ Observer Name(s) _____ Phone/Email _____
 Citizen Science Hours (includes driving, hiking + survey time)- Time at start of day: _____ Time at end of day: _____
 Trail hiked _____ Starting point _____ Ending Point _____ Number of miles _____

SURVEY TIME AND WEATHER: *Please review survey procedures on reverse side of this form prior to beginning survey.*

Observation facing north: Begin time: _____ End time: _____ **Observation facing south:** Begin time: _____ End time: _____

Power of binoculars used: _____ **Power of spotting scope used:** _____ (enter "none" if not used)

Temperature (circle one): below 30°F, 30°F to 40 °F; 40 to 50 °F; 50 to 60 °F; 60 to 70 °F; 70 to 80 °F; 80 to 90 °F; over 90 °F

Sky (circle one): clear sky; few clouds; partly cloudy/variable sky; cloudy/overcast; rain; fog; smoke; snow; intermittent rain showers

Comments about survey conditions: _____

GOATS AND SHEEP DETECTED, LOCATION AND BEHAVIORS: (Choose from categories below and write in corresponding columns)

Time at detection of each goat or sheep group	Goats or Sheep	Quadrant where located (NE, NW, SE, SW)	Total # of goats/sheep in group	# adults if known (F=females; M= males)	** Behavior of adults upon detection	# young if known (YOY=young of year; YG= yearlings)	** Behavior of young upon detection	*** Dominant landscape feature	Photo taken (Y/N)	Comments and Photo ID # of verification photo: (include interesting interactions and comments about uncertainty or any factors that may affect your ability to accurately count and classify goats during survey; note if goats detected after survey time)
Example: 8:15	Goats	SE	8	4 (3 F, 1 unknown)	walking	4 (2 YOY, 2YG)	sitting	ledge	Y	Young goats were obscured by adults at first
Example: 8:37	Sheep	NW	5	unknown	lying down			meadow	Y	Could not classify age or sex of sheep. Group was lying in the shade, may have been 2 young of year in group

****Behavior of adults/young of year/ yearlings upon detection:** sitting/lying down; standing; feeding; walking; other (describe).

***** Dominant landscape feature at location where group of goats or sheep was first detected:** (snow/ ice) permanent snow/icefield; (ledge) rock outcrop/cliff /ledge, (loose rock) talus/scree/moraine, (meadow) meadow dominated by grass and other forbs, (shrub/krummholz) area dominated by shrubs or sparse patches of stunted trees, (forest) area dominated by trees, (road) goat initially detected in paved or unpaved road, (trail) goat/ sheep initially detected in trail.

TOTAL NUMBER OF GOATS SHEEP SEEN DURING SURVEY PERIODS: *Note if quadrant not surveyed. Report all zero sightings!*

GOATS: NE Quadrant: _____ NW Quadrant: _____ SE Quadrant: _____ SW Quadrant: _____

SHEEP: NE Quadrant: _____ NW Quadrant: _____ SE Quadrant: _____ SW Quadrant: _____

OTHER WILDLIFE SEEN IN EACH QUADRANT DURING 30 MINUTE SURVEY PERIODS:

Time at detection	Species	Total # animals	# adults	# young	Quadrant located (NE, NW, SE, SW)	Comments (note behavior of species and any interactions with goats or sheep observed):

OTHER MOUNTAIN GOATS OR BIGHORN SHEEP SEEN DURING HIKE (OUTSIDE OF QUADRANTS AND SURVEY PERIODS):

Time at detection	Goats or Sheep	Total # in group	# adults if known	Behavior of adults	# young	Behavior of young	Photo taken (Y/ N)	UTM's (in NAD 83) Easting	UTM's (in NAD 83) Northing	Land-scape feature	Specific location (mountain, aspect, trail mileage, etc.)	Comments:

MOUNTAIN GOAT AND BIGHORN SHEEP SURVEY PROCEDURES:

1. Navigate to survey site using route map and description, GPS point location and photo of reference point on trail.
2. Set up your spotting scope and face due north using a compass. Declination for our area is 14.5°E (for compasses without pre-set declination).
3. Hold both arms straight out at your sides to encompass a 180° view to the north. The center line of the 180° view is the boundary between NE and NW quadrants.
4. Survey all terrain within the 180° view while facing north for 30 minutes. Complete at least 2 full sweeps with binoculars of all terrain within the 30 minute survey period. If the view of a whole quadrant is obstructed by trees or other features do not survey that quadrant.
5. Count any goats/ sheep you see. Document the initial time of detection of each goat/sheep or group of goats/ sheep and location in the chart entitled “GOATS AND SHEEP DETECTED...”. Do not double count goats/sheep that are moving. Be certain that you are not re-documenting the same individual or group.
6. Once you have completed two binocular sweeps, relocate the area(s) where goats/ sheep were seen with a spotting scope to accurately count and classify any goats/ sheep present. Spend the rest of the 30 minute survey time scanning the 180° view with a spotting scope. Photograph each group of goats or sheep seen through spotting scope.
7. Turn and face due south using compass. Repeat steps 2 through 6 for the SE and SW quadrants, surveying the 180° view to the south for 30 minutes.
8. Return survey forms and photos ASAP by fax: (406)888-7903; email: glac_citizen_science@nps.gov; or mail GNP-CCRLC, PO Box 128, West Glacier, MT 59936

Distinguishing mountain goats and bighorn sheep by age and sex**Mountain goat kids (young of year)** • ¼ adult size

- closely follow their mothers
- horns barely visible- < 3.5" (10 cm)

Yearlings • ½ adult size

- horns over 3.5" (10 cm)

Adults • Two year olds and adults are similar in size**Adult Male Goats:** • Larger horn base; wider than eye width

- Gradual horn curve
- Stretching urination posture, external genitalia

Adult Female Goats: • Smaller horn base; Wider space between horns

- Sharp horn curve (curving towards end)
- Squatting urination posture

Bighorn sheep lambs (young of year) • ¼ adult size

- closely follow their mothers
- horns barely visible- < 3.5" (10 cm)

Yearlings • yearling females are about ½ adult size

- yearling males are similar in size to adult females
- horns over 3.5" (10 cm)

Adults • Two year olds and adults are similar in size**Adult Male Bighorn Sheep:** • Thicker horns begin to curl at two years

- Stockier body size
- Stretching posture during urination, external genitalia

Adult Female Bighorn Sheep: • Slender, straighter horns, up to 8 to 10"

- Similar in size to yearling male
- Squatting urination posture

Appendix 4: 2015 Mountian Ungulate Citizen Science Surveys

Goat Survey Key	Site Name	Date	Observers	Start of Day	End of Day	Survey Hours	Volunteer Hours
1441	Apikuni Falls	7/10/15	7	9:07	13:55	4.8	33.6
1492	Apikuni Falls	8/7/15	5	10:05	14:50	4.8	23.8
1512	Apikuni Falls	8/13/15	2	16:30	21:15	4.8	9.5
1513	Apikuni Falls	8/16/15	2	9:07	12:48	3.7	7.4
1547	Apikuni Falls	8/23/15	2	9:00	17:45	8.8	17.5
1420	Autumn Creek	5/9/15	2	8:00	15:00	7.0	14.0
1442	Autumn Creek	6/29/15	8	9:00	16:00	7.0	56.0
1448	Autumn Creek	7/6/15	2	10:00	18:30	8.5	17.0
1493	Autumn Creek	8/6/15	4	9:30	16:30	7.0	28.0
1514	Autumn Creek	8/16/15	2	8:00	15:42	7.7	15.4
1515	Autumn Creek	8/16/15	3	9:00	16:00	7.0	21.0
1556	Autumn Creek	9/13/15	1	9:00	17:00	8.0	0.0
1559	Autumn Creek	9/8/15	1	9:00	16:00	7.0	7.0
1594	Autumn Creek	9/24/15	1	12:30	19:30	7.0	7.0
1421	Avalanche Lake	5/21/15	1	8:45	13:30	4.8	4.8
1422	Avalanche Lake	5/20/15	1	7:30	13:30	6.0	6.0
1443	Avalanche Lake	7/10/15	1	11:00	17:40	6.7	6.7
1516	Avalanche Lake	8/14/15	6	8:00	13:30	5.5	33.0
1517	Avalanche Lake	8/15/15	2	15:30	18:15	2.8	5.5
1548	Avalanche Lake	8/31/15	2	8:00	15:19	7.3	14.6
1467	Boulder Pass	7/18/15	1	7:40	18:15	10.6	10.6
1501	Boulder Pass	8/16/15	2	8:00	20:00	12.0	24.0
1518	Boulder Pass	8/16/15	1	9:30	14:30	5.0	5.0
1546	Boulder Pass	8/28/15	1	8:00	17:00	9.0	0.0
1468	Brown Pass	7/19/15	1	8:00	21:00	13.0	13.0
1519	Brown Pass	8/17/15	2	9:30	17:30	8.0	16.0
1545	Brown Pass	8/29/15	2	7:45	18:30	10.8	21.5
1427	Cobalt Lake	7/3/15	1	0:01	23:59	24.0	24.0
1520	Cobalt Lake	8/16/15	1	7:00	18:00	11.0	11.0
1560	Cobalt Lake	9/13/15	1	8:00	17:15	9.3	9.3
1588	Cobalt Lake	9/11/15	2	11:00	17:00	6.0	12.0
1428	Cosley Lake	7/4/15	1	6:30	21:00	14.5	14.5
1429	Cosley Lake	7/5/15	1	7:30	15:30	8.0	8.0
1435	Cosley Lake	7/7/15	3	7:00	16:30	9.5	28.5
1521	Cosley Lake	8/15/15	2	8:30	17:00	8.5	17.0
1423	Cut Bank Creek	6/3/15	1	7:30	12:30	5.0	5.0
1447	Cut Bank Creek	6/23/15	2	10:10	13:30	3.3	6.7
1495	Cut Bank Creek	8/3/15	2	13:00	19:00	6.0	12.0
1511	Cut Bank Creek	8/11/15	6	7:30	16:00	8.5	51.0
1562	Cut Bank Creek	9/12/15	2	7:00	19:00	12.0	24.0
1444	Dry Fork Creek	6/12/15	4	11:00	18:15	7.3	29.0
1445	Dry Fork Creek	6/19/15	11	13:02	17:30	4.5	49.1
1469	Dry Fork Creek	7/2/15	2	11:00	17:30	6.5	13.0
1557	Dry Fork Creek	9/7/15	2	8:00	16:00	8.0	16.0
1567	Dry Fork Creek	9/18/15	1				
1575	Dry Fork Creek	9/18/15	1	12:30	15:30	3.0	3.0

Appendix 4: 2015 Mountian Ungulate Citizen Science Surveys

Goat Survey Key	Site Name	Date	Observers	Start of Day	End of Day	Survey Hours	Volunteer Hours
1579	Dry Fork Creek	9/18/15	1	8:00	18:00	10.0	10.0
1582	Dry Fork Creek	9/18/15	1	12:15	15:45	3.5	3.5
1587	Dry Fork Creek	9/18/15	1	12:15	15:45	3.5	3.5
1590	Dry Fork Creek	9/20/15	1	7:00	18:00	11.0	11.0
1592	Dry Fork Creek	9/21/15	1	7:00	15:30	8.5	8.5
1431	Elizabeth Lake	7/4/15	1	6:30	21:00	14.5	14.5
1453	Elizabeth Lake	7/11/15	1	16:30	18:30	2.0	2.0
1470	Elizabeth Lake	7/18/15	1	9:00	21:30	12.5	12.5
1502	Elizabeth Lake	8/15/15	1	7:20	19:45	12.4	12.4
1522	Fifty Mountain	8/15/15	1	6:30	13:00	6.5	6.5
1549	Fifty Mountain	8/27/15	1	8:25			
1480	Firebrand Pass	7/12/15	3	7:00	17:30	10.5	31.5
1523	Firebrand Pass	8/15/15	1	5:30	14:00	8.5	8.5
1555	Firebrand Pass	9/9/15	1	9:00	17:45	8.8	8.8
1424	Grace Lake	6/3/15	2	8:30	16:30	8.0	16.0
1432	Grace Lake	7/1/15	1	9:00	21:00	12.0	12.0
1433	Grace Lake	7/2/15	1	4:40	15:00	10.3	10.3
1465	Grace Lake	7/18/15	1	7:00	21:30	14.5	0.0
1466	Grace Lake	7/19/15	1	6:00	17:30	11.5	0.0
1460	Gunsight Pass	7/20/15	1	8:00	20:00	12.0	0.0
1504	Gunsight Pass	8/15/15	3	8:50	20:15	11.4	34.3
1543	Gunsight Pass	6/24/15	1	7:00	17:30	10.5	10.5
1430	Harrison Lake	7/3/15	1	7:00	21:00	14.0	14.0
1434	Harrison Lake	7/4/15	1	0:01	23:59	24.0	24.0
1507	Harrison Lake	8/19/15	1	9:00	21:00	12.0	12.0
1524	Harrison Lake	8/17/15	2	7:30	18:45	11.3	22.5
1525	Harrison Lake	8/18/15	2	7:30	18:45	11.3	22.5
1446	Haystack Butte	7/8/15	1	7:20	18:00	10.7	10.7
1487	Haystack Butte	8/5/15	1	6:40	15:55	9.3	0.0
1489	Haystack Butte	8/2/15	2	12:00	21:30	9.5	19.0
1526	Haystack Butte	8/15/15	1	5:30	15:00	9.5	9.5
1552	Haystack Butte	8/30/15	1	7:00			
1554	Haystack Butte	9/15/15	1	9:00	16:30	7.5	0.0
1595	Haystack Butte	9/27/15	1	9:45	17:00	7.3	7.3
1481	Hidden Lake	8/1/15	2	6:00	16:00	10.0	20.0
1484	Hidden Lake	6/30/15	8	8:00	14:30	6.5	52.0
1503	Hidden Lake	8/18/15	1				
1509	Hidden Lake	8/20/15	1	6:30	14:30	8.0	8.0
1527	Hidden Lake	8/15/15	1	6:30	12:30	6.0	6.0
1535	Hidden Lake	8/23/15	1	7:30	16:00	8.5	8.5
1577	Hidden Lake	9/19/15	1	8:00	14:00	6.0	6.0
1593	Hidden Lake	9/19/15	25	12:00	18:00	6.0	150.0
1454	Iceberg Lake	7/15/15	1	8:45	15:50	7.1	7.1
1494	Iceberg Lake	8/4/15	5	9:00	17:00	8.0	40.0
1528	Iceberg Lake	8/15/15	1	9:04	14:51	5.8	0.0
1558	Iceberg Lake	9/13/15	2	9:30	21:30	12.0	24.0

Appendix 4: 2015 Mountian Ungulate Citizen Science Surveys

Goat Survey Key	Site Name	Date	Observers	Start of Day	End of Day	Survey Hours	Volunteer Hours
1566	Iceberg Lake	9/19/15	1				
1568	Iceberg Lake	9/19/15	1				
1572	Iceberg Lake	9/19/15	1	4:30	18:30	14.0	14.0
1574	Iceberg Lake	9/19/15	1	9:00	15:40	6.7	6.7
1580	Iceberg Lake	9/19/15	1	9:00	18:30	9.5	9.5
1583	Iceberg Lake	9/19/15	1	9:20	12:50	3.5	3.5
1584	Iceberg Lake	9/19/15	1	9:20	14:50	5.5	5.5
1440	Janet Lake	7/9/15	1	7:00	21:00	14.0	14.0
1458	Janet Lake	7/19/15	1	8:00	21:00	13.0	0.0
1485	Janet Lake	7/31/15	1	8:30	21:00	12.5	12.5
1425	Numa Lookout	6/26/15	1	7:10	17:30	10.3	10.3
1510	Numa Lookout	8/17/15	2	7:00	20:00	13.0	26.0
1529	Numa Lookout	8/12/15	1	10:00	11:00	1.0	1.0
1541	Numa Lookout	8/24/15	1	7:00	17:30	10.5	10.5
1426	Ole Creek	6/6/15	2	7:45	13:25	5.7	11.3
1451	Ole Creek	6/22/15	2	9:00	13:45	4.8	9.5
1530	Ole Creek	8/16/15	2	6:00	15:00	9.0	18.0
1449	Otokomi Lake	7/13/15		8:20	13:50	5.5	
1464	Otokomi Lake	7/9/15	1	10:01	17:30	7.5	0.0
1450	Preston Park	7/14/15	1	6:40	13:00	6.3	6.3
1459	Preston Park	7/19/15	1	10:00	19:15	9.3	0.0
1532	Preston Park	8/13/15	6	8:30	15:30	7.0	42.0
1533	Preston Park	8/15/15	1	6:15	15:05	8.8	8.8
1550	Preston Park	9/1/15	2	14:45	20:00	5.3	10.5
1561	Preston Park	9/13/15	1	7:30	16:50	9.3	9.3
1462	Poia Lake	7/20/15	1	8:00	20:00	12.0	0.0
1491	Poia Lake	8/4/15	1	8:40	18:15	9.6	9.6
1505	Poia Lake	8/16/15	1	8:00	21:00	13.0	13.0
1508	Poia Lake	8/15/15	1	7:00	19:00	12.0	12.0
1457	Scenic Point	7/13/15	2	9:00	18:15	9.3	18.5
1471	Scenic Point	7/13/15	2	9:00	18:15	9.3	18.5
1483	Scenic Point	6/6/15	2	7:00	16:00	9.0	18.0
1496	Scenic Point	8/4/15	2	8:30	17:15	8.8	17.5
1536	Scenic Point	8/16/15	1	10:30	15:30	5.0	5.0
1538	Scenic Point	8/12/15	6	8:30	16:00	7.5	45.0
1472	Siyeh Pass Loop	7/14/15	1	6:30	17:30	11.0	11.0
1498	Sperry Chalet	7/30/15	2	8:00	18:00	10.0	20.0
1506	Sperry Chalet	8/16/15	3	9:30	19:00	9.5	28.5
1542	Sperry Chalet	8/25/15	1	7:30	15:30	8.0	8.0
1551	Swiftcurrent Lookout	8/30/15	1	7:00	18:00	11.0	11.0
1486	Triple Divide Pass	8/5/15	1	7:20	19:00	11.7	11.7
1563	Triple Divide Pass	9/12/15	2	7:00	19:00	12.0	24.0
1473	Trout Lake	7/19/15	1	8:00	18:10	10.2	10.2
1474	Trout Lake	6/2/15	1	10:00	20:00	10.0	10.0
1475	Trout Lake	6/13/15	2	8:00	18:00	10.0	20.0
1476	Trout Lake	7/1/15	7	9:30	19:00	9.5	66.5

Appendix 4: 2015 Mountian Ungulate Citizen Science Surveys

Goat Survey Key	Site Name	Date	Observers	Start of Day	End of Day	Survey Hours	Volunteer Hours
1540	Trout Lake	8/16/15	1	7:45	18:00	10.3	10.3
1553	Trout Lake	9/6/15	1	11:00	20:00	9.0	9.0
1461	Upper Kintla	6/25/15	1	7:00	16:30	9.5	9.5
1477	Upper Kintla	6/23/15	2	7:00	20:00	13.0	26.0
1478	Upper Kintla	6/24/15	1	8:30	18:30	10.0	0.0
1479	Upper Kintla	7/17/15	1	7:15	18:00	10.8	10.8
1534	Upper Kintla	8/16/15	1	9:30	14:30	5.0	5.0
1544	Upper Kintla	8/27/15	2	5:00	15:30	10.5	21.0
1455	Pitamakin Pass	7/14/15	1	7:20	19:00	11.7	11.7
1591	Pitamakin Pass	9/20/15	1	7:00	18:00	11.0	11.0
1488	Grinnell Lake	8/4/15	2	7:00	17:45	10.8	21.5
1490	Swiftcurrent Pass- alternate site	8/3/15	2	8:00	21:45	13.8	27.5
1452	Park Creek	7/4/15	1	14:00	20:00	6.0	6.0
1463	Park Creek	6/21/15	2	9:00	13:45	4.8	9.5
1531	Park Creek	8/15/15	1	7:00	17:00	10.0	10.0
1589	Park Creek	9/21/15	1	6:15	18:45	12.5	12.5
1456	Red Eagle Lake	5/23/15	2	14:00	20:15	6.3	12.5
1482	Red Eagle Lake	5/25/15	1	9:30			
1537	Red Eagle Lake	8/16/15	1	6:30	8:00	1.5	1.5
1564	Piegan Pass	9/12/15	1	8:00	18:00	10.0	0.0
1569	Two Medicine	9/18/15	1				
1571	Two Medicine	9/18/15	1	7:30	18:00	10.5	10.5
1573	Two Medicine	9/18/15	1	10:14	11:14	1.0	1.0
1578	Two Medicine	9/19/15	1	10:19	18:30	8.2	8.2
1581	Two Medicine	9/18/15	1	10:15	11:15	1.0	1.0
1586	Two Medicine	9/18/15	1	10:14	11:14	1.0	1.0
1419	Apikuni Unofficial Site	4/23/15	1	11:30	14:00	2.5	2.5
1497	Sperry Area (unofficial)	6/27/15	1	5:30	14:00	8.5	8.5
1499	Sperry Area (unofficial)	7/29/15	1				
1500	Sperry Area (unofficial)	8/9/15	1	6:00	16:30	10.5	10.5
1565	Heaven's Peak	9/11/15	1	7:00	10:00	3.0	0.0
1570	Iceberg IB Site	9/19/15	1	9:00	18:30	9.5	9.5
1576	Iceberg IB Site	9/19/15	1	7:10	21:25	14.3	14.3
1585	Iceberg IB Site	9/18/15	1	12:55	19:45	6.8	6.8
	172 Surveys Completed						

Appendix 5: 2015 Mountain Ungulate Citizen Science Observer Involvement

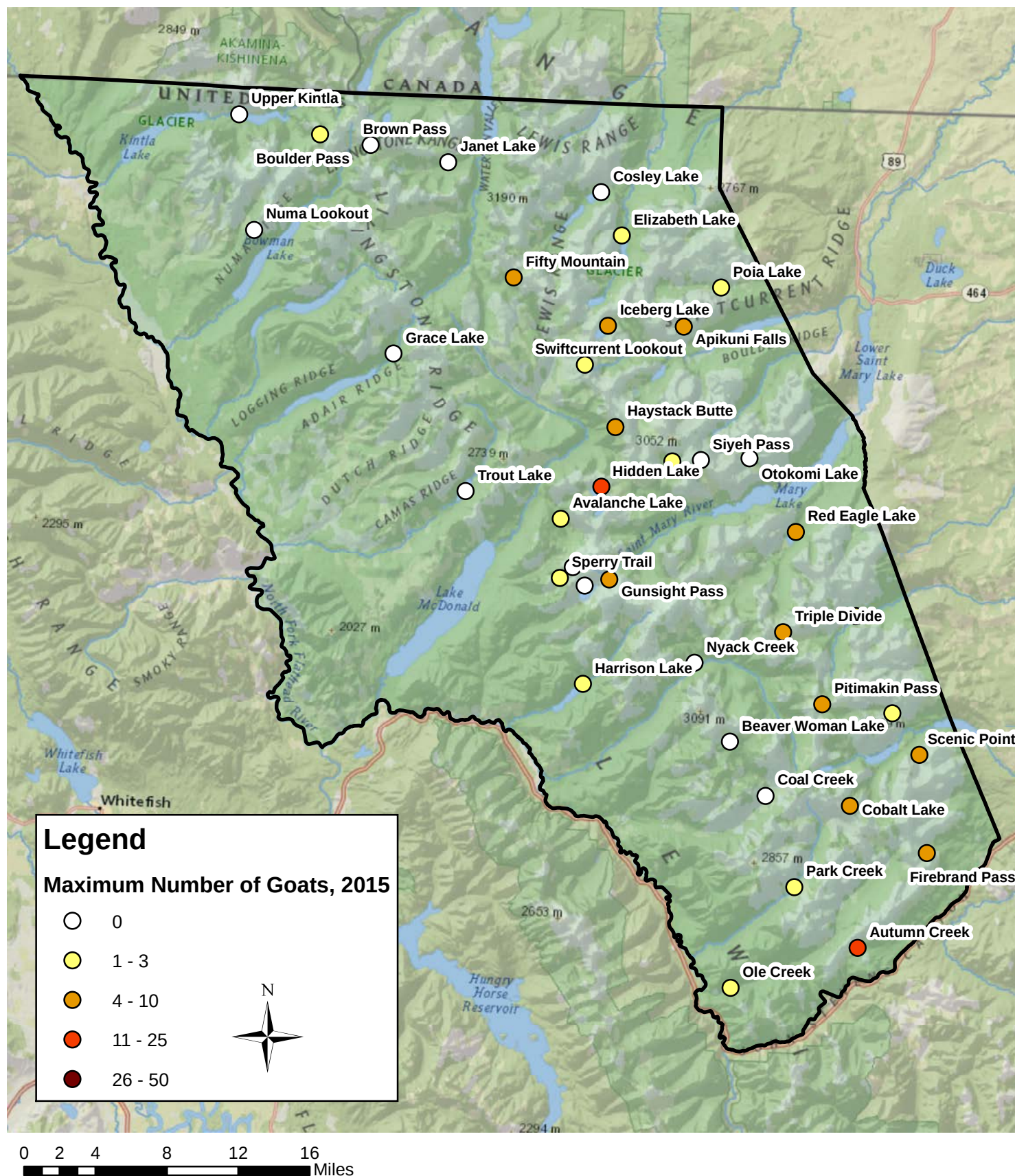
Observer	Surveys	Survey Hours	Group Size	Participants /Survey	Total Hours
Chickering, Karen	1	7.7	1	1	7.7
Chinn, Bob	4	36.9	1	1	36.9
Chinn, Mary	1	8.8	1	1	8.8
Clarín, Sam	1	2.8	1	1	2.8
Clarín, Sara	1	6.5	1	1	6.5
Clark, Carolyn	4	49.4	1	1	49.4
Clark, Jane	1	7.3	1	1	7.3
Clark, Jeffery	1	8.5	1	1	8.5
Clothier, Susan	12	77.9	1	1	77.9
Cronk, Virginia	4	27.0	1	1	27.0
Crowder, Wayne	1	11.0	1	1	11.0
Dow, Nancy	1	1.0	1	1	1.0
Ewert, Emily	1	7.3	1	1	7.3
Faist, Michael	4	21.0	1	1	21.0
Flathead High School, 2015	2	24.8	15	1	24.8
Flesch, Elizabeth	18	146.6	1	1	146.6
Graves, Tabitha	1	6.3	1	1	6.3
Gritts, Carleton	4	43.5	1	1	43.5
Harada, Sumio	1	11.0	1	1	11.0
Hathaway, Donna	5	37.9	1	1	37.9
Igoe, Bill	1	12.0	1	1	12.0
Igoe, Kate	1	12.0	1	1	12.0
Johnson, Brian	10	110.5	1	1	110.5
Kachelmeyer, John	3	22.5	1	1	22.5
Kermath, Leslie	2	16.5	1	1	16.5
Kyle, Diana	1	10.0	1	1	10.0
Kyle, John	1	10.0	1	1	10.0
Lahr, Andrew	3	18.5	1	1	18.5
Lamb, M	1	13.0	1	1	13.0
Lindstrom, Kim	1	3.0	1	1	3.0
Luther, Laura	11	113.8	1	1	113.8
Madison, Alex	1	9.5	1	1	9.5
Martin, Joshua	6	64.8	1	1	64.8
Mayes, Diane	7	64.8	1	1	64.8
McClelland, Pat	1	8.0	1	1	8.0
Montana Conservation Corps, Glacier Youth 2015	6	39.8	9	9	357.8
Montana Conservation Corps, Glacier Youth 2015 #2	4	28.5	6	6	171.0
Moyer, Robina	4	36.7	1	1	36.7
Mullings, Cyndi	1	7.0	1	1	7.0
Murphy, Carole	2	21.3	1	1	21.3
Murphy, Rick	3	32.3	1	1	32.3
Murray, Matthew	6	44.3	1	1	44.3
Peterson, Terry	2	9.5	1	1	9.5
Robbins, Dean	1	6.0	1	1	6.0
Ross, Kathy	3	25.2	1	1	25.2
Ryan, Sara	3	34.0	1	1	34.0
Shors, Ann	1	6.0	1	1	6.0
Siegler, Chris	2	9.5	1	1	9.5
Siegler, Jeannie	6	31.3	1	1	31.3
Sierra Club, 2015	4	27.3	12	4	109.3
Sloan, Joshua	3	22.5	1	1	22.5
Sloan, W	1	13.0	1	1	13.0
Steele, Gail	2	19.5	1	1	19.5
Steele, Theresa	2	18.2	1	1	18.2

Appendix 5: 2015 Mountain Ungulate Citizen Science Observer Involvement

Observer	Surveys	Survey Hours	Group Size	Participants /Survey	Total Hours
Summer, Barbara	7	61.0	1	1	61.0
Vaninetti, Angela	2	9.3	1	1	9.3
West, Joan	9	95.3	1	1	95.3
Wildlife Society, University of Montana	1	6.0	25	25	150.0
Williams, Becky	2	15.0	1	1	15.0
Wollner, Dave	2	15.8	1	1	15.8
Wollner, Sue	2	15.8	1	1	15.8
Zavadil, Anne	1	7.7	1	1	7.7
Zinn, Don	1	5.0	1	1	5.0
Total		1694.3	125 Unique Ungulate Observers		2380.8



Mountain Goat Results by Survey Site 2015



Goat Summary for year 2015

Site Name	Number of site visits	Number of Unknown (Sex or Age)	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total Goats	--	Maximum at Location
Apikuni Falls	5	0	5	0	1	1	0	0	6	--	6
Apikuni Unofficial Site	1	0	5	3	2	0	0	0	5	--	5
Autumn Creek	9	2	16	0	0	2	0	0	20	--	12
Avalanche Lake	6	0	2	0	0	0	0	0	2	--	2
Boulder Pass	4	0	1	0	0	0	0	0	1	--	1
Brown Pass	3	0	0	0	0	0	0	0	0	--	0
Cobalt Lake	4	0	8	1	3	2	2	0	10	--	6
Cosley Lake	4	0	0	0	0	0	0	0	0	--	0
Cut Bank Creek	5	0	2	1	0	2	0	0	4	--	3
Dry Fork Creek	11	1	3	1	0	0	0	0	4	--	2
Elizabeth Lake	4	0	0	0	0	1	1	0	1	--	1
Fifty Mountain	2	0	4	1	0	0	0	0	4	--	4
Firebrand Pass	3	1	3	0	1	1	1	0	5	--	4
Grace Lake	4	0	0	0	0	0	0	0	0	--	0
Grinnell Lake	1	0	0	0	0	0	0	0	0	--	0
Gunsight Pass	3	0	6	0	0	1	0	1	7	--	4
Harrison Lake	5	0	2	0	0	0	0	0	2	--	1
Haystack Butte	7	1	15	1	5	7	4	1	23	--	8
Heaven's Peak	1	0	2	1	1	0	0	0	2	--	2
Hidden Lake	7	0	16	0	3	13	2	4	29	--	11
Iceberg IB Site	3	0	35	11	10	12	9	3	47	--	30
Iceberg Lake	11	13	18	2	9	7	3	2	38	--	7
Janet Lake	3	0	0	0	0	0	0	0	0	--	0
Numa Lookout	4	0	0	0	0	0	0	0	0	--	0
Ole Creek	3	0	2	0	0	1	0	1	3	--	3
Otokomi Lake	2	0	0	0	0	0	0	0	0	--	0
Park Creek	4	0	2	0	0	1	0	0	3	--	3
Pitamakin Pass	2	1	3	0	1	1	1	0	5	--	5
Poia Lake	4	0	2	2	0	0	0	0	2	--	2
Preston Park	6	3	3	0	1	2	0	2	8	--	3
Red Eagle Lake	3	1	10	2	0	0	0	0	11	--	8
Scenic Point	6	0	3	0	0	1	0	1	4	--	4

Site Name	Number of site visits	Number of Unknown (Sex or Age)	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total Goats	--	Maximum at Location
Siyeh Pass Loop	1	0	0	0	0	0	0	0	0	--	0
Sperry Chalet	3	1	1	0	0	1	0	1	3	--	2
Swiftcurrent Lookout	1	0	1	0	0	0	0	0	1	--	1
Triple Divide Pass	2	1	7	0	0	1	0	0	9	--	7
Trout Lake	5	0	0	0	0	0	0	0	0	--	0
Two Medicine	6	4	4	4	0	0	0	0	8	--	2
Upper Kintla	5	0	0	0	0	0	0	0	0	--	0
Grand Totals:	163	29	181	30	37	57	23	16	267		

Detailed Summary for Goat Surveys: Year 2015

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Apikuni Falls										
7/10/2015	No	CS	0	0	0	0	0	0	0	0
8/7/2015	No	CS	0	0	0	0	0	0	0	0
8/13/2015	No	CS - VIP	0	5	0	1	1	0	0	6
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Apikuni Falls (5 site visits)			Sum	0	5	0	1	1	0	6
									Min	0
									Max	6
Apikuni Unofficial Site										
4/23/2015	No	CS - VIP	0	5	3	2	0	0	0	5
Summary for Apikuni Unofficial Site (1 site visit)			Sum	0	5	3	2	0	0	5
									Min	5
									Max	5
Autumn Creek										
5/9/2015	No	CS - VIP	2	10	0	0	0	0	0	12
6/29/2015	No	CS	0	6	0	0	2	0	0	8
7/6/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/6/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
9/8/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/13/2015	No	CS	0	0	0	0	0	0	0	0
9/24/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Autumn Creek (9 site visits)			Sum	2	16	0	0	2	0	20
									Min	0
									Max	12
Avalanche Lake										
5/20/2015	No	CS - VIP	0	2	0	0	0	0	0	2

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
5/21/2015	No	CS	0	0	0	0	0	0	0	0
7/10/2015	No	CS	0	0	0	0	0	0	0	0
8/14/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
8/31/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Summary for Avalanche Lake (6 site visits)

Sum	0	2	0	0	0	0	0	0	0	2
									Min	0
									Max	2

Boulder Pass

7/18/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/28/2015	No	CS - VIP	0	1	0	0	0	0	0	1

Summary for Boulder Pass (4 site visits)

Sum	0	1	0	0	0	0	0	0	0	1
									Min	0
									Max	1

Brown Pass

7/19/2015	No	CS	0	0	0	0	0	0	0	0
8/17/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/29/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Summary for Brown Pass (3 site visits)

Sum	0	0	0	0	0	0	0	0	0	0
									Min	0
									Max	0

Cobalt Lake

7/3/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	4	0	0	0	0	0	4
9/11/2015	No	CS		4	1	3	2	2	0	6
9/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Summary for Cobalt Lake (4 site visits)										
		Sum	0	8	1	3	2	2	0	10
									Min	0
									Max	6
Cosley Lake										
7/4/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/5/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/7/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Cosley Lake (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Cut Bank Creek										
6/3/2015	No	CS - VIP	0	1	0	0	2	0	0	3
6/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/3/2015	No	CS	0	1	1	0	0	0	0	1
8/11/2015	No	CS	0	0	0	0	0	0	0	0
9/12/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Cut Bank Creek (5 site visits)										
		Sum	0	2	1	0	2	0	0	4
									Min	0
									Max	3
Dry Fork Creek										
6/12/2015	No	Bio Tech	0	0	0	0	0	0	0	0
6/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/2/2015	No	CS - VIP	0	1	0	0	0	0	0	1
9/7/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	2	1	0	0	0	0	2
9/18/2015	No	CS	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
9/20/2015	No	CS - VIP	1	0	0	0	0	0	0	1
9/21/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Dry Fork Creek (11 site visits)										
		Sum	1	3	1	0	0	0	0	4
									Min	0
									Max	2
Elizabeth Lake										
7/4/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/11/2015	No	CS	0	0	0	0	0	0	0	0
7/18/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	1	1	0	1
Summary for Elizabeth Lake (4 site visits)										
		Sum	0	0	0	0	1	1	0	1
									Min	0
									Max	1
Fifty Mountain										
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/27/2015	No	CS	0	4	1	0	0	0	0	4
Summary for Fifty Mountain (2 site visits)										
		Sum	0	4	1	0	0	0	0	4
									Min	0
									Max	4
Firebrand Pass										
7/12/2015	No	CS - VIP	0	3	0	1	1	1	0	4
8/15/2015	No	CS - VIP	1	0	0	0	0	0	0	1
9/9/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Firebrand Pass (3 site visits)										
		Sum	1	3	0	1	1	1	0	5
									Min	0
									Max	4
Grace Lake										
7/1/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/2/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/18/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
7/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Grace Lake (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Grinnell Lake										
8/4/2015	No	Bio Tech	0	0	0	0	0	0	0	0
Summary for Grinnell Lake (1 site visit)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Gunsight Pass										
6/24/2015	No	CS - VIP	0	4	0	0	0	0	0	4
7/20/2015	No	CS	0	1	0	0	1	0	1	2
8/15/2015	No	CS	0	1	0	0	0	0	0	1
Summary for Gunsight Pass (3 site visits)										
		Sum	0	6	0	0	1	0	1	7
									Min	1
									Max	4
Harrison Lake										
7/3/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/4/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/17/2015	No	CS - VIP	0	1	0	0	0	0	0	1
8/18/2015	No	CS - VIP	0	1	0	0	0	0	0	1
8/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Harrison Lake (5 site visits)										
		Sum	0	2	0	0	0	0	0	2
									Min	0
									Max	1
Haystack Butte										
7/8/2015	No	CS	1	5	0	1	2	2	0	8
8/2/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/5/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS - VIP	0	2	0	0	0	0	0	2

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
8/30/2015	No	CS - VIP	0	3	0	2	2	1	1	5
9/15/2015	No	CS	0	2	0	0	2	0	0	4
9/27/2015	No	CS - VIP	0	3	1	2	1	1	0	4
Summary for Haystack Butte (7 site visits)										
		Sum	1	15	1	5	7	4	1	23
									Min	0
									Max	8
Heaven's Peak										
9/11/2015	No	CS	0	2	1	1	0	0	0	2
Summary for Heaven's Peak (1 site visit)										
		Sum	0	2	1	1	0	0	0	2
									Min	2
									Max	2
Hidden Lake										
6/30/2015	No	CS	0	1	0	1	5	1	4	6
8/1/2015	No	CS - VIP	0	3	0	1	1	1	0	4
8/15/2015	No	CS	0	0	0	0	0	0	0	0
8/20/2015	No	CS	0	7	0	1	4	0	0	11
8/23/2015	No	CS - VIP	0	3	0	0	3	0	0	6
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	Bio Tech	0	2	0	0	0	0	0	2
Summary for Hidden Lake (7 site visits)										
		Sum	0	16	0	3	13	2	4	29
									Min	0
									Max	11
Iceberg IB Site										
9/18/2015	No	CS	0	22	5	3	8	7	1	30
9/19/2015	No	CS	0	7	3	4	2	1	1	9
9/19/2015	No	CS	0	6	3	3	2	1	1	8
Summary for Iceberg IB Site (3 site visits)										
		Sum	0	35	11	10	12	9	3	47
									Min	8
									Max	30
Iceberg Lake										

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
7/15/2015	No	CS	1	3	0	3	3	3	0	7
8/4/2015	No	CS	2	0	0	0	0	0	0	2
8/15/2015	No	CS	0	0	0	0	0	0	0	0
9/13/2015	No	CS - VIP	0	4	0	0	0	0	0	4
9/19/2015	No	CS	1	1	0	1	1	0	1	3
9/19/2015	No	CS	0	2	0	2	1	0	1	3
9/19/2015	No	CS	0	3	0	0	0	0	0	3
9/19/2015	No	CS	2	1	1	0	0	0	0	3
9/19/2015	No	CS	1	4	1	3	2	0	0	7
9/19/2015	No	CS	3	0	0	0	0	0	0	3
9/19/2015	No	CS	3	0	0	0	0	0	0	3
Summary for Iceberg Lake (11 site visits)										
		Sum	13	18	2	9	7	3	2	38
									Min	0
									Max	7

Janet Lake

7/9/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/19/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/31/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Janet Lake (3 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0

Numa Lookout

6/26/2015	No	CS	0	0	0	0	0	0	0	0
8/12/2015	No	CS	0	0	0	0	0	0	0	0
8/17/2015	No	CS	0	0	0	0	0	0	0	0
8/24/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Numa Lookout (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0

Ole Creek

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
6/6/2015	No	CS - VIP	0	2	0	0	1	0	1	3
6/22/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/16/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Ole Creek (3 site visits)										
		Sum	0	2	0	0	1	0	1	3
									Min	0
									Max	3
Otokomi Lake										
7/9/2015	No	CS	0	0	0	0	0	0	0	0
7/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Otokomi Lake (2 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Park Creek										
6/21/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/4/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	Bio Tech	0	0	0	0	0	0	0	0
9/21/2015	No	CS - VIP	0	2	0	0	1	0	0	3
Summary for Park Creek (4 site visits)										
		Sum	0	2	0	0	1	0	0	3
									Min	0
									Max	3
Pitamakin Pass										
7/14/2015	No	CS	1	3	0	1	1	1	0	5
9/20/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Pitamakin Pass (2 site visits)										
		Sum	1	3	0	1	1	1	0	5
									Min	0
									Max	5
Poia Lake										
7/20/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/4/2015	No	CS	0	2	2	0	0	0	0	2
8/15/2015	No	CS	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
8/16/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Poia Lake (4 site visits)										
		Sum	0	2	2	0	0	0	0	2
									Min	0
									Max	2

Preston Park

7/14/2015	No	CS - VIP	3	0	0	0	0	0	0	3
7/19/2015	No	CS - VIP	0	1	0	0	1	0	1	2
8/13/2015	No	CS	0	2	0	1	1	0	1	3
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/1/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Preston Park (6 site visits)										
		Sum	3	3	0	1	2	0	2	8
									Min	0
									Max	3

Red Eagle Lake

5/23/2015	No	CS	1	7	2	0	0	0	0	8
5/25/2015	No	CS	0	3	0	0	0	0	0	3
8/16/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Red Eagle Lake (3 site visits)										
		Sum	1	10	2	0	0	0	0	11
									Min	0
									Max	8

Scenic Point

6/6/2015	No	CS - VIP	0	3	0	0	1	0	1	4
7/13/2015	No	CS	0	0	0	0	0	0	0	0
8/4/2015	No	CS	0	0	0	0	0	0	0	0
8/12/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Scenic Point (5 site visits)										
		Sum	0	3	0	0	1	0	1	4
									Min	0
									Max	4

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Siyeh Pass Loop										
7/14/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Siyeh Pass Loop (1 site visit)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Sperry Chalet										
7/30/2015	No	CS	1	0	0	0	0	0	0	1
8/16/2015	No	CS	0	1	0	0	1	0	1	2
8/25/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Sperry Chalet (3 site visits)										
		Sum	1	1	0	0	1	0	1	3
									Min	0
									Max	2
Swiftcurrent Lookout										
8/30/2015	No	CS - VIP	0	1	0	0	0	0	0	1
Summary for Swiftcurrent Lookout (1 site visit)										
		Sum	0	1	0	0	0	0	0	1
									Min	1
									Max	1
Triple Divide Pass										
8/5/2015	No	CS	1	1	0	0	0	0	0	2
9/12/2015	No	CS	0	6	0	0	1	0	0	7
Summary for Triple Divide Pass (2 site visits)										
		Sum	1	7	0	0	1	0	0	9
									Min	2
									Max	7
Trout Lake										
6/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/1/2015	No	CS	0	0	0	0	0	0	0	0
7/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/16/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/6/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Summary for Trout Lake (5 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Two Medicine										
9/18/2015	No	CS	1	1	1	0	0	0	0	2
9/18/2015	No	CS	1	0	0	0	0	0	0	1
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	1	1	0	0	0	0	1
9/18/2015	No	CS	2	0	0	0	0	0	0	2
9/19/2015	No	CS	0	2	2	0	0	0	0	2
Summary for Two Medicine (6 site visits)										
		Sum	4	4	4	0	0	0	0	8
									Min	0
									Max	2
Upper Kintla										
6/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
6/24/2015	No	Bio Tech	0	0	0	0	0	0	0	0
6/25/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/27/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Upper Kintla (5 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
		Grand Total	29	181	30	37	57	23	16	267

Sheep Summary for year 2015

Site Name	Number of site visits	Number of Unknown (Sex or Age)	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total Sheep	--	Maximum at Location
Apikuni Falls	5	11	3	0	0	0	2	1	14	--	11
Apikuni Unofficial Site	1	0	0	0	0	0	0	0	0	--	0
Autumn Creek	9	0	0	0	0	0	0	0	0	--	0
Avalanche Lake	6	0	0	0	0	0	0	0	0	--	0
Boulder Pass	4	0	0	0	0	0	0	0	0	--	0
Brown Pass	3	0	0	0	0	0	0	0	0	--	0
Cobalt Lake	4	17	3	0	3	0	0	0	20	--	12
Cosley Lake	4	0	0	0	0	0	0	0	0	--	0
Cut Bank Creek	5	0	2	0	2	2	2	0	4	--	4
Dry Fork Creek	11	0	0	0	0	0	0	0	0	--	0
Elizabeth Lake	4	0	0	0	0	0	0	0	0	--	0
Fifty Mountain	2	0	0	0	0	0	0	0	0	--	0
Firebrand Pass	3	0	0	0	0	0	0	0	0	--	0
Grace Lake	4	0	0	0	0	0	0	0	0	--	0
Grinnell Lake	1		7	7	0	0	0	0	7	--	7
Gunsight Pass	3	0	0	0	0	0	0	0	0	--	0
Harrison Lake	5	0	0	0	0	0	0	0	0	--	0
Haystack Butte	7	2	7	7	0	0	0	0	9	--	6
Heaven's Peak	1	0	0	0	0	0	0	0	0	--	0
Hidden Lake	7	0	3	3	0	0	0	0	3	--	3
Iceberg IB Site	3	0	0	0	0	0	0	0	0	--	0
Iceberg Lake	11	0	0	0	0	0	0	0	0	--	0
Janet Lake	3	1	1	1	0	0	0	0	2	--	2
Numa Lookout	4	0	0	0	0	0	0	0	0	--	0
Ole Creek	3	0	0	0	0	0	0	0	0	--	0
Otokomi Lake	2	0	0	0	0	0	0	0	0	--	0
Park Creek	4	0	0	0	0	0	0	0	0	--	0
Pitamakin Pass	2	0	15	0	15	9	9	0	24	--	24
Poia Lake	4	0	0	0	0	0	0	0	0	--	0
Preston Park	6	0	0	0	0	0	0	0	0	--	0
Red Eagle Lake	3	4	8	4	0	1	0	1	13	--	8
Scenic Point	6	0	1	1	0	0	0	0	1	--	1

Site Name	Number of site visits	Number of Unknown (Sex or Age)	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total Sheep	--	Maximum at Location
Siyeh Pass Loop	1	0	0	0	0	0	0	0	0	--	0
Sperry Chalet	3	0	0	0	0	0	0	0	0	--	0
Swiftcurrent Lookout	1	0	0	0	0	0	0	0	0	--	0
Triple Divide Pass	2	2	10	0	0	8	7	1	20	--	20
Trout Lake	5	0	0	0	0	0	0	0	0	--	0
Two Medicine	6	0	1	1	0	0	0	0	1	--	1
Upper Kintla	5	0	0	0	0	0	0	0	0	--	0
Grand Totals:	163	37	61	24	20	20	20	3	118		

Detailed Summary for Sheep Surveys: Year 2015

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Apikuni Falls										
7/10/2015	No	CS	0	0	0	0	0	0	0	0
8/7/2015	No	CS	11	0	0	0	0	0	0	11
8/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/23/2015	No	CS - VIP	0	3	0	0	0	2	1	3
Summary for Apikuni Falls (5 site visits)										
Sum			11	3	0	0	0	2	1	14
									Min	0
									Max	11
Apikuni Unofficial Site										
4/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Apikuni Unofficial Site (1 site visit)										
Sum			0	0	0	0	0	0	0	0
									Min	0
									Max	0
Autumn Creek										
5/9/2015	No	CS - VIP	0	0	0	0	0	0	0	0
6/29/2015	No	CS	0	0	0	0	0	0	0	0
7/6/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/6/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
9/8/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/13/2015	No	CS	0	0	0	0	0	0	0	0
9/24/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Autumn Creek (9 site visits)										
Sum			0	0	0	0	0	0	0	0
									Min	0
									Max	0
Avalanche Lake										
5/20/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
5/21/2015	No	CS	0	0	0	0	0	0	0	0
7/10/2015	No	CS	0	0	0	0	0	0	0	0
8/14/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
8/31/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Avalanche Lake (6 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Boulder Pass										
7/18/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/28/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Boulder Pass (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Brown Pass										
7/19/2015	No	CS	0	0	0	0	0	0	0	0
8/17/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/29/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Brown Pass (3 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Cobalt Lake										
7/3/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	3	0	3	0	0	0	3
9/11/2015	No	CS	12	0	0	0	0	0	0	12
9/13/2015	No	CS - VIP	5	0	0	0	0	0	0	5

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Summary for Cobalt Lake (4 site visits)										
		Sum	17	3	0	3	0	0	0	20
									Min	0
									Max	12
Cosley Lake										
7/4/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/5/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/7/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Cosley Lake (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Cut Bank Creek										
6/3/2015	No	CS - VIP	0	2	0	2	2	2	0	4
6/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/3/2015	No	CS	0	0	0	0	0	0	0	0
8/11/2015	No	CS	0	0	0	0	0	0	0	0
9/12/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Cut Bank Creek (5 site visits)										
		Sum	0	2	0	2	2	2	0	4
									Min	0
									Max	4
Dry Fork Creek										
6/12/2015	No	Bio Tech	0	0	0	0	0	0	0	0
6/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/2/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/7/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
9/20/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/21/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Dry Fork Creek (11 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Elizabeth Lake										
7/4/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/11/2015	No	CS	0	0	0	0	0	0	0	0
7/18/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Elizabeth Lake (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Fifty Mountain										
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/27/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Fifty Mountain (2 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Firebrand Pass										
7/12/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/9/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Firebrand Pass (3 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Grace Lake										
7/1/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/2/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/18/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
7/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Grace Lake (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Grinnell Lake										
8/4/2015	No	Bio Tech		7	7	0	0	0	0	7
Summary for Grinnell Lake (1 site visit)										
		Sum		7	7	0	0	0	0	7
									Min	7
									Max	7
Gunsight Pass										
6/24/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/20/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Gunsight Pass (3 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Harrison Lake										
7/3/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/4/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/17/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/18/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Harrison Lake (5 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Haystack Butte										
7/8/2015	No	CS	0	0	0	0	0	0	0	0
8/2/2015	No	Bio Tech	0	3	3	0	0	0	0	3
8/5/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS - VIP	2	4	4	0	0	0	0	6

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
9/15/2015	No	CS	0	0	0	0	0	0	0	0
9/27/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Haystack Butte (6 site visits)										
		Sum	2	7	7	0	0	0	0	9
									Min	0
									Max	6

Heaven's Peak

9/11/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Heaven's Peak (1 site visit)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0

Hidden Lake

6/30/2015	No	CS	0	0	0	0	0	0	0	0
8/1/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
8/20/2015	No	CS	0	0	0	0	0	0	0	0
8/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	3	3	0	0	0	0	3
9/19/2015	No	Bio Tech	0	0	0	0	0	0	0	0
Summary for Hidden Lake (7 site visits)										
		Sum	0	3	3	0	0	0	0	3
									Min	0
									Max	3

Iceberg IB Site

9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Iceberg IB Site (3 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0

Iceberg Lake

7/15/2015	No	CS	0	0	0	0	0	0	0	0
-----------	----	----	---	---	---	---	---	---	---	---

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
8/4/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
9/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0

Summary for Iceberg Lake (11 site visits)

Sum	0	0	0	0	0	0	0	0	0	0
								Min	0	
								Max	0	

Janet Lake

7/9/2015	No	Bio Tech	1	1	1	0	0	0	0	2
7/19/2015	No	Bio Tech	0	0	0	0	0	0	0	0
7/31/2015	No	CS - VIP	0	0	0	0	0	0	0	0

Summary for Janet Lake (3 site visits)

Sum	1	1	1	0	0	0	0	0	0	2
								Min	0	
								Max	2	

Numa Lookout

6/26/2015	No	CS	0	0	0	0	0	0	0	0
8/12/2015	No	CS	0	0	0	0	0	0	0	0
8/17/2015	No	CS	0	0	0	0	0	0	0	0
8/24/2015	No	CS	0	0	0	0	0	0	0	0

Summary for Numa Lookout (4 site visits)

Sum	0	0	0	0	0	0	0	0	0	0
								Min	0	
								Max	0	

Ole Creek

6/6/2015	No	CS - VIP	0	0	0	0	0	0	0	0
----------	----	----------	---	---	---	---	---	---	---	---

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
6/22/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/16/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Ole Creek (3 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Otokomi Lake										
7/9/2015	No	CS	0	0	0	0	0	0	0	0
7/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Otokomi Lake (2 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Park Creek										
6/21/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/4/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	Bio Tech	0	0	0	0	0	0	0	0
9/21/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Park Creek (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Piegan Pass										
9/12/2015	No	CS	0	15	15	0	0	0	0	15
Summary for Piegan Pass (1 site visit)										
		Sum	0	15	15	0	0	0	0	15
									Min	15
									Max	15
Pitamakin Pass										
7/14/2015	No	CS	0	15	0	15	9	9	0	24
9/20/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Pitamakin Pass (2 site visits)										
		Sum	0	15	0	15	9	9	0	24
									Min	0
									Max	24

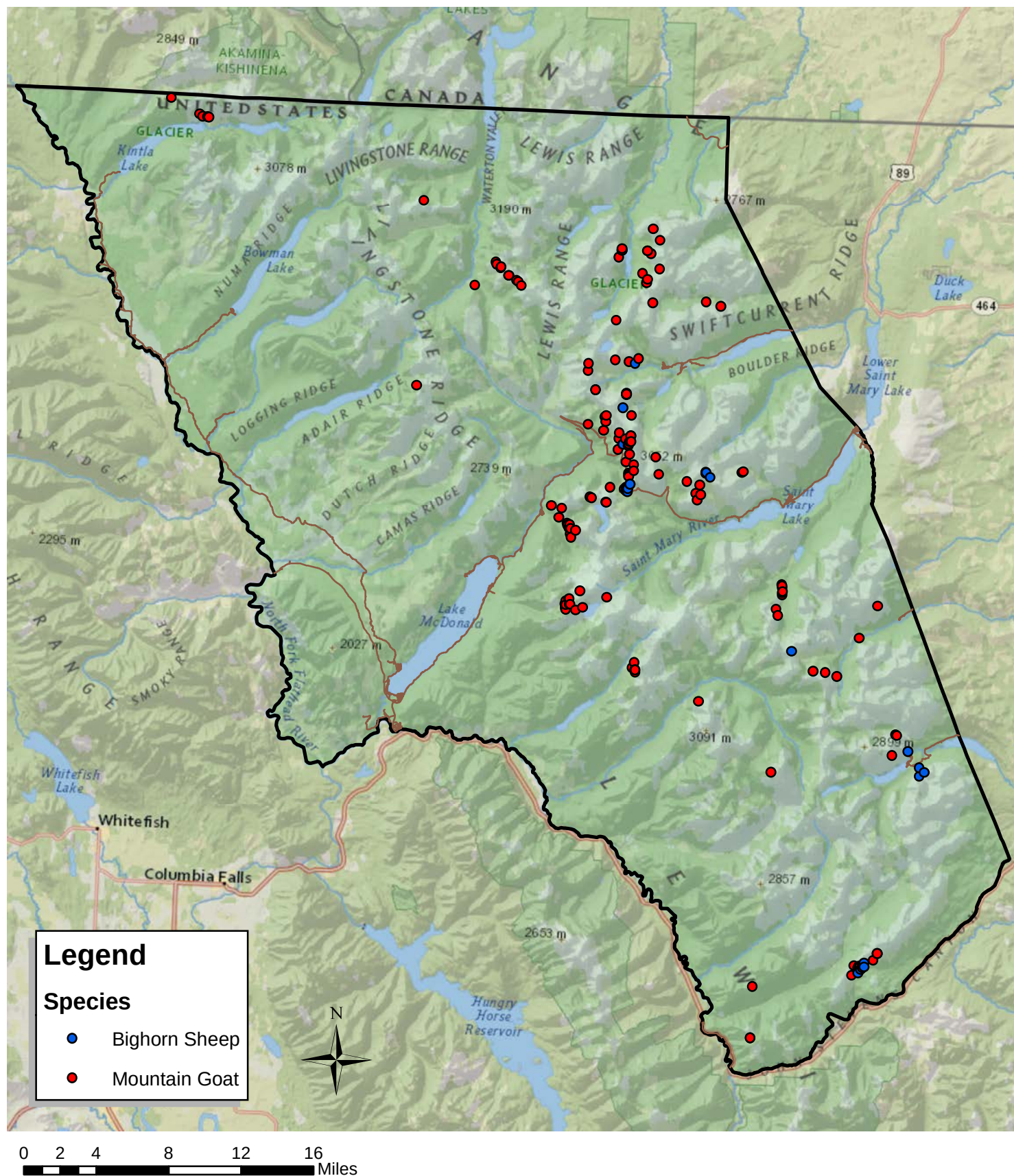
Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
Poia Lake										
7/20/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/4/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Poia Lake (4 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Preston Park										
7/14/2015	No	CS - VIP	0	0	0	0	0	0	0	0
7/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/13/2015	No	CS	0	0	0	0	0	0	0	0
8/15/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/1/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Preston Park (6 site visits)										
		Sum	0	0	0	0	0	0	0	0
									Min	0
									Max	0
Red Eagle Lake										
5/23/2015	No	CS	0	5	4	0	0	0	0	5
5/25/2015	No	CS	4	3	0	0	1	0	1	8
8/16/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Red Eagle Lake (3 site visits)										
		Sum	4	8	4	0	1	0	1	13
									Min	0
									Max	8
Scenic Point										
6/6/2015	No	CS - VIP	0	1	1	0	0	0	0	1
7/13/2015	No	CS	0	0	0	0	0	0	0	0
8/4/2015	No	CS	0	0	0	0	0	0	0	0
8/12/2015	No	CS	0	0	0	0	0	0	0	0

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total	
8/16/2015	No	CS	0	0	0	0	0	0	0	0	
Summary for Scenic Point (5 site visits)											
Sum			0	1	1	0	0	0	0	1	
										Min	0
										Max	1
Siyeh Pass Loop											
7/14/2015	No	CS - VIP	0	0	0	0	0	0	0	0	
Summary for Siyeh Pass Loop (1 site visit)											
Sum			0	0	0	0	0	0	0	0	
										Min	0
										Max	0
Sperry Chalet											
7/30/2015	No	CS	0	0	0	0	0	0	0	0	
8/16/2015	No	CS	0	0	0	0	0	0	0	0	
8/25/2015	No	CS - VIP	0	0	0	0	0	0	0	0	
Summary for Sperry Chalet (3 site visits)											
Sum			0	0	0	0	0	0	0	0	
										Min	0
										Max	0
Swiftcurrent Lookout											
8/30/2015	No	CS - VIP	0	0	0	0	0	0	0	0	
Summary for Swiftcurrent Lookout (1 site visit)											
Sum			0	0	0	0	0	0	0	0	
										Min	0
										Max	0
Triple Divide Pass											
8/5/2015	No	CS	2	10	0	0	8	7	1	20	
9/12/2015	No	CS	0	0	0	0	0	0	0	0	
Summary for Triple Divide Pass (2 site visits)											
Sum			2	10	0	0	8	7	1	20	
										Min	0
										Max	20
Trout Lake											
6/13/2015	No	CS - VIP	0	0	0	0	0	0	0	0	
7/1/2015	No	CS	0	0	0	0	0	0	0	0	

Survey Date	Paired Observation?	Most Experienced Observer	Number of Unknown	Number of Adults	Males	Females	Number of Young	Young of Year	Yearling	Total
7/19/2015	No	CS - VIP	0	0	0	0	0	0	0	0
8/16/2015	No	CS - VIP	0	0	0	0	0	0	0	0
9/6/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Trout Lake (5 site visits)			Sum	0	0	0	0	0	0	0
									Min	0
									Max	0
Two Medicine										
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	1	1	0	0	0	0	1
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/18/2015	No	CS	0	0	0	0	0	0	0	0
9/19/2015	No	CS	0	0	0	0	0	0	0	0
Summary for Two Medicine (6 site visits)			Sum	0	1	1	0	0	0	1
									Min	0
									Max	1
Upper Kintla										
6/23/2015	No	CS - VIP	0	0	0	0	0	0	0	0
6/24/2015	No	Bio Tech	0	0	0	0	0	0	0	0
6/25/2015	No	Bio Tech	0	0	0	0	0	0	0	0
8/16/2015	No	CS	0	0	0	0	0	0	0	0
8/27/2015	No	CS - VIP	0	0	0	0	0	0	0	0
Summary for Upper Kintla (5 site visits)			Sum	0	0	0	0	0	0	0
									Min	0
									Max	0
Grand Total			37	76	39	20	20	20	3	133

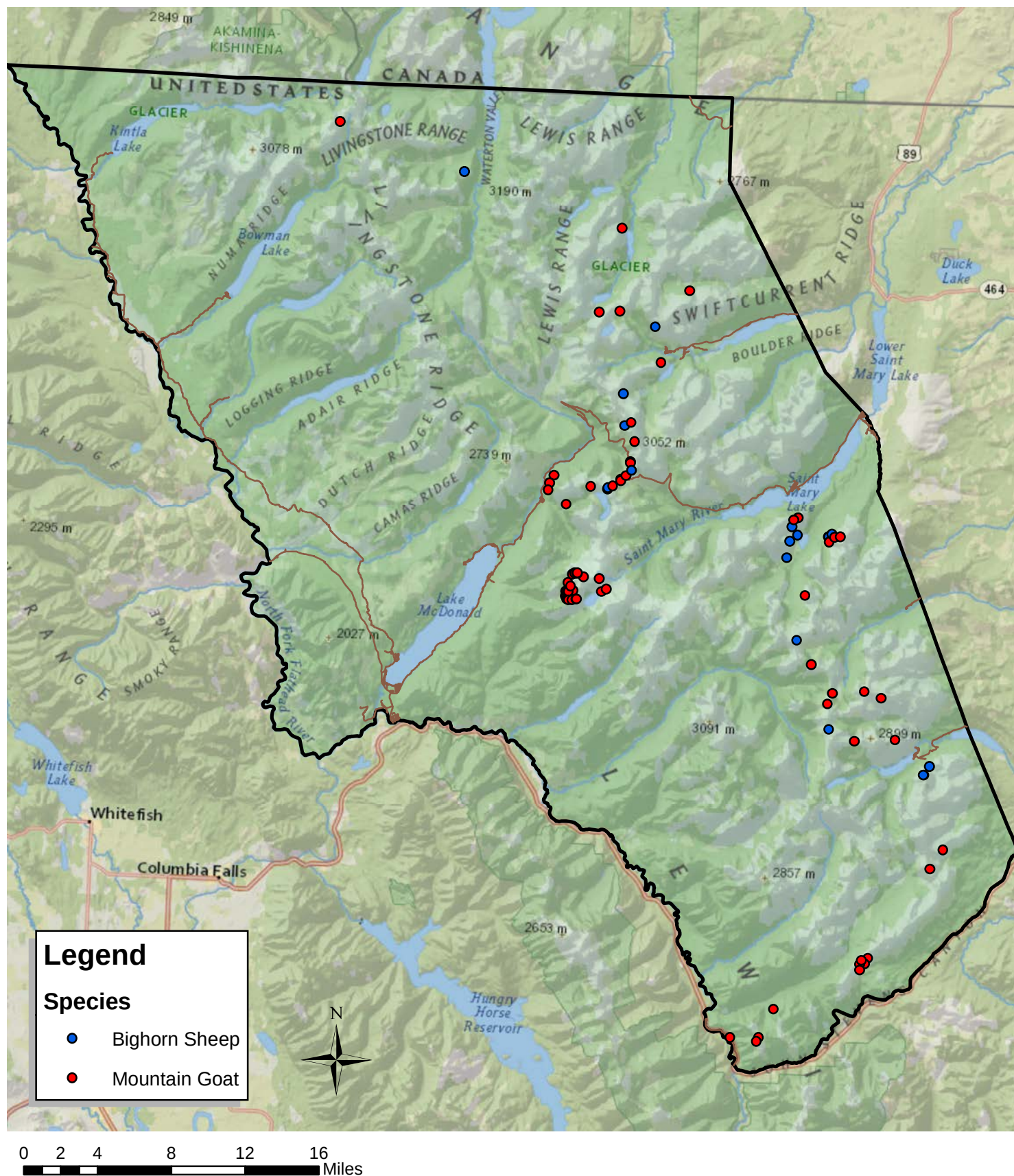


Mountain Ungulate Locations 2014



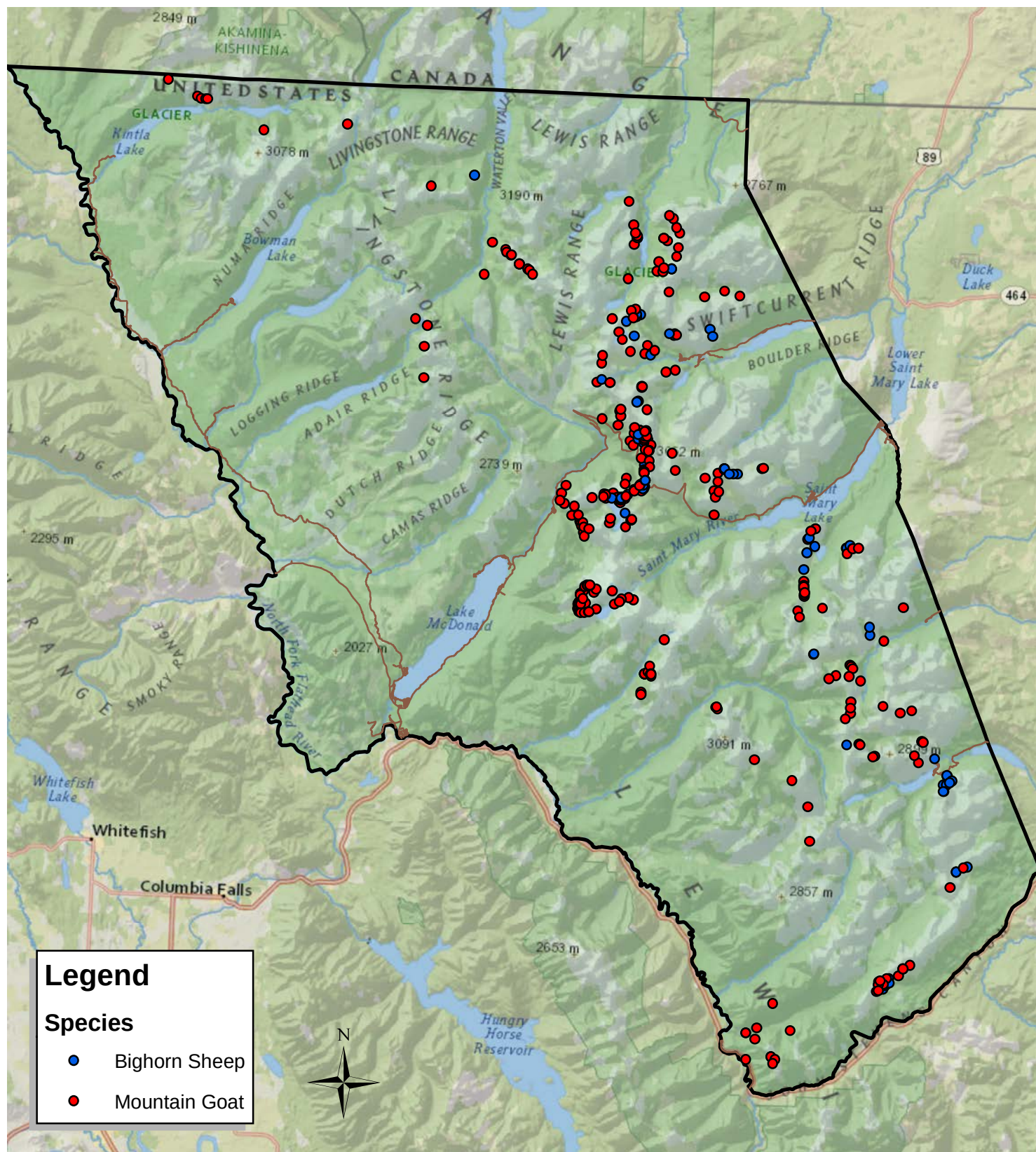


Mountain Ungulate Locations 2015





Mountain Ungulate Locations 2013-2015



0 2 4 8 12 16 Miles

2015 Goat Days Summary

Thursday, October 15, 2015

Date	Goat Total	Sheep Total	Goats Outside	Sheep Outside	Staff	Volunteers	Observer
Apikuni Falls							
8/13/2015	6	0	0	0	1	1	Matthew Murray
	6	0	0	0	1	1	Susan Clothier
8/16/2015	0	0	0	0	0	2	Chris Siegler
	0	0	0	0	0	2	Jeannie Siegler
Max Counts:	6	0					
Autumn Creek							
8/16/2015	0	0	0	0	0	2	Anne Zavadil
	0	0	0	0	0	2	Karen Chickering
8/16/2015	0	0	0	0	0	3	Virginia Cronk
Max Counts:	0	0					
Avalanche Lake							
8/14/2015	0	0	0	0	0	6	Glacier Youth 2015 #2 Montana Conservation Corps
8/15/2015	0	0	0	0	0	2	Angela Vaninetti
	0	0	0	0	0	2	Sam Clarin
Max Counts:	0	0					
Boulder Pass							
8/16/2015	0	0	2	0	1	1	Laura Luther
8/16/2015	0	0	0	0	0	1	Michael Faist
Max Counts:	0	0					
Brown Pass							
8/17/2015	0	0	0	0	1	1	Carleton Gritts
	0	0	0	0	1	1	Laura Luther
Max Counts:	0	0					
Cobalt Lake							
8/16/2015	8	12	4	8	0	1	Sumio Harada
Max Counts:	8	12					
Cosley Lake							
8/15/2015	0	0	0	0	0	2	Carolyn Clark
	0	0	0	0	0	2	Jeffery Clark
Max Counts:	0	0					

Date	Goat Total	Sheep Total	Goats Outside	Sheep Outside	Staff	Volunteers	Observer
Cut Bank Creek							
8/11/2015	0	0	0	0	0	6	Glacier Youth 2015 #2 Montana Conservation Corps
Max Counts:	0	0					
Elizabeth Lake							
8/15/2015	1	0	1	2	1	0	Elizabeth Flesch
Max Counts:	1	0					
Fifty Mountain							
8/15/2015	0	0	0	0	0	1	Diane Mayes
Max Counts:	0	0					
Firebrand Pass							
8/15/2015	1	0	0	0	0	1	Diane Mayes
Max Counts:	1	0					
Gunsight Pass							
8/15/2015	1	0	4	0	0	3	Robina Moyer
Max Counts:	1	0					
Harrison Lake							
8/17/2015	1	0	0	0	1	1	Matthew Murray
	1	0	0	0	1	1	Susan Clothier
8/18/2015	1	0	0	0	1	1	Matthew Murray
	1	0	0	0	1	1	Susan Clothier
Max Counts:	1	0					
Haystack Butte							
8/15/2015	4	6	4	0	0	1	Barbara Summer
Max Counts:	4	6					
Hidden Lake							
8/15/2015	0	0	0	0	0	1	Virginia Cronk
Max Counts:	0	0					
Iceberg Lake							
8/15/2015	0	0	0	0	0	2	Chris Siegler
	0	0	0	0	0	2	Jeannie Siegler
Max Counts:	0	0					

Date	Goat Total	Sheep Total	Goats Outside	Sheep Outside	Staff	Volunteers	Observer
Numa Lookout							
8/17/2015	0	0	0	0	0	2	M Lamb
	0	0	0	0	0	2	W Sloan
8/12/2015	0	0	0	0	1	0	Nancy Dow
Max Counts:	0	0					
Ole Creek							
8/16/2015	0	0	0	0	0	2	Barbara Summer
	0	0	0	0	0	2	Kathy Ross
Max Counts:	0	0					
Park Creek							
8/15/2015	0	0	0	0	1	0	Joshua Martin
Max Counts:	0	0					
Poia Lake							
8/16/2015	0	0	1	0	1	0	Elizabeth Flesch
8/15/2015	0	0	9	0	0	1	Carleton Gritts
Max Counts:	0	0					
Preston Park							
8/13/2015	3	0	0	0	0	6	Glacier Youth 2015 #2 Montana Conservation Corps
8/15/2015	0	0	0	0	0	1	Theresa Steele
Max Counts:	3	0					
Red Eagle Lake							
8/16/2015	0	0	0	0	1	0	Terry Peterson
Max Counts:	0	0					
Scenic Point							
8/16/2015	0	0	0	1	0	1	Don Zinn
8/12/2015	0	0	0	0	0	6	Glacier Youth 2015 #2 Montana Conservation Corps
Max Counts:	0	0					
Sperry Chalet							
8/16/2015	8	0	9	0	0	3	Robina Moyer
Max Counts:	8	0					
Trout Lake							
8/16/2015	0	0	0	0	0	1	Diane Mayes
Max Counts:	0	0					

Date	Goat Total	Sheep Total	Goats Outside	Sheep Outside	Staff	Volunteers	Observer
Upper Kintla							
8/16/2015	0	0	0	0	0	1	Michael Faist
Max Counts:	0	0					

46 Surveys Completed

High Country Citizen Science Project: 2015

Pika Monitoring

Abstract

The American Pika could be negatively impacted by climate change, due to their dependence on alpine habitat and physiological sensitivity to warm temperatures and early snowmelt. In 2012, Glacier National Park joined a network of parks to collect baseline information about pikas for the National Park Service Inventory and Monitoring Program's initiative. In 2012, 47 pika survey sites were established by research technicians. The summer of 2013 was the first field season that the Glacier National Park Citizen Science Program coordinated all surveys of pika monitoring sites, and pika monitoring continued during the summers of 2014 and 2015. In 2015, 89 citizen scientists and staff contributed 1041 hours to complete pika surveys. Observers completed 67 pika surveys and visited 38 official sites. Of the 9 official sites not visited, one was considered unsafe to send volunteers to, and several others were inaccessible for most of the survey season due to fire-related area closures. Of the 38 sites surveyed, 25 (66%) were recorded as "currently occupied," meaning that fresh sign or a pika was observed during the 2015 field season. Four sites were classified as formerly occupied and 7 sites were unoccupied. The rate of occupancy at surveyed sites was 0.66, slightly below the average of 0.70 over the four years of data. We will continue monitoring during 2016 to attain a fourth year of baseline data and enable us to evaluate trend in pika occupancy and determine detection rates for planning long-term monitoring.

Introduction

The American pika is a small mammal that selects rocky, often high elevation habitat in mountainous areas of North America. There is growing concern that pikas could be negatively impacted by climate change, due to their dependence on alpine habitat and physiological sensitivity to warm temperatures. In addition, pikas could serve as an indicator as to how warming temperatures impact alpine communities. Therefore, the National Park Service Upper Columbia Basin Inventory and Monitoring Network established pika monitoring as part of Vital Signs Monitoring in select national parks that contain pika habitat. The first part of the initiative, the Pikas in Peril program, involved three years of monitoring to assess pika vulnerability and conduct genetic sampling at eight locations, including Craters of the Moon, Lava Beds, Lassen Volcanic, Crater Lake, Great Sand Dunes, Grand Teton, Yellowstone, and Rocky Mountain National Parks. Of those parks, four locations (Craters of the Moon, Lassen Volcanic, Lava Beds, and Crater Lake) conducted five years of vital signs monitoring to serve as further baseline data to determine the influence of climate change on pikas. Glacier National Park joined the Inventory and Monitoring (I & M) Vital Signs Monitoring program in 2012 to test the efficacy of using citizen science to monitor pikas and to determine how to continue vital signs monitoring using the pika as an indicator species.

Due to the prevalence of alpine habitat, Glacier National Park is an excellent study system to also examine pika occupancy. In 2012, 47 survey sites were established by and mapped by research technicians. Glacier and I&M staff determined that at least three years of data collection would be necessary to analyze Glacier's pika occupancy, site turnover, and efficacy of citizen science involvement. The summer of 2013 was the first field season that the Glacier National Park Citizen Science Program coordinated all surveys of pika monitoring sites using the

new I&M protocol. The Citizen Science Program continued and improved pika monitoring during the summers of 2014 and 2015.

The following is a modified excerpt from the 2012 Glacier report written by Jeffress et al. 2013:

A recent (2007-2009) survey of pikas and their habitat in Glacier National Park conducted by Moyer-Horner (2011) identified 400 suitable habitat patches and documented a relatively large pika population (2071-4052 individuals) within the park. The park also has a very active citizen science program coordinated by the Crown of the Continent Research Learning Center with volunteers collecting scientific data regarding common loons, mountain ungulates, and pikas. The program led Moyer-Horner et al. (2012) sought to examine the ability of participants, including field technicians and citizen scientists, with wide ranges of experience and training to collect reliable data. Although Moyer-Horner et al. (2012) found that citizen scientists can collect reliable data via sitting surveys (focusing on visual and aural detections), they found that citizen scientists could not adequately estimate pika densities. However, this type of observer comparison has not occurred with the site occupancy survey methodologies described in the Jeffress et al. (2011) pika monitoring protocol that is being used widely in the National Park Service.

The purpose of this project was to pilot test a peer-reviewed, long-term pika monitoring protocol (Jeffress et al. 2011) for the American pika (*Ochotona princeps*) in Glacier National Park. The pika is a climate-sensitive species and this effort provided new information on the distribution, survey methodologies, and habitat associations of the species in the park. In particular, this project established long-term monitoring sites to estimate the proportion of sample sites occupied by pikas and assessed detectability of pika using both direct and indirect evidence of pika presence (via visuals, aural, scat, and haypiles) for observers with various levels of experience and training.

Therefore, the objectives of the pika monitoring program in 2015 were to:

- Enlist the help of volunteers and GNP staff to collect baseline information about pikas;
- Survey 47 Inventory and Monitoring pika sites to determine occupancy;
- Complete staff re-surveys of a portion of sites surveyed by volunteers to compare detection results between volunteers and technicians.

Methods

Survey site selection

Survey sites were originally established and surveyed in 2012 by research technicians (Jeffress et al. 2013). The following is a modified excerpt from Jeffress et al. 2013 describing site selection methods: “Using a combination of existing GIS shapefiles provided by the park (file “Pot_Habitat_10k_100m_20120412.shp” stored in the GLAC project file directory in the DVD provided to the park at the end of this project and available upon request from the UCBN), including a potential pika talus habitat map created by L. Moyer-Horner and the park vegetation map, we identified ~32 trails (file “10k_trailsselected_20120511.shp”) and several road sites that had potential pika habitat of slopes < 35° and within 100 m of the trail or road. These areas were targeted for field sampling.

Each surveying effort began with the field technicians conducting an exploratory hike out 10 km or to the end of the trail, whichever came first. GPS coordinates for guidance as to where the trail starts, ends, and intersects other trails were provided. Also, coordinates for the center of mapped potential habitat patches that met our sampling criteria were provided to the technicians; however, it is important to note that patches on the maps often did not represent what was actually on the ground. Sometimes mapped habitat was not present on the ground and sometimes potential habitat was encountered but not identified using the GIS shapefiles. Therefore, technicians marked (with a GPS) the start and ending coordinates for each talus patch encountered (whether it was currently identified in the potential habitat map or not) along or near the trail (i.e., line-of-sight and within 100 m) and noted the approximate size of each patch (i.e., roughly < 1 football field = small patch; > 1 football field = large patch).

At the end of each trail, the technicians counted the number of talus patches encountered and based on the patch size, how many sites could be placed in each patch. If the patch was generally less than or equal to one football field in size (average area of 4,460 m²), one site could be placed in that patch; if greater than one football field in size, two sites could be placed in that patch. The number of sites per trail was dependent on the length and habitat abundance and sites had to be a minimum of 50 m apart.

After the exploratory hike and as the technicians were hiking back toward the trailhead, they attempted to establish and survey as many of the sites identified for that trail as time allowed that day. However, some trails required multiple days to survey. Once the technicians encounter the first talus edge, they hiked 25 m farther along the trail and stopped and evaluated the habitat. Distances were measured using a GPS unit and/or rangefinder. If the talus slope was accessible within 100 m in both left and right directions (perpendicular from the trail) they flipped a coin to determine which direction to go. Once direction was established the technician used a random distance chart to determine where to place the first site. The chart provided a list of randomized distances (12-100 m; 12 m minimum from the trail so the plot would not overlap with the trail). At that point, the technicians began to establish a site for surveying and recorded the distance and direction used on the data form. If, for some reason, the technicians were not able to establish a site from 25 m along the trail (e.g., due to irregularly shaped talus, etc.), they walked another 5 m along the trail and evaluated if a site could be placed from there. The 5 m increments continued until a site could be established. The reverse was also possible for very small patches (i.e., 20 m or 15 m along the trail). A site was defined as a 12-m radius plot containing ≥10% target habitat. Once the technician(s) reached the location for a site center, the center was marked with an aluminum tree tag and rock cairn. Finally, the technician(s) recorded directions and took photos of the site and the route to access the site in order to develop site location maps for the citizen scientists.

If a second site was to be established (= large patch), the technicians returned to the trail from the first site and hiked another 50 m along the trail (or halfway to the far end of the patch if it was a large patch, whichever was the farthest distance) to establish the second site. Once this distance was met, the technicians used the same criteria (i.e., new random distance, coin flip, etc.) as the first site. All sites met the required potential habitat definition (see Table 1). Safety and ease of access was considered when establishing sites. As stated below, sites were not placed on slopes >35° or slopes that were perceived to be dangerous or unstable. The same considerations were

made for the route to access the site; keeping in mind that citizen scientists/volunteers of varying skill/ability levels for hiking and/or cross-country navigation using a GPS unit would be resurveying the sites.” The rationale for site selection was explained for citizen scientists in a handout found in Appendix 3. Following site establishment, Glacier National Park citizen science staff tracked and maintained site information, such as site marker condition and volunteer ability to locate site markers.

Citizen scientist involvement

Volunteers were recruited and coordinated to complete pika surveys throughout Glacier National Park. To ensure accurate data collection, volunteers were asked to attend a full-day citizen science training session. Citizen science staff provided background information through a PowerPoint presentation and showed the protocol to participants in the field by conducting an actual survey. Staff sought to increase precision of data by conducting additional training and focusing on surveys during the most active time period for pikas (late July through September). Upon completion of training, citizen scientists borrowed NPS pika survey equipment, maps, and GPS units to complete pika surveys independently using a standardized survey form (Appendix 1). Volunteers navigated to sites using survey site description (Appendix 2).

Pika occupancy monitoring

The 2015 season was the third season during which the majority of surveys were conducted by citizen scientists. Volunteers conducted pika surveys by locating a site marker, defining a 12m radius circle ($\approx 452\text{m}^2$) representative of an individual pika territory, conducting a 5 minute observational survey, traversing the talus for 15 to 30 minutes, and documenting the presence of scat, haypiles, pikas or calls. The 12-m radius search area was temporarily marked using four pre-measured cords that were 12 m in length and orange pin flags. Volunteers thoroughly searched the entire plot and recorded all evidence of pika activity detected, including pika sightings, calls, scat, and hay. Information about the detection(s), including time, distance to center, number of scat pellets (if applicable), was also recorded. Surveys were conducted for a minimum of 15 minutes. If no fresh sign or pikas were detected, the survey continued for a maximum of 30 minutes and the end time was noted. The citizen scientists then conducted a vegetation survey, estimating the percentage of the plot that was rock, bare, graminoid (i.e., grasses), forbs (i.e., flowering, non-woody plants), shrubs, and trees. Volunteers were asked to collect pika scat and take photographs of haypiles; however, the return rate for scat samples and photographs was low.

Current occupancy of pikas was confirmed if the citizen scientist observed a pika, heard a pika call, collected fresh scat, or observed a fresh haypile during a survey. Each site was surveyed up to three times or until current occupancy was confirmed. A site was classified as formerly occupied if only old scat or old haypiles were detected. After three surveys, a site that was not confirmed as currently occupied or formerly occupied was classified as unoccupied. If current occupancy was not confirmed and a site was surveyed less than three times, that site was considered unconfirmed. We also continued to monitor known occupied sites and locations of opportunistic observations along the Going to the Sun Road to map pika habitat along the road corridor and plan for future monitoring efforts.

Detection accuracy and precision

Glacier National Park is the first park to conduct I&M pika surveys using predominantly citizen scientists, rather than paid biological science technicians. More parks are likely to transition to using citizen scientists for their pika monitoring in future years due to lack of long-term funding. To assist with this effort, we sought to ultimately make recommendations to the I & M program for ensuring data quality and for maximizing the reliability of data from citizen scientists. Therefore, we attempted to re-survey at least 12 sites using biological science technicians (citizen science staff) to compare results from citizen scientists to those from biological science technicians, evaluate detection rates, and determine common sources of error or areas where additional training is needed. We also attempted to have citizen scientists resurvey one-third of the survey sites to determine detection consistency among citizen scientists and try to determine the factors that might impact detection precision. In addition, we compiled feedback from citizen scientists to help us refine the protocols for our own use and in other parks that will need to use citizen science to continue their pika monitoring efforts in future years.

Results

Citizen scientist involvement

In 2015 High Country citizen scientists contributed 1041 hours for pika surveys (Appendix 5). A total of 89 volunteers and staff conducted pika surveys. Observers completed 67 pika surveys and visited 38 out of 47 official sites (Appendix 4). We conducted seven training sessions (including outreach groups who conducted surveys) with 89 citizen scientist participants, of which 83 were new and outreach attendees (Appendices 5 and 6). Outreach groups included two Glacier Youth Conservation Corps crews, Flathead High School International Baccalaureate class, the Sierra Club, and the University of Montana Wildlife Society (See Internships, VIPs, Citizen Scientists and Training section for details).

Pika occupancy monitoring

Of the 38 sites surveyed, 25 (66%) were recorded as “currently occupied,” meaning that fresh sign or a pika was observed during the 2015 field season (Table 1, Figure 1; Appendix 7). Four sites were classified as formerly occupied and seven sites were unoccupied. Of the 11 sites that did not have fresh sign detection, nine (69%) were surveyed less than three times, which introduces some uncertainty about these results. One pika site (Janet Lake 044) was not surveyed due to safety hazards. Some of the other unvisited sites were inaccessible for much of the season due to fire-related area closures. In addition, 118 incidental pika observations were captured outside of survey plot areas and survey time.

Detection accuracy and precision

Eleven pika sites out of 38 surveyed (29%) had two independent surveys, with the plot classification results found by one citizen scientist effort matching the result found by a different citizen scientist effort at only five of the eleven sites (45%). Of the six sites where the results did not match:

Two sites were classified as formerly occupied on the first survey and unoccupied on the second survey, and one site was classified as currently occupied on the first survey and formerly occupied on the second survey; these discrepancies could be explained by the aging, decay, and burial of scat and haypiles through the season.

Three sites were classified as unoccupied or formerly occupied on the first survey, and currently occupied on the second survey; these discrepancies could be explained by an increase in pika activity at the site after the first survey.

An additional 8 pika sites (21% of sites surveyed) had three or more independent surveys; of these, one was found to be unoccupied by all every group, one was found to be currently occupied by every group, and the other 6 had inconsistent results.

Year	Currently Occupied	Formerly Occupied	Unoccupied	Not Surveyed	Currently Occupied /Total Surveyed
2012*	38	1	8	0	0.81
2013	31	6	6	4	0.72
2014	28	7	10	2	0.62
2015	25	4	5	9	0.66

*Surveys were completed by research technicians who established survey sites, not citizen scientists.

Table 1. Summary of pika occupancy surveys completed at 47 Inventory and Monitoring official monitoring sites in Glacier National Park from 2012 to 2015. Currently occupied sites had fresh sign or pika observed during the current field season. A site was considered formerly occupied if only old scat or old haypiles were detected. After three surveys, a site that was not confirmed as currently occupied or formerly occupied was considered unoccupied.

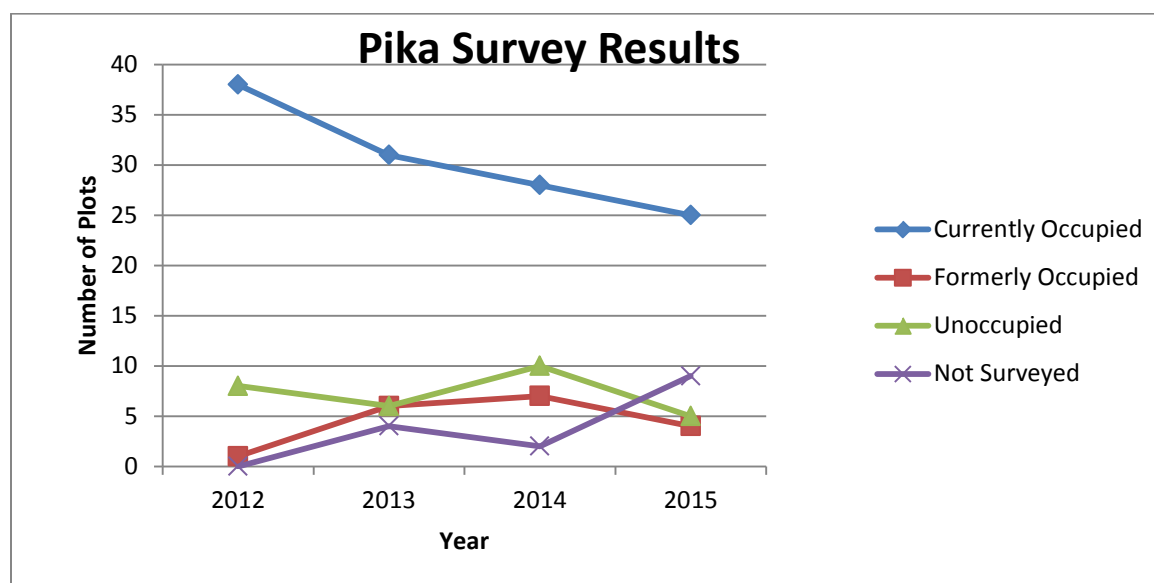


Figure 1. Pika occupancy surveys completed at 47 Inventory and Monitoring official monitoring sites in Glacier National Park from 2012 to 2015.

Discussion

The pika citizen science program had limited success this year, with only 77% of sites surveyed, the lowest survey rate since the current monitoring sites were established in 2012. The Thompson and Reynolds Creek fires resulted in area closures which made several of the pika sites inaccessible for much of August and September. Many volunteers also chose not to hike, or not to visit the park at all during this time, due to the heavy smoke and very limited visibility. This time period is the prime time for CS pika surveys for several reasons: all of the sites are

generally free of snow, weather is generally warm, volunteers who live in the area seasonally are available, and many volunteers who are already in the field for ungulate and loon surveys do pika surveys as well. The rate of occupancy at surveyed sites was 0.66, slightly below the average of 0.70 over the four-year period.

Four site markers which were damaged or could not be found during surveys in the 2014 season, at Poia Lake 026, Apikuni Falls 001, Cobalt Lake 024, and Cracker Lake 029, were replaced, along with the marker at Triple Divide Pass 025. Janet Lake site 044 was identified in 2014 as being unsafe for volunteers to access, as reaching the site required crossing an unstable avalanche chute and steep streambank with dense vegetation and many downed trees. No attempt was made to survey the site this year, and it is likely to remain inaccessible. Citizen Science staff need to consult with I&M about removing this site from the list.

The Glacier National Park Citizen Science Program provides an excellent opportunity to continue long-term pika monitoring and educate the public regarding pikas and climate change. We plan to continue pika monitoring during the 2016 summer field season, in order to attain a fourth year of baseline data.

Literature Cited

Jeffress, M. R., J. Apel, L. K. Garrett, G. Holm, D. Larson, N. Nordensten, and T. J. Rodhouse. 2011. Monitoring the American pika (*Ochotona princeps*) in the Pacific West Region – Crater Lake National Park, Craters of the Moon National Monument and Preserve, Lassen Volcanic National Park, and Lava Beds National Monument: Narrative Version 1.0. Natural Resource Report NPS/UCBN/NRR-2011/336. National Park Service, Fort Collins, Colorado.

Jeffress, M., J. Belt, T. Carolin, T. J. Rodhouse, and M. Britten. 2013. Pilot testing a pika monitoring protocol in Glacier National Park: Project Report 2012. Natural Resource Technical Report NPS/UCBN/NRTR—2013/667. National Park Service, Fort Collins, Colorado.

Moyer-Horner, L. 2011. American pika distribution, behavior, and observer variability. Dissertation, University of Wisconsin, Madison.

Moyer-Horner, L., M. M. Smith, and J. Belt. 2012. Citizen science and observer variability during American pika surveys. *The Journal of Wildlife Management* 76:1472-1479.

GLACIER NATIONAL PARK HIGH COUNTRY CITIZEN SCIENCE PIKA SURVEY FORM (2014)

*Date:		Observer (s): (circle person who conducted search)			Phone/Email:		
<i>Citizen Science Hours (includes driving, hiking & survey time)</i>				Time at start of day:		Time at end of day:	
Trail Name:				Number of miles hiked:		Site Name (#on marker and/or map): If Site marker is not found, enter GPS coordinates of where you began your survey.	
Arrival time at site:		Begin time for traverse search:		End time for traverse search:		Departure time from site:	
TIME AND TYPE OF PIKA DETECTION (<i>Please write "none" if no pikas or sign observed during survey.</i>) PIKA DETECTION TYPES = Pika Sighting, Pika Call, Fresh Haypile, Old Haypile, Fresh Scat, Old Scat <i>Fresh hay/scat contains visible chlorophyll (green tint) and some plasticity when squeezed. Old hay/scat is more brittle, contains little (hay) or no (scat) visible chlorophyll.</i> <i>*For the number of pellets, approximate into the following categories: <5, 5-10, 11-50, 51-100, >100</i>							
	Time of detection	Detection type (may list multiples per location)	Distance (m) from site center	If fresh scat, # of pellets*	If old scat, # of pellets*	Verification photo (Y/N)	Comments (Other wildlife and/or sign, uncertain detections, etc.)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Estimate % cover for each ground cover type (0, <1, 1-5, 5-25, 25-50, 50-75, 75-95, 95-100, or 100%):		Rock:	Bare ground (dirt, mineral soil, plant debris/ sticks):	Grass:	Forb (non-woody plants):	Shrub:	Tree:

CONTINUE ON REVERSE

GLACIER NATIONAL PARK HIGH COUNTRY CITIZEN SCIENCE PIKA SURVEY FORM (2014)

<i>Please rate the following for this site on a scale of 1-5 (1 very easy; 5 very difficult):</i>						Approx. time to locate marker from trail (minutes):	
Ability to reach the talus field	1	2	3	4	5	NA	Why did you select this site (check all that apply): ☐ Scenic location ☐ New area of park ☐ Optimal hiking distance/strenuousness ☐ Optimal driving time/convenience ☐ Safety consideration Other: _____
Ability to traverse talus	1	2	3	4	5	NA	
Ability to navigate to/locate the site marker	1	2	3	4	5	NA	
Ability to follow/understand the instructions and survey methods	1	2	3	4	5	NA	
Ability to detect and identify pikas	1	2	3	4	5	NA	
Ability to see under rocks completely	1	2	3	4	5	NA	
Ability to detect and recognize pika scat	1	2	3	4	5	NA	
Ability to detect and recognize pika haypiles	1	2	3	4	5	NA	
Ability to age pika haypiles and scat	1	2	3	4	5	NA	
Ability to complete search in allotted time	1	2	3	4	5	NA	
Ability to estimate vegetation cover	1	2	3	4	5	NA	If last survey of the day, how many sites did you survey today: _____ sites
Notes, comments, or general feedback:							

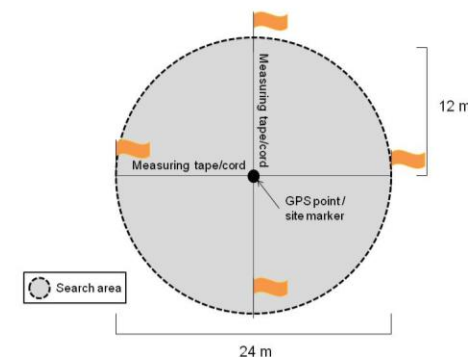
PIKA SURVEY PROCEDURES

Survey equipment: Measuring tape/cord, pin flags, and GPS unit.

Recommended: Leather gloves, camera, flashlight, and watch.

****Surveys should not be conducted in inclement weather such as rain, snow, high winds****

1. Navigate to survey site using route map, GPS point location and photo of reference on trail. Once close (~10 m) begin looking for the metal site marker and/or rock cairn. Once you find the site marker*, enter the site number as "Site Name" on the data form.*If you cannot find the site marker after 15 minutes, conduct your survey from the closest location (within 10 feet according to your GPS unit), **record the GPS coordinates and notify us.**
2. Use the measuring tape or cord to measure out 12-m to four edges of the plot, leaving a pin flag at each edge (see right). This will help you establish/visualize the search area. Note: Sometimes the plot will extend beyond the talus but you should still use same site center and plot edges. In these cases, all rock in the plot should be searched and all ground cover types in the plot, even if beyond the talus, incorporated in the cover estimates.
3. Sit quietly for 5 minutes, looking and listening for pikas. Record any detection of pikas within the plot as well as the approximate distance of the detection from the marker. Document all pikas and marmots seen or heard outside of the plot on the table below. Note type of observation in comments.
4. Begin searching the entire circular plot for the pika sign types (noting the start time on the form). You may record multiple detections in one row if those were found at the same location (e.g., fresh haypile and fresh scat in the same rock crevice). Search the site for a minimum of 15 minutes and a maximum of 30 minutes, ensuring to look in every possible crack and crevice through the search area. Record the time you completed the search.
5. Estimate the percent cover for each ground cover type and complete survey questionnaire (above).
6. Return survey forms ASAP by fax (406) 888-7903, or email glac_citizen_science@nps.gov, or mail GNP-CCRLC, PO Box 128, West Glacier, MT 59936

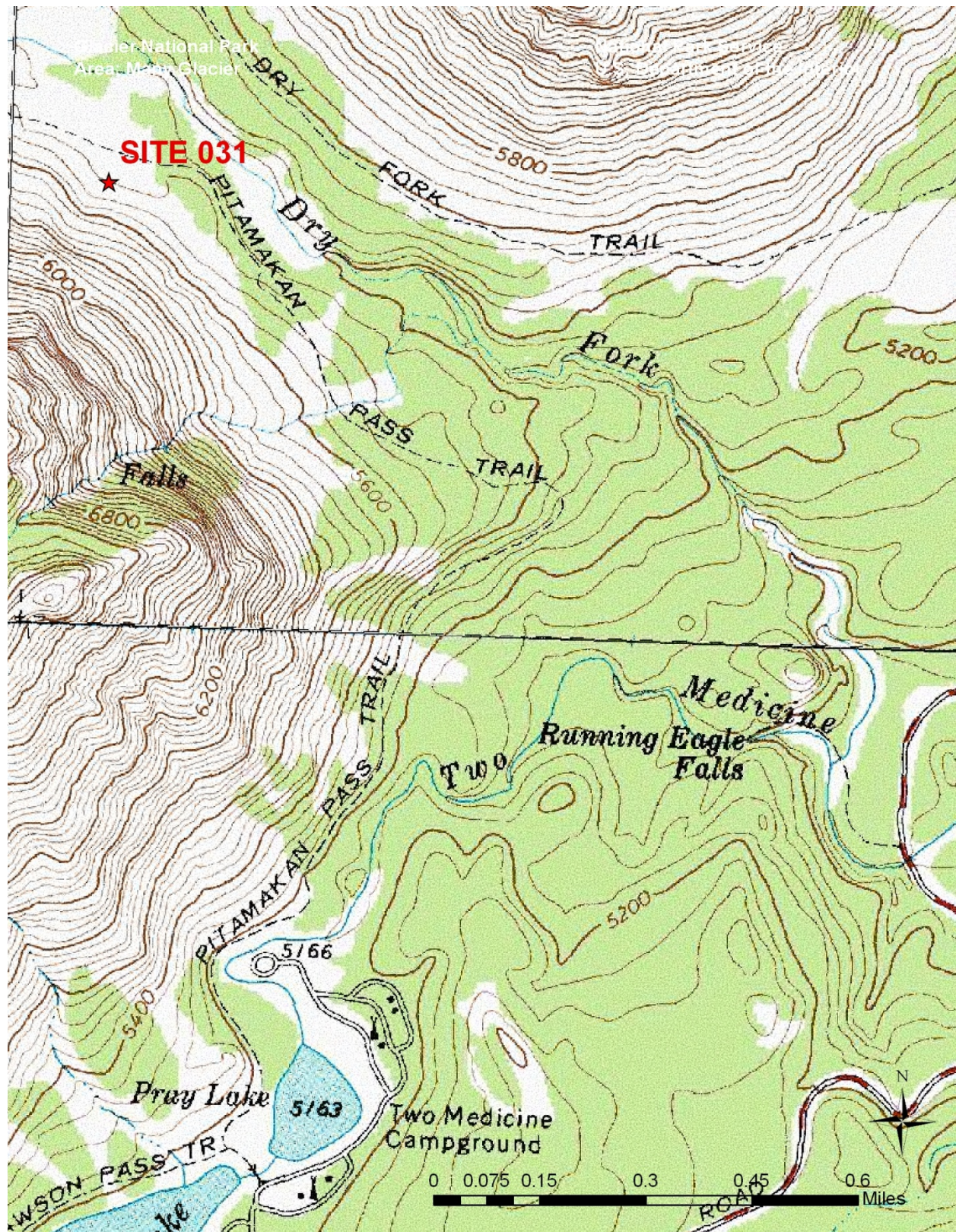


OTHER OBSERVATIONS: MARMOTS AND PIKAS

Did you see a pika outside of the survey plot or survey time? Did you see a marmot during your hike or survey? If so, please record species and details here:

Time at detection	Species (Marmot or Pika)	Detection type (may list multiple types per location)	UTM's (NAD 83) Easting	UTM's (NAD 83) Northing	Specific location (mountain, aspect, trail mileage, etc.)	Comments

Route to Pika Survey Site 031 – Dry Fork Creek (From Two Medicine Campground)



Route to Pika Survey Site 031 – Dry Fork Creek (From Two Medicine Campground)

To Reach Dry Fork Creek Site 031:

1. Begin hiking from the Two Medicine Campground, towards Old Man Lake. Turn your GPS unit on when you begin descending a series of short switchbacks, in the forest. As you emerge from the forest, you will see a large talus slope on your left hand side. The site is located in this first talus patch. If you cross the river bed and reach the trail junction, you've gone too far.



Photo (left) and coordinates for point to leave trail:

**12 U 0324777
5375672**

2. The pika site marker (a small aluminum tag) is 80 meters from the trail, across a small field (photo below). The site will be about 20 meters up from the bottom of the talus slope. The marker is wired to a rock, next to a cairn.



Coordinates for pika site marker:

**12 U 0324750
5375595**

Citizen Science Pika Program Pika Monitoring

A brief overview of how sites were originally selected

Hello! You are about to re-survey one or more pika survey sites that were established in 2012. Here is a brief overview of how we originally chose the sites, and what you can expect to find on your re-survey.

Each of the sites that you will be re-surveying was placed within the talus patch using a random sampling method, outlined below.

There were many criteria used in the original establishment of sites. Each site is up to 10 kilometers from a trail head and up to 100 meters from a trail. In addition, for the safety of you, our volunteers, the sites are on slopes less than 35 degrees. We used maps made from satellite images to tell us where there might be potential pika habitat along each trail, then hiked the trails ourselves to find out what was actually present on the ground.

At each point where we discovered potential habitat, we marked the beginning and end of the talus from the trail using a GPS. Then starting at the talus edge, we hiked a set trail distance along the talus. From this point we used a randomly-selected distance between 12-100 meters to determine how far the site should be from the trail. Standing on the trail, we turned to face the talus at a 90 degree angle from the trail, took the azimuth of this direction, and then walked our random distance into the talus. The point where we ended was where we established our plot/site center. Note: Our criterion for a site is that the circular plot must contain 10% or greater potential habitat (e.g., broken/creviced rock).

You will discover on your re-survey that often this random method for site selection did not place our plot in what you might think of as “optimal” pika habitat. Frequently you will see that, just a few meters away, there are perfect boulders and our site is placed on the margin; that is okay. What we are trying to establish with this study is presence/absence. We want to know which areas pikas are inhabiting, which areas they are not, what is different between these sites, and how that changes over time. If we were to have picked our sites based on which ones looked the nicest, our data would have been biased and inaccurate. There were some plots that we surveyed where we didn't find any sign, and the same will be true for you. Finding no pika sign in your site is just as important as finding sign because it is all part of the data set. You will also find many sites that look like they are not suitable pika habitat whatsoever, but when you begin your actual survey you will be overwhelmed by how much pika sign you find. This is also important. Although we may have an ideal image in our minds of pikas using giant boulder fields, the reality is that pikas use many different kinds of creviced rock, some of which won't fit your ideal image at all! No matter what your expectations were before you began your re-survey, I'm sure that you will come away from today with a different, and hopefully better understanding of pikas, science, and Glacier National Park.

I hope this brief overview gives you a better understanding of how and why we chose the sites that we did. Thank you for the time and interest that you are volunteering and please know that you are helping us understand what is truly happening with the pika population over time here in Glacier National Park. **We are so glad to have you be part of the team. Have a wonderful day in the field!**

Appendix 4: 2015 Pika Occupancy Summary

Site Name	Survey				Occupancy Status	Fresh sign detected or site surveyed >=3 times				
	1	2	3	4						
001 Apikuni Falls	2	2			Currently Occupied	Confirmed				
002 St. Mary Lake					Not Surveyed	Unconfirmed				
003 St. Mary Lake					Not Surveyed	Unconfirmed				
004 Highline Trail	1				Formerly Occupied	Unconfirmed				
005 Highline Trail	2				Currently Occupied	Confirmed				
006 Highline Trail	2				Currently Occupied	Confirmed				
007 North Highline Trail	0				Unoccupied	Unconfirmed				
008 North Highline Trail	0				Unoccupied	Unconfirmed				
009 North Highline Trail	0				Unoccupied	Unconfirmed				
010 North Highline Trail	1	0			Formerly Occupied	Unconfirmed				
011 Swiftcurrent Pass	2				Currently Occupied	Confirmed				
012 Highline Trail	2				Currently Occupied	Confirmed				
013 Highline Trail	0	2	0	2	Currently Occupied	Confirmed				
014 Ptarmigan Lake	1	0			Formerly Occupied	Unconfirmed				
015 Many Glacier	2	2	2		Currently Occupied	Confirmed				
016 Piegan Pass	0				Unoccupied	Unconfirmed				
017 Piegan Pass	0	0			Unoccupied	Unconfirmed				
018 Piegan Pass	0				Unoccupied	Unconfirmed				
019 Piegan Pass	2	0			Currently Occupied	Confirmed				
020 Piegan Pass	0	2	0		Currently Occupied	Confirmed				
021 Piegan Pass	0	0			Unoccupied	Unconfirmed				
022 Siyeh Pass	2				Currently Occupied	Confirmed				
023 Siyeh Pass					Not Surveyed	Unconfirmed				
024 Cobalt Lake	2				Currently Occupied	Confirmed				
025 Triple Divide Pass					Not Surveyed	Unconfirmed				
026 Poia Lake (Red Gap Pass)	0	0			Unoccupied	Unconfirmed				
027 Poia Lake (Red Gap Pass)	1	2			Currently Occupied	Confirmed				
028 Cracker Lake	1	1	0	0	Formerly Occupied	Confirmed				
029 Cracker Lake	2	2	2	0	Currently Occupied	Confirmed				
030 Otokomi Lake	2				Currently Occupied	Confirmed				
031 Dry Fork Creek	2	2			Currently Occupied	Confirmed				
032 Slide Lake to Gable Pass					Not Surveyed	Unconfirmed				
033 Slide Lake to Gable Pass					Not Surveyed	Unconfirmed				
034 Slide Lake to Gable Pass					Not Surveyed	Unconfirmed				
035 Slide Lake to Gable Pass					Not Surveyed	Unconfirmed				
036 Snyder Lake	0	2	1		Currently Occupied	Confirmed				
037 Sperry Chalet	1	2			Currently Occupied	Confirmed				
038 Sperry Chalet	2				Currently Occupied	Confirmed				
039 Sperry Chalet	2				Currently Occupied	Confirmed				

Key

0 = no sign detected

1 = old sign detected

2 = fresh sign or pikas detected

Appendix 4: 2015 Pika Occupancy Summary

Site Name	Survey				Occupancy Status	Fresh sign detected or site surveyed >=3 times				
	1	2	3	4						
040 Sperry Chalet	2				Currently Occupied	Confirmed				
041 Upper McDonald Creek	0	0	0	0	Unoccupied	Confirmed				
042 Janet Lake	2				Currently Occupied	Confirmed				
043 Janet Lake	2				Currently Occupied	Confirmed				
044 Janet Lake					Not Surveyed	Unconfirmed				
045 Hidden Lake	1	2	2		Currently Occupied	Confirmed				
046 Hidden Lake	2				Currently Occupied	Confirmed				
047 Hidden Lake	2	1			Currently Occupied	Confirmed				

Appendix 5: 2015 Pika Survey Hours

Site	Date	Day Start	Day End	Volunteer	Group Size	Hours	Total Hours
Apikuni Falls 01	7/10/2015	9:07	13:55	Glacier Youth 2015 Montana Conservation Corps	8	4.8	38.4
	8/6/2015	10:25	12:00	2015 Sierra Club	4	1.6	6.3
Cobalt Lake 24	7/3/2015	20:00	14:00	Michael Faist	1	6.0	6.0
Cracker Lake 28	6/20/2015	9:45	13:10	Adelle Donohue	1	3.4	3.4
	8/3/2015	7:45	16:15	Susan Clothier	1	8.5	8.5
	8/4/2015	12:50	15:28	2015 Sierra Club	4	2.6	10.5
	8/22/2015	9:15	15:55	Bob Chinn	1	6.7	6.7
				Mary Chinn	1	6.7	6.7
Cracker Lake 29	6/21/2015	10:00	13:30	Adelle Donohue	1	3.5	3.5
	8/3/2015	7:45	16:15	Susan Clothier	1	8.5	8.5
	8/4/2015	10:05	12:50	2015 Sierra Club	4	2.8	11.0
	8/26/2015	10:00	19:30	Bob Chinn	1	9.5	9.5
Dry Fork 31	6/19/2015	11:00	17:30	Elizabeth Flesch	1	6.5	6.5
				Glacier Youth 2015 Montana Conservation Corps	8	6.5	52.0
	7/2/2015	11:00	17:00	Elizabeth Flesch	1	6.0	6.0
				Leslie Kermath	1	6.0	6.0
Hidden Lake 45	6/30/2015	8:00	16:30	Glacier Youth 2015 Montana Conservation Corps	8	8.5	68.0
	9/2/2015	6:30	15:00	Donna Hathaway	1	8.5	8.5
	9/19/2015	10:00	18:00	Joshua Martin	1	8.0	8.0
				University of Montana Wildlife Society	25	8.0	200.0
Hidden Lake 46	8/20/2015	7:30	15:00	Mary Nelesen	1	7.5	7.5
				Tom Nelesen	1	7.5	7.5
Hidden Lake 47	8/2/2015	8:00	16:30	Glacier Youth 2015 Montana Conservation Corps	8	8.5	68.0
	8/23/2015	7:30	16:00	Diane Mayes	1	8.5	8.5
Highline Trail 04	8/2/2015	12:00	21:30	Laura Luther	1	9.5	9.5
				Sara Ryan	1	9.5	9.5
Highline Trail 06	8/2/2015	14:30	15:00	Laura Luther	1	0.5	0.5
				Sara Ryan	1	0.5	0.5
Highline Trail 12	7/8/2015	7:20	18:00	Elizabeth Flesch	1	10.7	10.7
Highline Trail 13	7/8/2015	7:20	18:00	Elizabeth Flesch	1	10.7	10.7
	9/11/2015	10:30	19:30	Carole Murphy	1	9.0	9.0
				Rick Murphy	1	9.0	9.0
	9/14/2015	9:15	16:20	Donna Hathaway	1	7.1	7.1
	9/27/2015	9:45	17:00	Susan Clothier	1	7.3	7.3
Janet Lake 42	7/9/2015	7:00	21:00	Joshua Martin	1	14.0	14.0
Janet Lake 43	7/9/2015	7:00	21:00	Joshua Martin	1	14.0	14.0
Many Glacier 15	7/10/2015	9:07	13:55	Glacier Youth 2015 Montana Conservation Corps	8	4.8	38.4
	8/6/2015	11:00	13:20	2015 Sierra Club	4	2.3	9.3
	9/19/2015	9:30	18:00	2015 Flathead High School	1	8.5	8.5
			18:30	2015 Flathead High School	1	9.0	9.0
		16:30	19:30	2015 Flathead High School	1	3.0	3.0

Appendix 5: 2015 Pika Survey Hours

Site	Date	Day Start	Day End	Volunteer	Group Size	Hours	Total Hours
North Highline Trail 07	8/27/2015	7:00	19:00	Andrew Lahr	1	12.0	12.0
North Highline Trail 08	8/27/2015	7:00	19:00	Andrew Lahr	1	12.0	12.0
North Highline Trail 09	8/27/2015	7:00	19:00	Andrew Lahr	1	12.0	12.0
North Highline Trail 10	8/2/2015	12:00	21:30	Laura Luther	1	9.5	9.5
				Sara Ryan	1	9.5	9.5
	8/27/2015	7:00	19:00	Andrew Lahr	1	12.0	12.0
Otokomi Lake 30	7/9/2015	10:01	17:30	Glacier Youth 2015 Montana Conservation Corps	8	7.5	59.9
Piegan Pass 17	9/14/2015	10:00	18:30	Emily Miller	1	8.5	8.5
	10/25/2015	8:25	18:30	Bill Igoe	1	10.1	10.1
				Kate Igoe	1	10.1	10.1
Piegan Pass 18	10/25/2015	8:25	18:30	Bill Igoe	1	10.1	10.1
				Kate Igoe	1	10.1	10.1
Piegan Pass 19	9/18/2015	8:00	17:30	Nancy Barrus	1	9.5	9.5
	10/25/2015	8:25	18:30	Bill Igoe	1	10.1	10.1
				Kate Igoe	1	10.1	10.1
Piegan Pass 20	9/8/2015	9:30	17:20	Jeanie Siegler	1	7.8	7.8
	9/14/2015	10:00	18:30	Emily Miller	1	8.5	8.5
				Sam Harkness	1	8.5	8.5
	10/25/2015	8:25	18:30	Bill Igoe	1	10.1	10.1
				Kate Igoe	1	10.1	10.1
Piegan Pass 21	9/8/2015	9:30	17:20	Jeanie Siegler	1	7.8	7.8
	10/25/2015	8:25	18:30	Bill Igoe	1	10.1	10.1
				Kate Igoe	1	10.1	10.1
Poia Lake (Red Gap Pass) 27	8/4/2015	8:40	18:15	2015 Sierra Club	4	9.6	38.3
	9/26/2015	8:30	16:30	Bill Igoe	1	8.0	8.0
				Kate Igoe	1	8.0	8.0
Poia Lake (Red Gap Pass) 26	8/4/2015	8:40	18:15	2015 Sierra Club	4	9.6	38.3
	9/26/2015	8:30	16:30	Bill Igoe	1	8.0	8.0
				Kate Igoe	1	8.0	8.0
Ptarmigan Lake 14	7/11/2015	8:30	18:30	Michael Faist	1	10.0	10.0
	8/24/2015	9:30	18:00	Bob Chinn	1	8.5	8.5
				Mary Chinn	1	8.5	8.5
Siyeh Pass 22	9/12/2015	6:30	18:30	Donna Hathaway	1	12.0	12.0
Snyder Lake 36	6/11/2015	8:30	14:30	Jeanie Siegler	1	6.0	6.0
	6/30/2015	7:30		Elizabeth Flesch	1	0.0	0.0
				Tabitha Graves	1	0.0	0.0
	7/3/2015	9:15	13:00	Glacier Youth 2015 Montana Conservation Corps	8	3.8	30.0
Sperry Chalet 37	6/12/2015	11:00	18:00	Elizabeth Flesch	1	7.0	7.0
				Jeanie Siegler	1	7.0	7.0
				Kirstan Andrews	1	7.0	7.0
				Laura Luther	1	7.0	7.0

Appendix 5: 2015 Pika Survey Hours

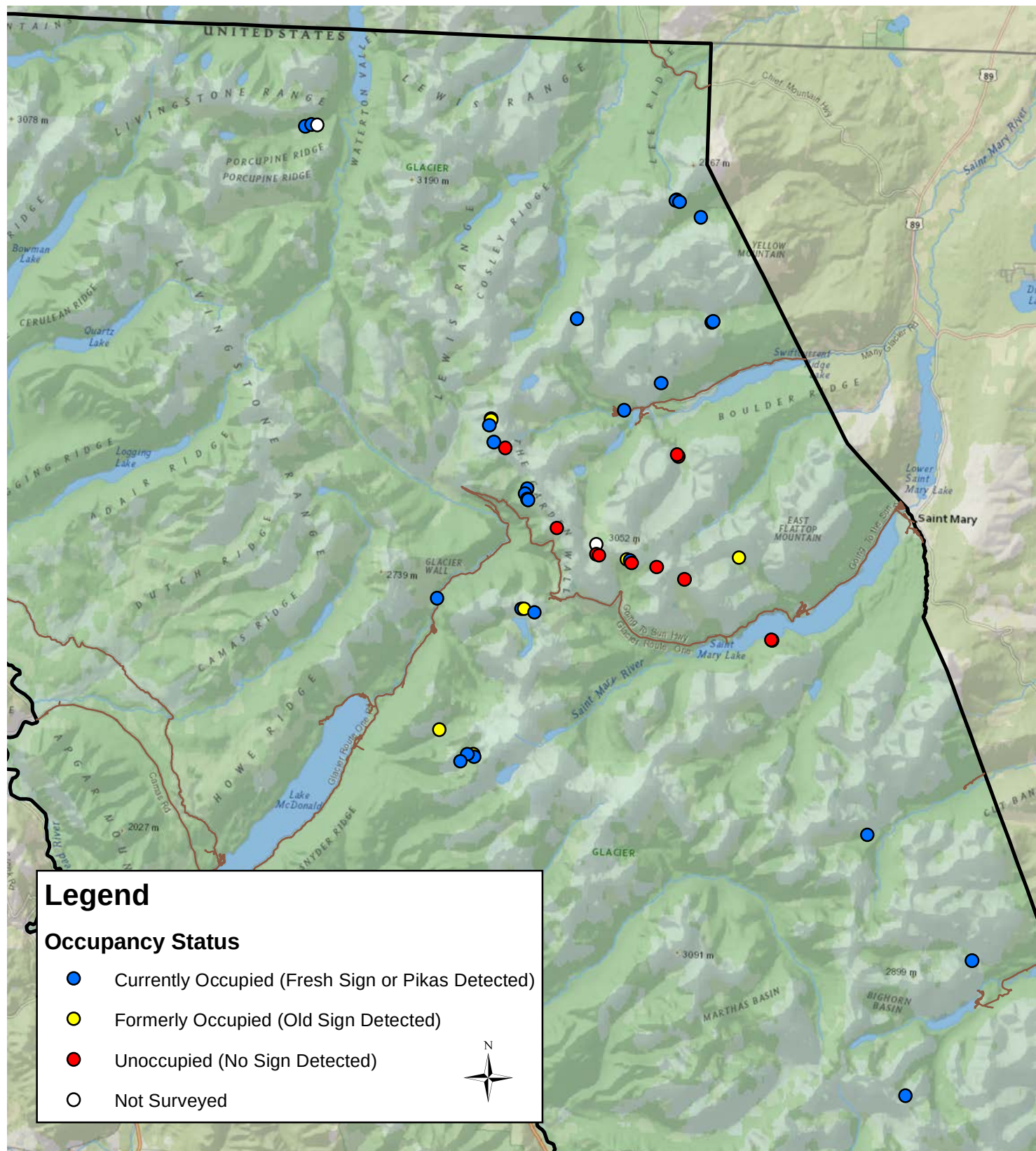
Site	Date	Day Start	Day End	Volunteer	Group Size	Hours	Total Hours
	7/30/2015	8:00	18:00	Michael Faist	1	7.0	7.0
				robina moyer	1	7.0	7.0
				Elizabeth Flesch	1	10.0	10.0
				Jeanie Siegler	1	10.0	10.0
Sperry Chalet 38	7/30/2015	8:00	18:00	Elizabeth Flesch	1	10.0	10.0
				Jeanie Siegler	1	10.0	10.0
Sperry Chalet 39	7/29/2015	7:45	18:00	Elizabeth Flesch	1	10.3	10.3
				Jeanie Siegler	1	10.3	10.3
Sperry Chalet 40	7/29/2015	7:45	18:00	Elizabeth Flesch	1	10.3	10.3
				Jeanie Siegler	1	10.3	10.3
Swiftcurrent Pass 11	8/3/2015	8:00	21:45	Laura Luther	1	13.8	13.8
				Sara Ryan	1	13.8	13.8
Upper McDonald Creek 41	8/26/2015	8:00	17:30	Laura Luther	1	9.5	9.5
	9/4/2015	7:30	11:15	Becky Williams	1	3.8	3.8
	9/10/2015	8:00	12:25	Donna Hathaway	1	4.4	4.4
	9/18/2015	12:00	15:30	Carleton Gritts	1	3.5	3.5
				Laura Luther	1	3.5	3.5
Total Surveys: 67							

Appendix 6: 2015 Pika Observer Involvement

Name	Group Size	Surveys	Survey Hours	Volunteer Hours
Andrews, Kirstan	1	1	7.0	7.0
Barrus, Nancy	1	1	9.5	9.5
Chinn, Bob	1	3	24.7	24.7
Chinn, Mary	1	2	15.2	15.2
Clothier, Susan	1	3	15.8	15.8
Donohue, Adelle	1	2	6.9	6.9
Faist, Michael	1	3	11.0	11.0
Flathead High School, 2015	15	4	9.0	9.0
Flesch, Elizabeth	1	10	50.4	50.4
Graves, Tabitha	1	1		0.0
Gritts, Carleton	1	1	3.5	3.5
Harkness, Sam	1	1	8.5	8.5
Hathaway, Donna	1	4	32.0	32.0
Igoe, Bill	1	2	18.1	18.1
Igoe, Kate	1	2	18.1	18.1
Kermath, Leslie	1	1	6.0	6.0
Lahr, Andrew	1	4	12.0	12.0
Luther, Laura	1	7	43.3	43.3
Martin, Joshua	1	3	22.0	22.0
Mayes, Diane	1	1	8.5	8.5
Miller, Emily	1	2	8.5	8.5
Montana Conservation Corps, Glacier Youth 2015	9	7	39.5	355.8
Moyer, Robina	1	1	7.0	7.0
Murphy, Carole	1	1	9.0	9.0
Murphy, Rick	1	1	9.0	9.0
Nelesen, Tom	1	1	7.5	7.5
Nelesen, Mary	1	1	7.5	7.5
Ryan, Sara	1	4	23.3	23.3
Siegler, Jeannie	1	8	41.1	41.1
Sierra Club, 2015	12	6	11.9	47.7
Wildlife Society, University of Montana	25	1	8.0	200.0
Williams, Becky	1	1	3.8	3.8
Total	89 Participants		497.4	1041.4



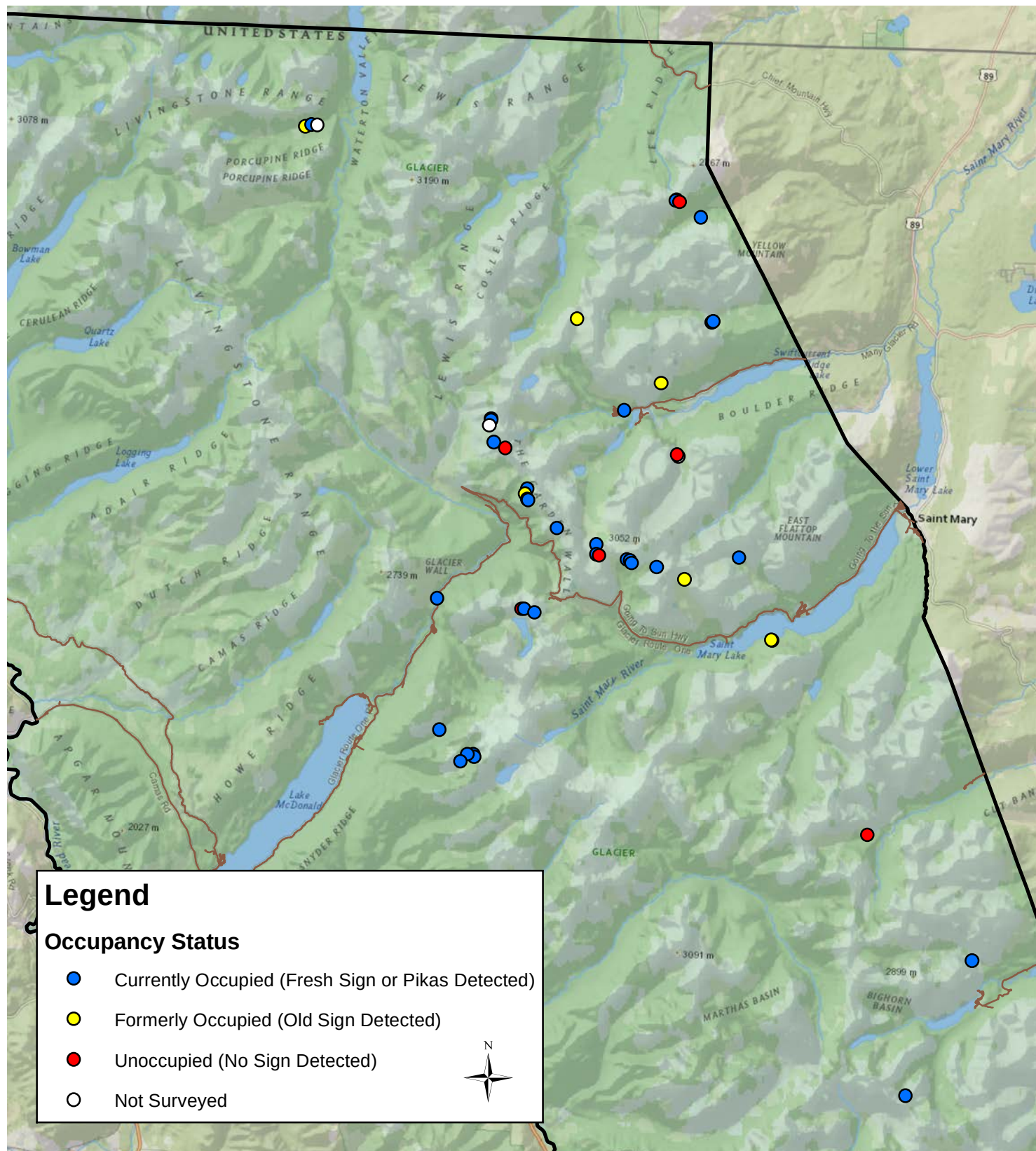
Pika Survey Site Results 2014



0 1.5 3 6 9 12
Miles



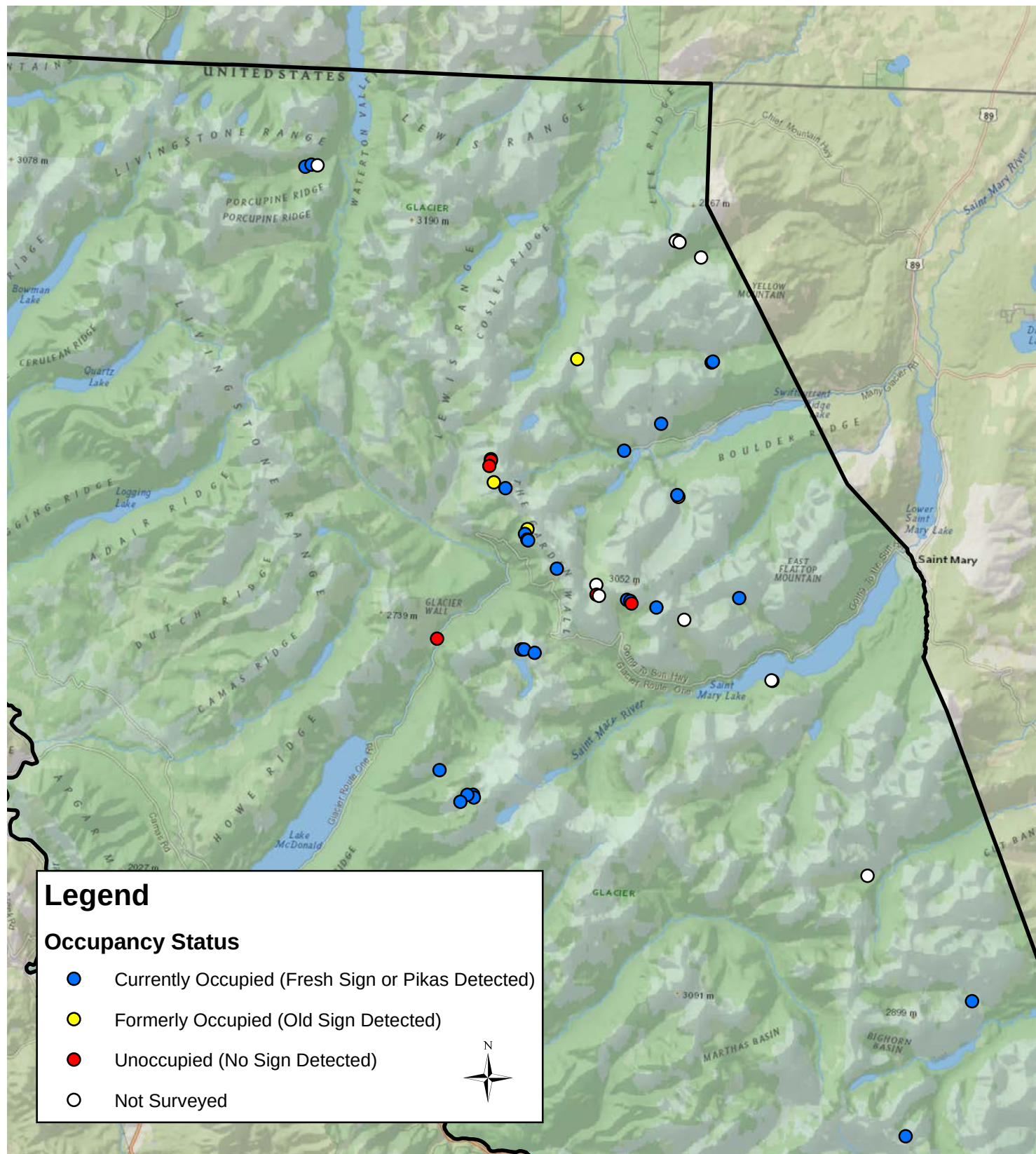
Pika Survey Site Results 2013



0 1.5 3 6 9 12
Miles



Pika Survey Site Results 2015



0 1.5 3 6 9 12
Miles

Invasive Plant Citizen Science Project: 2015

Abstract

Invasive plants are one of the greatest challenges facing land managers in the Crown of the Continent Ecosystem. Early detection of new invasive plants in GNP's backcountry is a high priority to ensure persistence of native plant communities. In 2008, Glacier National Park (GNP) established the Invasive Plant Citizen Science project. The primary goal is for citizen scientists to assist Glacier's Invasive Plant Management Team with early detection/rapid response by documenting invasive plants in locations that park staff cannot regularly survey. The Invasive Plant Citizen Science Project trains members of the public to detect and report the locations of target invasive plants in the backcountry and assists park managers with early detection of these plants in new locations. In 2015, Invasive Plant citizen scientists contributed 437 hours while conducting 32 invasive plant surveys in 23 areas throughout GNP. A total of 38 citizen scientists (including 30 Noxious Weed Blitz attendees) participated in surveying 208 miles of backcountry trails and hiking over 349 miles. Invasive plant species were reported in 19 of the 23 areas surveyed. Four of the five target species (spotted knapweed, Saint John's wort, oxeye daisy, and yellow toadflax) and two watch list species (orange hawkweed and yellow starthistle), and two additional species (Canada thistle and meadow hawkweed) were detected with a total area of approximately 201,784 square feet (4.6 acres). Citizen science programs in Glacier successfully provided educational outreach for park visitors and local communities, as well as collected baseline information. The Invasive Plant Citizen Science Project was successful in educating participants about the issue of invasive plants and how to identify them. The project also contributed valuable information through detection of new infestations of invasive plants in GNP's backcountry and documentation of spread in infestations that were known from previous years.

Introduction

Native plant communities are the foundation of the ecosystem. They stabilize the soil and provide nutrients and habitat for wildlife and insects. However, native plants are often outcompeted for soil moisture, nutrients and sunlight by invasive plants. Invasive plants decrease organic matter and soil nutrients, decrease native plant diversity, alter the structure of native plant communities and threaten the economy (Belt, LaFleur and Sladek 2009). Invasive plants have numerous competitive advantages including continuous seed production and long dormancy periods for seed in the soil, adaptation to a wide variety of growing conditions, and unique ways of dispersing and spreading. Invasive plants are one of the greatest challenges facing land managers in the Crown of the Continent Ecosystem. Glacier National Park (GNP) developed an Integrated Pest Management program in 1991, focused on managing invasive plants that are considered noxious weeds. A noxious weed is a classification determined by state law applied to a non-native plant that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses, or that may harm native plant communities.

Glacier NP hosts over 1,000 different types of plants, but our unique native flora has serious competition. There are currently 126 non-native plant species within the park. Many of them are not invasive, but the list does include 20 noxious weeds, or highly invasive plants that are a direct threat to the proliferation of native plant communities. GNP's Invasive Plant Management Team (IPMT) monitors and treats new and established infestations of invasive plants, but with over one million acres they need help to ensure that new invasive plants are detected before they

become established. In the front country and developed areas, where access by vehicle is easy and where invasive plants are more commonly introduced, detection and treatment is less of a challenge. In the backcountry, however, invasive plant detection and treatment involves a larger investment of time and resources. The IPMT identified early detection of new invasive plants in GNP's backcountry as a high priority. To fulfill the goal of increasing early detection of invasive plants in the backcountry GNP's Vegetation Specialist teamed up with the Crown of the Continent Research Learning Center to create Invasive Plant Citizen Science project.

In 2008, Glacier National Park (GNP) established the Invasive Plant Citizen Science project. The primary goal is for citizen scientists to assist Glacier's Invasive Plant Management Team with early detection/rapid response by documenting invasive plants in locations that park staff cannot regularly survey. The Invasive Plant Citizen Science Project trains members of the public to detect and report the locations of target invasive plant species in the backcountry and assists park managers with early detection of these plants in new locations. Citizen scientists learn how to identify five species of noxious weeds that are already well-established in Glacier as well as three additional watch-list species that are new invaders in GNP or have been found in locations near Glacier's borders. Having the additional eyes of citizen scientists on Glacier's plant communities can help Glacier's Invasive Plant Management Team become aware of and treat new infestations before they become established. The project also helps educate community members and visitors about invasive plants which are a threat to Glacier.

Study Area

Glacier NP contains 4,081 km² of federally protected land situated in the northern Rocky Mountains, Montana, USA. Glacier NP hosts over 1,000 plant species including 126 non-native plants. Of those non-native species, 20 species are noxious weeds. The project doesn't assign locations to monitor, but rather asked people to choose locations on their own. Therefore, our study area included all trails and off-trail areas where participants conducted surveys.

Methods

Survey site selection

Because the goal is to increase early detection of plants in the backcountry, we asked people to hike any trail in GNP and document whether they detected one of the target invasive plant species. On occasion, we also targeted participants who were going into remote areas that get infrequent coverage by GNP's IPMT and other staff, and asked them to conduct invasive plant surveys for that area, using a standardized survey form and accompanying protocol (Appendix 1).

Selection of target invasive plant species

While many non-native invasive species grow in the park, we asked participant to focus on detection of five target species and three additional watch-list species. We limited the number of species in order to make it manageable for participants and ensure that they would be able to learn how to properly identify each species to avoid data quality issues. The five target species are Spotted Knapweed (*Centaurea maculosa*), Oxeye Daisy (*Leucanthemum vulgare*), Houndstongue, (*Cynoglossum officinale*), St. Johnswort (*Hypericum perforatum*) and Yellow Toadflax (*Linaria vulgaris*). These five chosen species threaten many native plant communities in the park and are easy to identify. Additionally, these species may bloom into the fall making

them easier to detect than early blooming species that may have already gone to seed before many of GNP's trails are easily accessible to hikers. The three watch-list species are Yellow Starthistle (*Centaurea solstitialis*), Orange Hawkweed (*Heiracium aurantiacum*) and Blueweed (*Echium vulgare*). Orange Hawkweed is a relatively new invader in GNP and is spreading rapidly. Blueweed is also a new invader and has so far been detected only in the Belly River area of GNP. Yellow Starthistle is a highly invasive and detrimental species that GNP wants to be certain to detect immediately if it shows up in the area.

These invasive plant species pose many threats to GNP's ecosystem and this program provides an opportunity for raising awareness among the public about those threats. For example, invasive plants like St Johnswort decrease forage for livestock and wildlife. Spotted Knapweed and Houndstongue out-compete native plants by having deep taproots that take up water and nutrients more efficiently. Rhizomatous plants like Oxeye Daisy "choke" out native species by forming dense vegetation mats. In healthy native plant communities a variety of root systems hold the soil in place, but when a single invasive plant such as Orange Hawkweed dominates, only one type of root is present. This often leads to soil erosion, which threatens water resources. Some invasive plants, such as Spotted Knapweed, also secrete chemicals into the ground through their roots that prevent seed germination of other plant species nearby.

Citizen scientist involvement

Citizen science volunteers were recruited and coordinated to complete invasive plant surveys throughout Glacier National Park. To ensure accurate data collection, volunteers were asked to complete a citizen science training session to learn to identify targeted invasive plants and map their locations while hiking in Glacier's backcountry. Participants interested in getting involved with our Invasive Plant Citizen Science Project were trained in one of two ways; by completing our on-line training session at http://www.nps.gov/glac/naturescience/ccrlc-citizen-science_weeds.htm, or by attending our Annual Weed Blitz in late July.

We conducted all training sessions in-person prior to 2011, but lacked the personnel to continue that approach. We wanted to continue providing training opportunities without a significant investment in staff time. In 2012, we launched an on-line training to make it easier for participants to attend training on their own schedule. The on-line training also provided an opportunity to engage short-term visitors, school groups and other outreach groups who were unable to make it to scheduled in-person training sessions. In 2012, CCRLC staff also developed a podcast (<http://www.crownsience.org/node/1238>) to provide more information about the Invasive Plant Citizen Science Project and to recruit more participants.

The Invasive Plant Citizen Science on-line training session is a downloadable Power Point presentation that teaches participants why invasive plants are a threat, how to identify the target species and how to conduct surveys. After the training, participants were asked to complete a ten question quiz in a second downloadable Power Point presentation. Participants were required to complete the following steps in order to be able to conduct surveys

1. Complete the Invasive Plant Citizen Science Training.
2. Print the Quick Identification Card (Appendix 2) or the Field Identification guide booklet ([Invasive Plants of the Crown of the Continent](#)).
3. Complete Invasive Plant Citizen Science Quiz.

4. Contact project coordinator to let us know you have completed the training.

Once they completed the training session, we provided them with survey forms via email and answered any additional questions. We instructed them on how to coordinate with us to borrow a GPS unit, or how to use their own if they had one by setting the datum to NAD83. We then asked them to choose trails to hike based on their schedule, hiking ability, and preference. We asked participants to try to complete a minimum of three surveys.

Many participants indicated that they would like to assist with treatment of invasive plants that they detect in the backcountry through hand-pulling. Glacier NP's Vegetation Specialist provided the following guidelines to facilitate their efforts while ensuring that participants did not mistakenly pull native species.

- Is it a small infestation of the targeted invasive plant(s)?
- Are you 100% sure that you have correctly identified the plant?
- If so, you may hand pull or remove the flowering head.
- Please remove all parts of plant (especially if buds, flowers or seeds are present), and carry out in a plastic bag.
- Please submit a photo of the invasive plant you pulled to confirm identification, and please indicate on your survey form in the comments section, that you have hand pulled or removed flower heads in that patch

Invasive plant monitoring

Citizen scientists searched for five targeted invasive plants and three additional watch list species while hiking along trails and reported any invasive plants that they detected or to completed a report with "No invasive plants detected" if none were detected during their survey. Locations of any invasive plants detected were recorded with GPS units, size of patch and number of plants was estimated, and distribution and stage of growth was recorded on the Invasive Plant Citizen Science survey form. We asked citizen scientists to take verification photos of all species using a digital camera, whenever possible. We also asked participants to submit comments about location of patch, observations of animal browsing on invasive plants and other details about their detections.

After data forms were submitted, citizen science staff worked to ensure data quality by double-checking that data sheets were completed correctly, verifying correct species identification in photos, and contacting volunteers with any questions regarding questionable observations. Citizen science staff then sent copies of all data sheets to GNP's IPMT staff who entered all data into a Microsoft Access database.

Annual Noxious Weed Blitz

Every year since 2012, the Citizen Science Program and GNP's Vegetation Specialist have coordinated a Noxious Weed Blitz event. This event provides an opportunity to facilitate volunteer participation, education and engagement, and to engage the public in assisting with invasive plant treatment through hand-pulling. Participants were recruited to attend the Weed Blitz through a press release and a flyer (Appendix 3) posted in locations throughout the Flathead Valley and East Glacier and St Mary areas. Glacier NP's Volunteer Program

Coordinator also recruited participants from outreach groups who were planning to be in the Park and were interested in conducting a service project during that time.

During the Weed Blitz, staff provided background information on the IPMT program and the Citizen Science Program. Glacier NP's Vegetation Specialist taught participants about invasive plants and identification through a PowerPoint presentation during a morning classroom session in the Community Building. After lunch, we split the participants up into smaller groups to take to field location within short walking or driving distance from the Community Building. Citizen Science staff instructed the groups on how to complete survey forms and how to use GPS units. At field locations, staff showed participants how to identify invasive plants and assisted them with hand-pulling and bagging. We also demonstrated the Invasive Plant survey protocol to participants by conducting an actual survey.

Results

Citizen Science Involvement

In 2015 Invasive Plant citizen scientists contributed 437 hours for invasive plant surveys (Appendix 4). A total of 38 citizen scientists (including 30 Noxious Weed Blitz attendees) conducted invasive plant surveys (Appendix 5). Citizen scientists completed 32 invasive plant surveys in 23 areas throughout GNP.

Attendees at the Weed Blitz included a Glacier Youth Conservation Corps group of 6 and a Boy Scout troop of 12. Three participants notified us that they had completed training on their own using the on-line training module before their visit to the park. Of these, only one participant submitted an invasive plant survey after completing training. Several people inquired about the on-line training and it is likely that additional participants completed the on-line training but they did not notify us as requested in the training materials.

Invasive Plant Monitoring

During the 2015 season, citizen scientists surveyed 208 miles of backcountry trails, hiking over 349 miles. Targeted invasive plant species were reported on 19 of the 23 trails surveyed (Table 1). Four of the five target species (spotted knapweed, Saint John's wort, oxeye daisy, and yellow toadflax) and two watch list species (orange hawkweed and an unconfirmed report of yellow starthistle), and two additional species (Canada thistle and meadow hawkweed) were detected with a total area of approximately 201,784 square feet (4.6 acres) (Appendix 4).

The treatment for these infestations will vary by species and would include hand pulling the entire plant or cutting and bagging the flower heads. This work will be done by the Integrated Pest Management (IPM) crew, backcountry rangers, volunteers and other park employees. Priorities will depend on the species and the size of the infestation and the effectiveness of hand pulling or cutting off the flower heads.

Discussion

Citizen science programs in Glacier successfully provided educational outreach for park visitors and local communities, as well as collected baseline information. We also engaged a large number of participants in learning about invasive plants and the threat they pose to the ecosystem. The annual Noxious Weed Blitz continues to be our most successful venue for

engaging participants in the Invasive Plant Citizen Science Project and should be continued and possibly expanded in future years.

To enhance the value of this project's contribution to GNP's IPMT program we need to continue to improve the way in which we engage volunteers beyond the Noxious Weed Blitz. The on-line invasive plant training was established to make it easier for short-term visitors to participate and to encourage participants in other citizen science projects to also conduct weed surveys while they are on the trails. The online training had a low participation rate this year. Only three people reported completing the online training; of these, only one submitted any surveys.

Another way to promote increased participation is to encourage the use of new technologies for documenting invasive plants. The National Park Service is developing an app called IP Alert that would facilitate mobile app mapping of invasive plants. Glacier NP has been included as a pilot park and we have beta tested the on-line database and provided feedback. Currently, the app is still under development and we are awaiting the release to continue beta testing. If the app seems user friendly and provides data in a format that is useful to the GNP IPMT crew, we will implement use of the app.

Citizen Science program staff will meet with GNP IPMT crew leaders to determine what changes to make to the program in future years to increase the amount of useful data that is contributed by citizen scientists. We will discuss ways to expand the Noxious Weed Blitz, and whether a new format for the on-line invasive plant training is warranted.

Works Cited

Belt, J.B., D. LaFleur and M. Sladek. 2009. Invasive Plants of the Crown of the Continent. West Glacier, MT: Crown of the Continent Research Learning Center and Crown Managers Partnership.

GLACIER NATIONAL PARK INVASIVE PLANT CITIZEN SCIENCE SURVEY FORM

Site Name: _____ Date: ____/____/____ Name of Observer(s): _____
 Citizen Science Hours (includes driving, hiking & survey time): _____ Time at start of day: _____ Time at end of day: _____
 Trail hiked: _____ Start Location: _____ End Location: _____ Number of Miles: _____
 GPS make and model: _____ GPS Datum: NAD 83 (select if using Citizen Science GPS unit) _____ NAD 27 _____ Other: _____

Invasive plants and codes:

Spotted Knapweed = **CENMAC**

Oxeye Daisy = **CHRLEU**

Houndstongue = **CYNOFF**

*Yellow Starthistle = **CENSOL**

St. Johnswort = **HYPPER**

Yellow Toadflax = **LINVUL**

*Orange Hawkweed = **HEIAUR**

*Blueweed = **ECHVUL**

*Additional species to report if you are able identify them

**List other invasive plants you can identify with certainty by common or scientific name

Patch	Species	Length of patch (ft)	Width of patch (ft)	Distribution	# of plants	UTM easting from GPS unit	UTM northing from GPS unit	Error (ft)	Stage of growth	Photo taken (y/n)	Comments: (include landmarks to locate patch, observation of animal browse on invasive plants, etc.)

- **Patch-** denotes the first location you see an invasive plant species or group of species
- **Species-** use codes above to list all species in patch that you can correctly identify
- **Length and Width-** Estimate the length and width of the area covered by each species in the patch.
 If the patch is too large to measure, record a beginning and ending UTM coordinate for length, then estimate the width of the infestation.
- **Distribution- choose one:** scattered (across patch); clumped; continuous cover (covering all ground); isolated individual; isolated clump
- **# of plants- choose one:** 1plant; 2-10; 11-20; 21- 50; 51-200; over 200
- **UTM easting, UTM northing and Error-** record this from the satellite page of your GPS. This info is critical- please record whenever possible.
- **Stage of growth- choose one:** rosette (first year growth of leaves only); bud; flowering; seeding
- **Please send completed survey forms and photos to Glac_Citizen_Science@nps.gov; or GNP-CCRLC, P.O. Box 128, West Glacier, MT 59936, or fax to (406)888-7903**

Invasive plants and codes:Spotted Knapweed = **CENMAC**Oxeye Daisy = **CHRLEU**Houndstongue = **CYNOFF***Yellow Starthistle = **CENSOL**St. Johnswort = **HYPPER**Yellow Toadflax = **LINVUL***Orange Hawkweed = **HEIAUR***Blueweed = **ECHVUL**

*Additional species to report if you are able identify them

**List other invasive plants you can identify with certainty by common or scientific name

Patch	Species	Length of patch (ft)	Width of patch (ft)	Distribution	# of plants	UTM easting from GPS	UTM northing from GPS	Error (ft)	Stage of growth	Photo taken (y/n)	Comments: (include landmarks to locate patch, observation of animal browse on invasive plants, etc.)

- **Patch-** denotes the first location you see an invasive plant species or group of species
- **Species-** use codes above to list all species in patch that you can correctly identify
- **Length and Width-** Estimate the length and width of the area covered by each species in the patch.
If the patch is too large to measure you can estimate the acreage of the unit or record a beginning and ending UTM coordinate
- **Distribution- choose one:** scattered; clumped; continuous cover; gradient (denser on one side); isolated individual; isolated patch
- **# of plants- choose one:** 1plant; 2-10; 11-20; 21- 50; 51-100; 101- 200; over 200
- **UTM easting, UTM northing and Error-** record these numbers from the satellite page of your GPS unit.
- **Stage of growth- choose one:** rosette (first year growth of leaves only); bud; flowering; seeding
- **Please send completed survey forms and photos to [Glac Citizen Science@nps.gov](mailto:Glac_Citizen_Science@nps.gov); or GNP-CCRLC, P.O. Box 128, West Glacier, MT 59936, or fax to (406)888-7903**

Invasive Plant Citizen Science Quick Identification Card



Why worry about invasive plant species?

Glacier National Park's native plant communities stabilize the soil and provide nutrients and habitats to other plants, animals and insects. Invasion from non-native plants threatens the ecosystem's biodiversity. Most infestations of invasive plants in Glacier are closely correlated to disturbed areas, but backcountry trails are also threatened. We need your help to detect the spread of invasive plants.

St. Johnswort *Hypericum perforatum*

- Yellow flowers with black dots at petal edge
- Oval leaves with tiny transparent dots
- Rust colored stems
- Native alpine look alike



St. Johnswort

Leaf



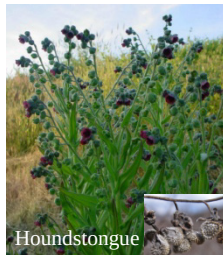
Yellow Toadflax

Yellow Toadflax *Linaria vulgaris*

- Yellow flowers with orange center
- Stems have many narrow, waxy leaves
- Pale green leaves, pointed at both ends

Houndstongue *Cynoglossum officinale*

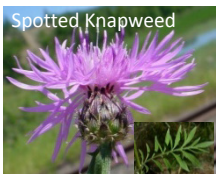
- Red-purple flowers, 5 petals on branched tips
- Bur-like seeds stick to clothing and fur
- Stem leaves alternating and have soft hair



Houndstongue

Burs

Spotted Knapweed *Centaurea biebersteinii*



Spotted Knapweed

Stalk

- Pinkish-purple flowers with terminal heads
- Rosette leaves deeply lobed and grayish-green
- Floral bracts with triangular, brown tips and comb-like fringe

Oxeye Daisy *Leucanthemum vulgare*

- White daisy-like flowers with yellow center
- Leaves with wavy margins
- Stalked basal leaves, stem leaves clasping base



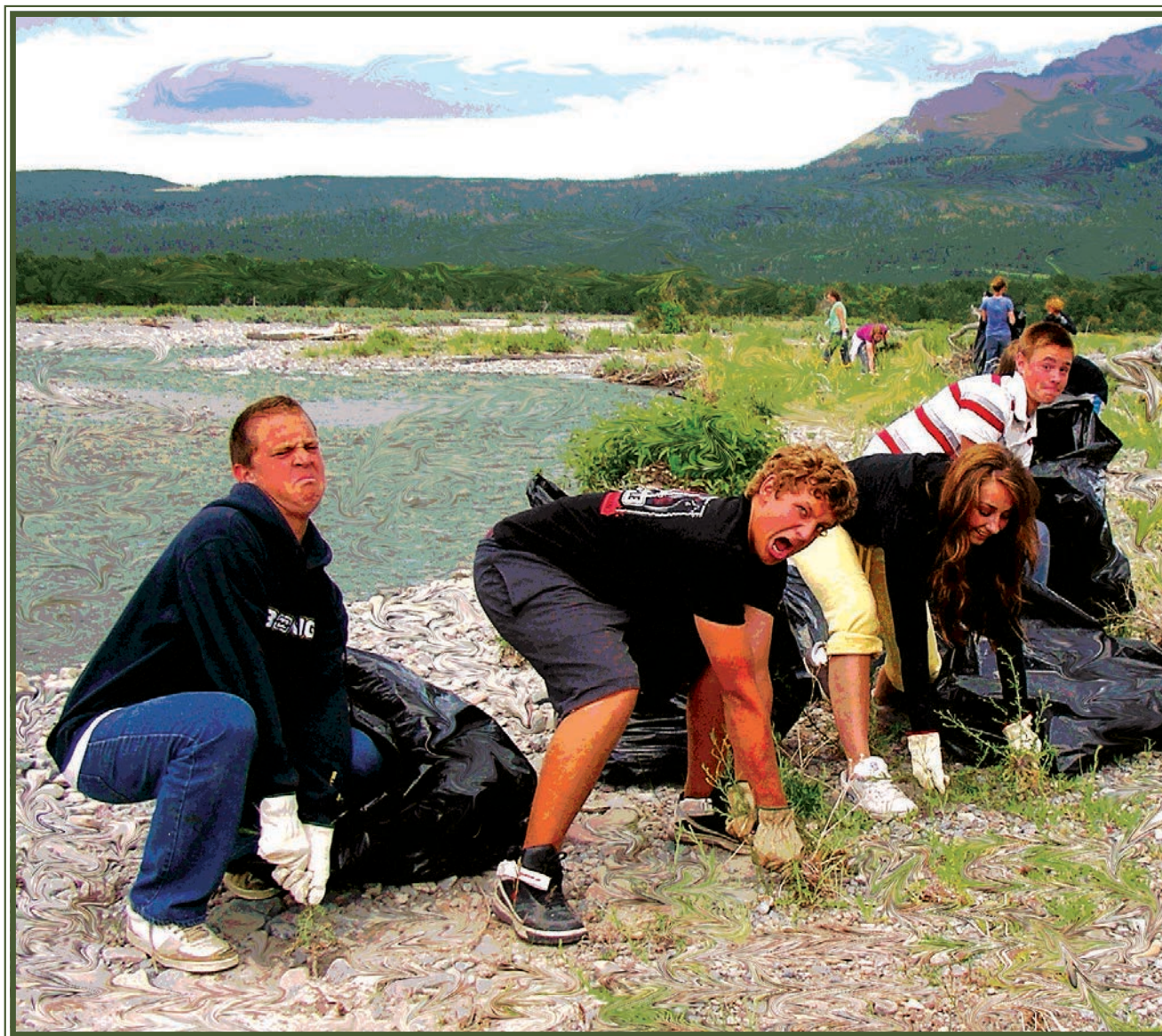
Oxeye Daisy

Leaf

Please help us by reporting location of those plants. Contact the Research Learning Center at glac_citizen_science@nps.gov or 406-888-7986



Weed Warriors Wanted!



Help us Preserve Glacier's Diverse Community of Native Plants!

Join us for Glacier National Park's sixth annual Noxious Weed Blitz! We will learn how to identify 5 targeted invasive plant species in the morning followed by mapping and pulling weeds in the afternoon. Please bring gloves, appropriate footwear, and drinking water.

Tuesday, July 21, 2015 10:00 a.m. – 4:00 p.m.

Community Building, West Glacier, MT

Lunch provided by the Glacier National Park Conservancy!

Please RSVP to glac_citizen_science@nps.gov or 406-888-7986

2013 Invasive Plant Participants				
Participants	Number of surveys	Number of people in group	Appreciation certificate sent	Notes
Bev O'Brien	3	1		
Bill O'Brien	3	1		
Bob Chinn	1	1		
Brian Johnson	6	1		
Dee Blank	1	1		
Elizabeth Flesch	2	1	n/a	
Flathead High School	1	9	n/a	
Heather Jameson	2	1		
Jami Belt	3	1	n/a	
Jeannie Siegler	3	1		
				additional participants (Jonathan Hickling, C. Hudel)
Julie Bennett-Hudel	13	3		
MCC crew	5	10		
Racheal Headley	1	1		
Sonja Hartmann	1	1		
Weed Blitz Participants	1	11	n/a	
Total Participants		44		

2015 Invasive Plant Surveys

2015 Invasive Plant Surveys																							
		Target	Survey	Group	Total		Total		Area		Area	CHRLE	Area		Area		Area	HEIAU	Area		Area		Area
Trail Name or Site	Surveys	weeds found	Hours	Size	Hours	Miles	Miles	HYPPER	(ft^2)	CENMAC	(ft^2)	U	(ft^2)	CENSOL	(ft^2)	LINVUL	(ft^2)	R	(ft^2)	CIRARV	(ft^2)	HIECEA	(ft^2)
Granite Park Loop	1	TRUE	6	1	6	4	4	TRUE	500											TRUE	3600		
Trout Lake to Arrow Lake	1	FALSE	10	1	10	4.6	4.6															TRUE	300
Elizabeth, Cosley, Mokowanis Lake Trails	2	TRUE	24	1	24	34	34											TRUE	150	TRUE	38531		
Logging Lake Trail	1	TRUE	11.5	1	11.5	26.4	26.4											TRUE	24	TRUE	500		
Jackson Overlook to Lake McDonald	1	FALSE	40	1	40	20	20													TRUE	64000		
Pitamakin Pass	1	FALSE	8	1	8	7	7																
Boundary Trail	2	TRUE	8	1	8	12	12	TRUE	6150			TRUE	1010	TRUE	1					TRUE	150		
Huckleberry Trail	1	TRUE	3.5	1	3.5	6	6					TRUE	3100										
Lake McDonald Trail	1	TRUE	5.25	1	5.25	4	4	TRUE	300	TRUE	300	TRUE	1										
Rocky Point Trail	2	FALSE	1	1	1	1.9	1.9																
Sperry from McDonald																							
Lodge to Fish Lake	1	TRUE	6	1	6	6	6	TRUE	100	TRUE	500	TRUE	400							TRUE	100		
Avalanche Trail	2	TRUE	8	2	16	10	20					TRUE	1901					TRUE	625	TRUE	2300		
Upper McDonald Creek	1	TRUE	6	1	6	5	5	TRUE	1500			TRUE	100							TRUE	100		
Apgar Lookout	2	TRUE	15	1	15	10	10	TRUE	10200			TRUE	6597					TRUE	185				
Running Eagle Falls Trail	1	FALSE	4	1	4	1	1																
Rocky Point & Mdconald Lake	1	TRUE	3	1	3	8	8									TRUE							
Iceberg Lake Trail	2	TRUE	14.3	2	28.6	19.4	38.8			TRUE	2600	TRUE	1			TRUE	145						
Apikuni Falls Trail	1	TRUE	3.7	2	7.4	4	8			TRUE	2550												
Preston Park	1	TRUE	9.25	2	18.5	7	14					TRUE				TRUE	750						
Grinnel Lake Trail	1	TRUE	9.25	2	18.5	6.8	13.6			TRUE	12	TRUE	30										
Flattop Mountain Trail	1	TRUE	5.5	2	11	4.5	9	TRUE	4046	TRUE	300	TRUE	5087					TRUE	215	TRUE	29001		
Weed Blitz Sites	4	TRUE	6	30	180	3	90																
North Fork Rd and Howe Ridge	1	TRUE	6	1	6	6	6	TRUE	100			TRUE	10622							TRUE	3100		
Totals	32				437.25	210.6	349.3																
Sites with Target Weed								8		6		12		1		3		5		10		1	
Total Area Each Weed									22,896		6,262		28,849		1		895		1,199		141,382		300
Toral Area All Weeds	201,784																						
Species Abbreviation Key																							
Spotted Knapweed	CENMAC																						
St. Johnswort	HYPPER																						
Oxeye Daisy	CHRLEU																						
Yellow Toadflax	LINVUL																						
Orange Hawkweed	HEIAUR																						
Yellow Starthistle	CENSOL																						
Canada Thistle	CIRARV																						
Meadow Hawkweek	HIECEA																						

Appendix 5: 2015 Invasive Plant Observer Involvement

[illegible]

Common Loon Citizen Science Project: 2015

Abstract

The Common Loon (*Gavia immer*) is considered a Species of Special Concern by Montana Fish Wildlife and Parks, due to the species' sensitivity to disturbance during nesting season and its low reproductive and recruitment rates. In 2006, GNP established the Common Loon Citizen Science project to train volunteers and GNP staff to gather baseline data on population and distribution of common loons, to improve accuracy during an annual Loon Day count, and to increase survey coverage of lakes with loons. In 2015, 129 citizen scientists contributed 3298 hours and completed 316 loon surveys. Forty-four of the 45 priority lakes were surveyed at least three times including all priority 1, 2 and 3 lakes. The season-long loon population estimate was 54 resident adults (14 pairs and 26 singles) and six chicks in five successful broods on five lakes. During loon days, 45 adults (11 pairs and 23 singles) and five chicks in four successful broods on four lakes were observed. Chick production was slightly below average this year, with six chicks detected. The long-term trend indicates that the number of common loons detected in GNP is increasing, but it is unclear whether that is a result of increased chick production or better detection of chicks. The fecundity rate of GNP's loon population (0.48) is near the minimum required maintain a stable population and is lower than the fecundity rate of Montana's common loon population as a whole. Chick hatch dates were pinpointed to within three weeks at three of five lakes with successful nesting, providing an invaluable resource for managers aiming to prevent nest disturbance. More frequent monitoring is needed to refine chick hatch dates and find both successful and unsuccessful nests. This information will allow us to better detect disturbance patterns and to track changes that may occur with life cycle timing due to climate changes. The project will continue during the summer of 2016.

Introduction

The Common Loon (*Gavia immer*) is considered a Species of Special Concern by Montana Fish Wildlife and Parks, due to the species' sensitivity to disturbance during the nesting season and its low reproductive and recruitment rates. Common loons in northwest Montana, including GNP's population, exist on the southern periphery of their range, making them potentially vulnerable to range contraction. Common loon breeding habitat, once present as far south as Utah and California, is now restricted to lakes in the forested regions of Alaska, Canada and the northern-most states in the continental U.S (McIntyre and Barr 1997). Additionally, common loons are expected to decline significantly in abundance under all climate change scenarios (Rodenhouse et al. 2008).

Due to concerns about the nationwide decline of loon populations, the Montana Loon Society established the first systematic breeding survey or "Loon Day" in 1986, and GNP joined the effort in 1988. Results from GNP's Loon Day from 1988-2004 raised concerns that the common loon population in GNP may have lower reproductive rates than what is necessary to maintain a stable population. Reproductive rate calculations rely on accurate data on territorial pairs, but single surveys like Loon Day cannot adequately distinguish visiting loons from territorial pairs, nor detect all loons (Belant et al. 1993). To determine whether Glacier's population was stable GNP needed more information than what could be provided in a single-day survey conducted largely by untrained volunteers.

In 2005, GNP began the Common Loon Citizen Science project to train volunteers and GNP staff to gather baseline data on population and distribution of common loons, to improve accuracy during the annual Loon Day count, and to increase survey coverage of lakes with loons. The project was established as a season-long effort in 2006. The primary project goals are to: 1) gather season-long information to gain a better estimate of population health, and 2) begin to identify factors affecting nesting success. Documenting chick loss is a critical factor in determining nesting success rates especially in Montana, with its average statewide production of about 35 chicks per year (Hammond 2009). Therefore, another goal of the project is to document nest success and chick survival rates.

Glacier National Park contains 45 lakes with suitable habitat for loon breeding or foraging. Montana supports the largest breeding population of common loons in the western continental U.S. (Hammond 2009) and GNP harbors approximately 23- 32% of Montana's breeding loons, according to data from the Common Loon Citizen Science project in GNP from 2005- 2015. Glacier has an average of 44 adult loons and eight chicks hatched each year. Less than 20% of the loon chicks born in Montana will survive to return to Montana after migrating to the coast as mature breeding age loons (Hammond 2009). When those loons do return, after they have attained adult plumage at three years of age, they will need to establish a new breeding territory, usually dispersing less than ten miles from their natal lake (Montana Partners in Flight Bird Conservation Plan 2000). Average age at first successful breeding is around seven years. Loons looking for new territories rarely return to lakes more than 40 miles from their natal lake, which makes this species poor at pioneering or re-inhabiting vacant territories unless they are adjacent to existing, successful territories. Nesting pairs are also highly territorial which limits the number of suitable lakes that are available to loons looking for new territories. Determining whether successful territories persist in each breeding area is critical. For these reasons, Glacier NP's Common Loon Citizen Science Project emphasizes monitoring on lakes with historic nesting records and new territorial pairs to obtain information about which breeding areas produce chicks that will be able to disperse to vacant territories.

Locating loon nests and monitoring them to determine whether they successfully hatch and fledge chicks are additional priorities of the Common Loon Citizen Science Project. Loon pairs often re-establish territories, and will often use the same nest site year after year if no significant habitat change has occurred. Keeping records of all nests located by citizen scientists and staff, as well as nest initiation dates and chick hatch dates, provides a valuable resource for advising managers on how to avoid disturbance at nest sites.

Loon nests are susceptible to water level fluctuations, predation, and nest site disturbance. While the first two threats are natural occurrences in GNP, nest disturbance by humans is of primary concern. If loons are disturbed and leave the nest, the eggs are vulnerable to predation and may become chilled if the adults are absent for an hour or more. Citizen Science volunteers document loon disturbance behaviors that they observe and concurrent activities on the lake to help us look for patterns of disturbance and nest failures.

Newly hatched chicks remain vulnerable for the first 4 weeks after hatching. During this time, the loon pair often moves the chicks to a nursery area, characterized as a shallow backwater or protected cove with abundant small fish and insects. Citizen scientists document the location of nursery areas and monitor lakes with nests and chicks more frequently in order to document hatch dates and chick survival. In GNP, where loons exist amidst nearly two million visitors per year, it is critical to monitor the long-term success of the populations and be aware of the impact visitors and other potential threats may be having on loon reproduction.

We provide information about nest and nursery area locations to inform GNP's compliance team and other work crews (trails, fisheries, backcountry rangers etc.) about sensitive areas that may be impacted by maintenance activities, infrastructure, projects or management or recreational activities within the park. The data are also shared with the Common Loon Working Group, a group of government agencies and non-government organization who collaborate on loon management in Montana including GNP, Montana Department of Fish, Wildlife and Parks (MTFWP), US Forest Service, Montana Department of Natural Resources, US Fish and Wildlife Service, and Confederated Salish and Kootenai Tribes, Plum Creek Timber Company, the Montana Loon Society and other interested citizens and organizations.

The objectives of the loon monitoring program from 2006- 2015 are to

- Enlist the help of volunteers and GNP staff to improve accuracy and increase coverage on 45 priority lakes throughout the nesting season.

- Survey 45 lakes to gather season-long information to gain a better estimate of population health and reproductive rate.
- Map locations of territories, nests, and nursery areas.
- Document disturbance behaviors to begin to identify factors affecting nesting success.

Study Area

Glacier NP contains 4,081 km² of federally protected land and is situated in the northern Rocky Mountains, Montana, USA. Glacier NP's is divided lengthwise by the Continental Divide, with water flowing into the Pacific, Atlantic Oceans and Arctic oceans (via Hudson Bay as an Arctic tributary). Most lakes in GNP were formed by glaciation and many of these are paternoster lakes, or one of a series of glacial lakes connected by a single stream system. Wetland lakes also occur as well as two lakes that have been augmented by concrete or earthen dams. Glacier NP maintains an extensive network of >1,127 km of hiking trails which access most survey lakes. Our study area included all lakes within the park that were over ten acres in size and under 5200 feet as well as a small number of lakes that did not meet these criteria but were adjacent to suitable breeding lakes or had historic records of loon observations.

Methods

Lake selection

Common loons breed on inland freshwater lakes in boreal and mixed forest. Common loons in Montana tend towards isolated clear water lakes of at least ten acres in size and below 5200' elevation (Hammond 2009). The lake must be also long enough to facilitate landings and take-offs. Ideal habitat includes deep-water and shallow-water areas, islands and areas that allow protection from winds and waves. Loons also require ample fish or invertebrate populations for food, along with abundant water plants and shoreline vegetation for nest building. When GNP began conducting Loon Day surveys in 1988, former wildlife biologist Steve Gniadek listed all lakes meeting these criteria as well as a small number of lakes that did not meet these criteria but were adjacent to suitable breeding lakes or had historic records of loon observations. Upon starting the Common Loon Citizen Science Project in 2005, S. Gniadek reviewed Loon day data from 1988- 2004 and created five lake status categories that were similar to those used by the Common Loon Working Group. The categories set priorities for which lakes should be monitored most frequently and are as follows:

Priority 1: Nesting attempted in the last five years, as evidenced by presence of brood or observation of nesting behavior.

Priority 2: Nesting records exist, but nesting attempts have not been recorded in the previous 5 years.

Priority 3: Lake has been occupied during the nesting season sometime in the previous 5 years by a pair.

Priority 4: Additional lakes with potential breeding habitat (over 10 acres in size and at elevations less than 5200 feet).

Priority 5: Additional lakes under 10 acres and/or at elevations over 5200 feet.

Each year lake status is reviewed based on the previous years of data and the priority list is updated. The 2015 priority lakes are listed in Appendix 19.

Citizen scientist involvement

We recruited and coordinated volunteers and GNP staff to complete loon surveys throughout GNP. To ensure accurate data collection, participants were asked to attend a six hour citizen science training session. Citizen science staff provided background information on common loon ecology, threats and management concerns, status and identification and important behaviors to report through a PowerPoint presentation. Staff also showed the survey protocol to participants in the field by conducting an actual survey. Staff sought to increase accuracy of information reported about nesting, chick rearing and courtship by conducting advanced training sessions for any interested participants who had conducted at least three surveys in prior years. After completion of training, citizen scientists borrowed NPS survey

equipment including binoculars, scopes, GPS units and lake maps to complete loon surveys independently, using a standardized protocol and survey form (Appendix 1).

Season-long loon monitoring

Citizen science volunteers went into the field throughout the nesting season (May through September) to monitor one or more of Glacier's lakes to document loon occupancy and behavior. The goal was to monitor each of the priority 1, 2 and 3 lakes at least three times during the nesting season; once prior to Loon Day, once during Loon Day (July 18-19, 2015), and once after Loon Day. Priority 4 and 5 lakes were also monitored at least once during Loon Day, and ideally at least 3 times whenever possible. In September and October in Montana, adult Common Loons gather on staging lakes in preparation for the fall migration which typically takes them to the Pacific Coast, so monitoring typically ends by the end of September.

The preferred standard for selecting a lake to survey was to contact the Project Coordinator at least three days prior to the survey date to find out which lakes needed to be surveyed. A checklist of the 45 priority lakes was kept to keep track of each of the minimum surveys needed. Loon observations were collected in two separate formats. Trained observers filled out a "Glacier Loon Observation Form" and a localized topographic map for each lake they visited. Loon observations or absence of loons reported by untrained observers were entered onto a Wildlife Observation Form (r-10) either by the observer him/herself or by the project coordinator when reports were given to her verbally or via email. All Wildlife Observations Forms were entered into the GNP Loon Survey Access database and were also submitted for data entry by GNP wildlife staff.

Loon Days event

Each year GNP participates in Montana Loon Day, an annual statewide common loon population count that takes place in mid-July after most chicks have hatched. Loon Days has taken place in GNP every year since 1988 and provides a long-term record of the loon population during that time period. Loon Day took place on July 18-19 in 2015. All surveys must be completed during that time period to be counted for this annual population snapshot. During Loon Day in Glacier volunteers and Park staff survey each of the 45 high priority lakes that have been identified as potential common loon nesting or foraging habitat. Some lakes were surveyed independently by more than one surveyor (or group of surveyors) to ensure that we get the most accurate results. We planned for double coverage for such situations as lakes that are large and hard to survey or cases where surveyors were new to the project. When double coverage occurred, the survey that was most consistent with season-long results, or the one that had the best coverage was the one that was used for the Loon Day tally.

Spring loon surveys and nest monitoring

Territorial pairs arrive in Montana in April and begin nesting in early May. Priority 1 and 2 lakes were targeted for monitoring as many times as necessary to determine nesting or territory status beginning in mid-May (or as soon as they are accessible before mid-June). Like Loon Day in July, this "Spring Loon Survey" period is also conducted by loon area coordinators throughout the state and helps prioritize which lakes to monitor more frequently for the duration of the nesting season. Nest searching involved watching for behaviors that suggest nesting may be occurring and then looking for loons on land. Nesting behaviors include loons localizing near shore, courting, or only one loon present where a pair was previously present. Loons only leave the water during copulation, nest testing, nest building, incubating, or if they are sick or injured. Participants scanned all visible areas of the shoreline and any islands, within one meter of the water's edge to look for the profile of a loon head incubating and photograph actual or potential nest sites located. Nests were monitored as frequently as possible once they were documented to watch for nest failures and subsequent re-nesting that may occur and to pinpoint chick hatch date. Chick hatch dates were estimated as the range of dates between the first sighting of a chicks and the last survey date prior to an observation of a chick. Participants estimate chick age by placing the chick into one of

three categories; downy young, small young or large young (Appendix 2). Estimates of chick age along with verification photos of chicks submitted were used to refine chick hatch dates when possible.

Determining loon occupancy and territorial loon population

One of the primary project objectives is to determine the number of Common Loons residing in Glacier National Park each year. With a large dataset and repeated visits to each lake it was necessary to analyze each lake on an individual basis to determine the number of resident loons present. In order to calculate fecundity and compare our data with the MTFWP data from the rest of the state, we needed to identify how many territorial pairs we have each year. Because we were unable to observe loons at all of our priority 1, 2 and 3 lakes during the courtship/ nesting season, due to limited access in spring, we used residential loons as a surrogate for territorial loons when nesting, courtship, or other forms of territoriality were not confirmed.

Surveys with questionable data were omitted during analysis unless they had been verified directly, but were retained in the full dataset. Data were considered questionable when sightings reported seem contrary to typical loon behavior and verification of the data either failed to produce similar results or was impossible to conduct. When it was not possible to verify data due to logistical reasons the Project Coordinator contacted the citizen scientist to ask questions that may illuminate whether the data were valid based on the observer's description and bird identification skill level. A few examples of questionable data reports were more than two chicks sighted on one lake, reported lack of binoculars, or reported uncertainty of observers.

A series of decisions was made in order to select a survey for each lake that appeared to be representative of the resident population. The steps were as follows:

1. If a brood was observed by at least one observer and verified by at least one observer, that lake was determined to have a resident brood.
2. If a pair of loons was observed during at least one-third of the surveys on a given lake that lake was determined to have a resident pair.
3. If more than one pairs of loons was observed during at least one-third of the surveys on a given lake, that lake was determined to have two (or more) resident pairs.
4. If a single loon was observed during at least one-third of the surveys on a given lake that lake was determined to have a resident single loon.
5. In cases of lakes with poor access or visibility, or lakes that were very large in size, the survey that covered the lake most thoroughly, was conducted by the most skilled observer *and* took place closest to Loon Day was determined to be representative of the resident population.

Verification of loon observations

Citizen scientists were encouraged to take photos for verification purposes through a spotting scope whenever possible, or to take distant photos that could be zoomed in for verification of identification. We emphasized the importance of taking verification photos of all chicks and nests or nesting related behaviors. When a clear photo showing a chick or nest site was submitted with a data report of the same those observations were considered verified.

Verification was not possible on all surveys that were conducted. Due to the numerous replications of surveys on many of the lakes verification was not always necessary. Efforts were made to verify loon observations when chicks or nesting were reported, but a clear photo was not submitted to show the nest location or chick age, or when the sightings reported seem contrary to typical loon behavior. Verification was done by either the Project Coordinator or a selected citizen scientist with a solid bird identification background within two weeks of the initial report if possible.

Protecting sensitive information about nests and nursery areas

Citizen science volunteers receive training on the sensitivity of loons and most come to the program because they care about wildlife and want to invest their time into helping ensure that our loon population persists. It would be unlikely that participants would intentionally get too close to nesting loons, but citizen science staff stay vigilant about that and issue frequent reminders. We also ask participants not to share information that they have learned about locations of nests, nursery areas or lakes with successful broods with others outside of the project.

Information about nest and nursery locations can only be shared during the breeding season, for the purpose of directing a trusted volunteer to these locations to determine the status of an active or failed nest. After the breeding season is over, staff can share overall information about successful broods or unsuccessful nests if the information does not include specific locations of nests or nursery areas. That approach is subject to change if we see evidence that participants are getting too close to nesting loons or nursery areas.

All specific references to nesting or nursery locations are removed from the public version of final reports in order to protect sensitive information. A map of nesting pairs is included in the public version of the final report. That map doesn't include specific locations, but rather a center point location at each lake that had a successful or failed nest.

Results

Citizen scientist involvement

In 2015, citizen scientists engaged in the Common Loon Citizen Science project contributed 3298 hours for common loon surveys. A total of 129 citizen scientists conducted loon surveys (Appendix 4). Citizen scientists completed 316 loon surveys including 25 surveys at sites not on the priority list (Appendix 3). We conducted five training sessions with 12 citizen scientists, one VIP, and three park staff, and 50 outreach participants, for a total of 66 people attending. Of these, 65 were new participants. The remaining participants were returning volunteers and GNP staff who had been trained in previous years. Outreach groups included Glacier Youth Conservation Corps, a Glacier Institute Master Naturalist class, and The Woods Project (Chicago and Houston students) (See Internships, VIP's, Citizen Scientists and Training section for details).

Season-long loon monitoring

From April 8 to October 9, 2015, citizen scientists and park staff completed a total of 316 loon surveys. Forty-four of the 45 priority lakes were surveyed at least 3 times. Hidden Lake was only surveyed twice.

Throughout the course of the season, 54 resident adults and six chicks were observed (Appendix 5). The adults were comprised of 14 pairs and 26 singles and the six chicks were from five broods on five lakes. Incubation was observed on Spoon Lake and Trout Lake indicating two additional broods, but no chicks were detected at these lakes. Maps of season-long loon results (Appendix 6), resident loon pairs (Appendix 7), resident loon singles (Appendix 8) and lakes with no loons observed (Appendix 9) show status of each lake for 2015.

Loon Days event

During July Loon Days (Appendix 10) there were 38 observers contributing 369 hours to survey 44 lakes (one lake inaccessible due to trail closure for bear activity). There were 45 adults (11 pairs and 23 singles) and five chicks in four broods observed (Appendix 11). One chick was seen on each of the following lakes: Babb Beaver Pond, Middle Quartz, and Winona/Mud. A brood of two chicks was seen on Doverspike with no adults. These numbers compare to 50 adults, 17 pairs, and 11 chicks observed during Loon Day in 2014.

2005 - 2015 Common Loon Citizen Science Project

Resident vs. Loon Day Population

	Resident					Loon Day					Fecundity - Chicks per Resident Pair	Fecundity - Chicks per 2 Resident Adults
	Pairs	Chicks	Broods	Singles	Adults	Pairs	Chicks	Broods	Singles	Adults		
2005	n/a	n/a	n/a	n/a	n/a	14	4	3	11	39		
2006	16	5	3	13	45	9	4	3	18	36	0.31	0.22
2007	20	10	6	6	46	10	6	5	23	43	0.5	0.43
2008	14	7	6	19	47	12	4	4	5	29	0.5	0.3
2009	16	11	6	9	41	12	9	7	11	35	0.69	0.54
2010	18	5	3	5	41	8	5	3	10	26	0.28	0.24
2011	17	8	5	11	45	11	3	3	12	35	0.47	0.36
2012	14	6	4	8	36	15	7	5	10	40	0.43	0.33
2013	17	8	6	13	47	10	8	6	14	30	0.47	0.34
2014	18	12	9	15	51	17	11	8	16	50	0.67	0.47
2015	14	6	5	26	54	11	5	4	23	45	0.43	0.22
Mean	16.4	7.8	5.5	12.5	45.3	11.7	6	4.6	13.9	37.1	0.48	0.34
Min	14	5	3	5	36	8	3	3	5	26		
Max	20	12	9	26	54	17	11	8	23	50		

Table 1. Season-long and Loon Day results from 2005-2015, including the number of loon pairs, singles, chicks and broods observed season-long and during July Loon Days.

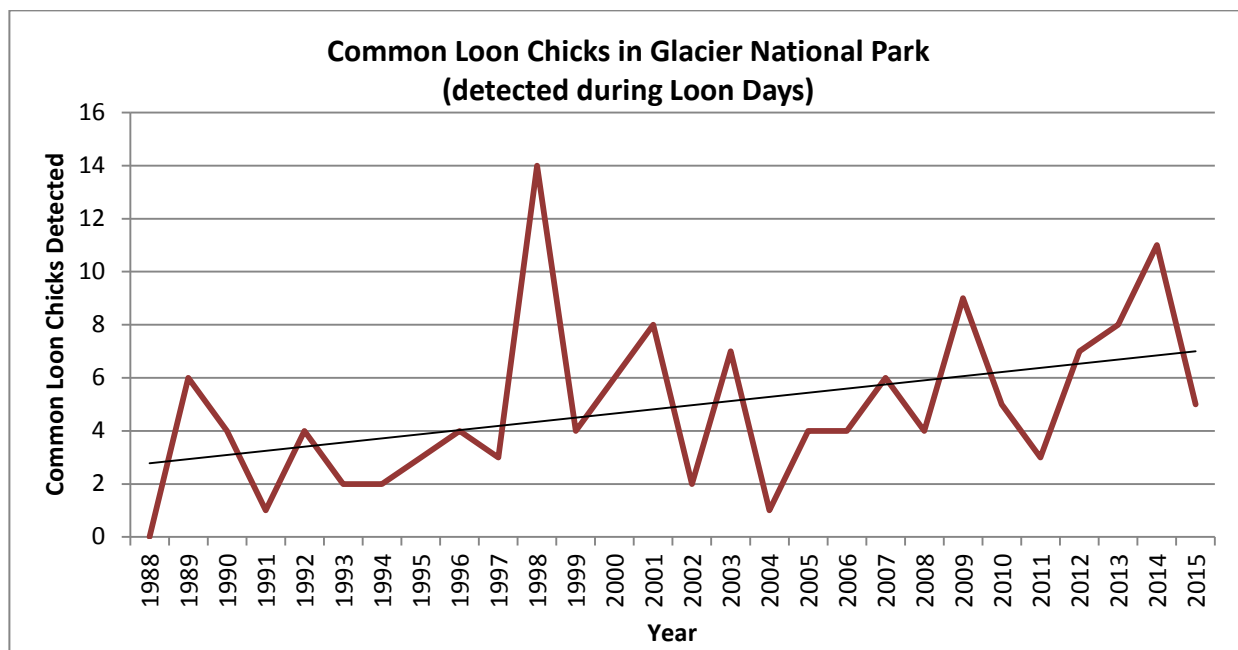


Figure 1: Common loon chicks detected during July Loon Days in Glacier National Park, 1988 - 2015. Records from 1988 - 2004 were collected prior to establishment of the Common Loon Citizen Science Project.

Data from Loon Days from 1988 - 2015 show an increasing trend in the number of common loon chicks detected each year. Data from 1988 - 2005, prior to full establishment of the Common Loon Citizen

Science Project, are more variable (Appendix 12). Average detection rate of chicks on loon day (versus chicks detected before or after loon day) is slightly higher for data collected during the citizen science project (detection rate = 0.82) as compared to data collected prior to establishment of the citizen science project (detection rate = 0.70), but the difference is not statistically significant ($p = 0.11$).

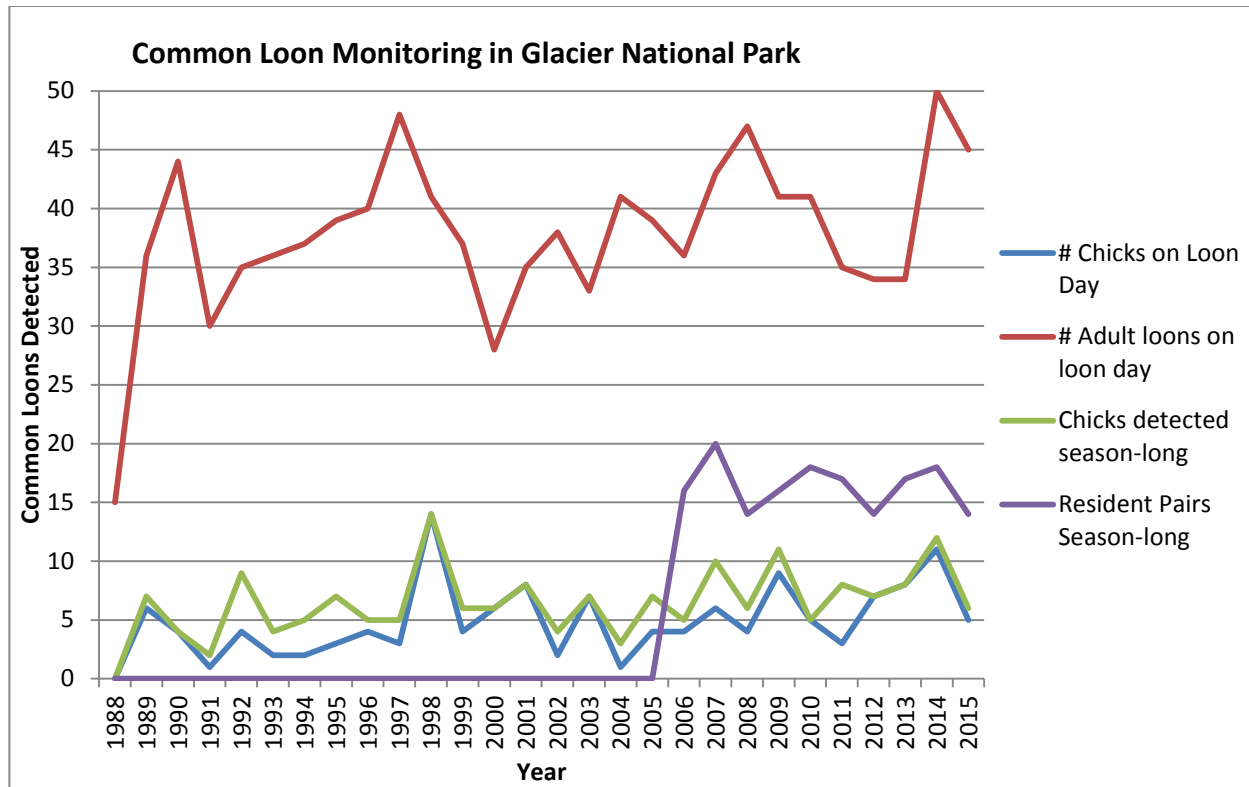


Figure 2: Common loon chicks and adults detected in Glacier National Park, 1988 - 2015. Records from 1988- 2004 were collected prior to establishment of the Common Loon Citizen Science Project.

Spring loon surveys and nest monitoring

Spring loon surveys were conducted at 24 of the 31 priority 1, 2 and 3 lakes and nine of the 14 priority four and five lakes before June 20, 2015 to determine territorial status of loons on each lake (Appendix 13). Nest searching was continued at lakes determined during spring loon surveys to have territorial pairs, and lakes where nests were found were monitored frequently. Locations of all nesting pairs are included in Appendix 14. The North Fork had three successful nests, at Doverspike, Middle Quartz, and Winona. The Many Glacier area had one successful nest at Babb Beaver Pond, outside the Park. For each brood observed or nest attempt observed, nest locations (when known), chick hatch dates, verification photos and potential causes of nest failures were recorded (Appendix 15). One failed nest was located at Spoon Lake, outside the Park; the only location where the actual nest location was found.

Loon data from 2006- 2015 indicates an average annual fecundity of 0.48, calculated as number of chicks fledged per territorial pair. We calculate this using resident pairs as a surrogate for territorial pairs (see methods section *Determining loon occupancy and territorial loon population*). Evers (2007) estimates that approximately 0.48 fledged chicks per territorial pair are needed to maintain a stable population. This is slightly lower than the value of 0.54 chicks fledged per territorial pair reported in Birds of North America (McIntyre and Barr 1997) as the rate needed to maintain a stable population.

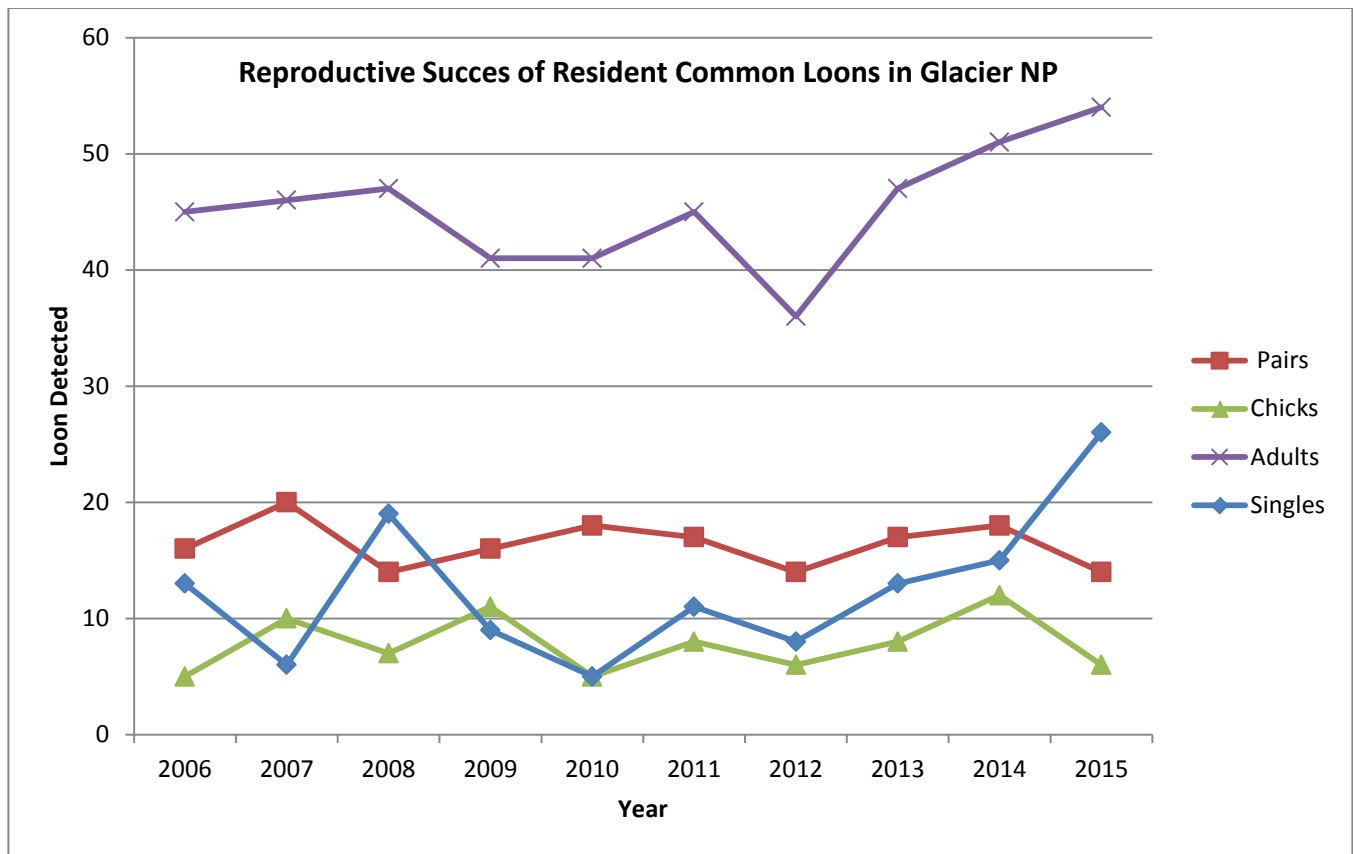


Figure 3: Reproductive success, or fecundity, of common loons from data collected from the citizen science project between 2006- 2015. Fecundity is calculated using number of chicks detected during season-long monitoring per number of residential pairs. Residential pairs are used as a surrogate for territorial pairs because we are unable to observe loons at all of our priority 1, 2 and 3 lakes during the courtship/ nesting season.

Discussion

Citizen science programs in Glacier successfully provided educational outreach for park visitors and local communities, as well as collected baseline information regarding species of interest. Specifically, the Common Loon Citizen Science project was successful in continuing long-term monitoring of common loon occupancy, nesting and chick production. We also engaged a large number of participants in learning about this species and the threats it faces. In addition to gaining a much more solid estimate of Glacier's population, we were able to document valuable information about loons that would have been missed by only monitoring on Loon Day. We successfully surveyed all but one of our priority lakes at least three times each and were able to pinpoint chick hatch dates to within three weeks on three of the four lakes with successful nesting, but only one nest site was located. More emphasis on frequent surveys at nesting lakes is needed in future years to pinpoint hatch dates to look for phenological changes that may occur with climate change and for patterns in occurrences of nest failure. Additionally, advanced training for returning volunteers may assist with helping participants find nest sites and to detect more nest sites that are established but fail before they are ever detected.

Chick production was lower than average this year, with 6 chicks detected compared to an average of 6.4 chicks/year since monitoring began in 1988, and an average of 7.6 chicks/year since the citizen science program began monitoring loons in 2005. The long-term trend indicates that the number of common loons detected in GNP is increasing. It is unclear whether that is a result of increased chick production or if the numbers are higher due to better detection of chicks from increased training of participants and larger numbers of surveys. The detection of chicks during Loon Day compared with the number of chicks observed season-long is slightly higher for the time period between 2006- 2015, after establishment of the citizen science program, as compared to the detection rate of chicks during Loon Day prior from

1988- 2005. However, the difference between the two detection rates is not statistically significant to support the hypothesis that detection rates have improved during the citizen science project. However, this result may be misleading because detection rates calculated for many of the years prior to 2006 are artificially inflated by the fact that only one survey was done on each lake.

The fecundity rate of GNP's loon population (0.48) is equal to the criteria of 0.48 chicks fledged per territorial pair cited by Evers (2007) as needed to maintain a stable population, and lower than the value of 0.54 cited in the Birds of North America (McIntyre and Barr 1997), and is much lower than the rate of 0.66 - 0.7 calculated for the state of Montana's common loons (Hammond 2009). While GNP's loon chick numbers appear to be increasing the number of residential pairs also tracks that trend closely, increasing and decreasing proportionally with the number of loon chicks each year.

In 2014, to create better data comparability with data by other agencies within the Common Loon Working Group we also slightly revised GNP's definition of priority 2 lakes to more closely align with those used by MTFWP. The former definition for priority 2 lakes was "Nesting records exist, but nesting attempts have not been recorded in the previous 5 years." We changed the definition to for priority 2 lakes to "Nesting records exist **and** lake occupied by resident pair in the previous 5 years, **or** historic nesting records exist but lake has not been occupied by resident pair in previous 5 years." This will allow us to put more emphasis on lakes that have had historic nesting whether or not they have had resident pairs in recent years.

The definitions were not aligned when the initial list was created in 2005. This was not done previously due to concern by the Citizen Science Program Coordinator about whether resident pairs were a reliable surrogate for territorial pairs. A review of our data with MTFWP staff and Common Loon Working Group representatives indicated that resident pairs are comparable to territorial pairs and reliable. All other priority definitions remain the same. The updated list of priority lakes for 2015 is included in Appendix 16.

Currently Babb Beaver Pond (east of GNP, about one mile from Babb on the Blackfeet Reservation) is the only lake east of the Continental Divide within GNP where we have detected successful nesting in the previous five years. Other lakes on the east side had successful nesting in previous years, including Elizabeth Lake in 1998, 2008 and 2009, Glenn's Lake in 1997, Mokowanis Lake in 1998, Red Eagle Lake in 2000, and Lower St Mary in 2008, but have been unsuccessful in recent years. To ensure that loons persist in each breeding area, we need a better understanding of what is limiting loon reproductive success on the east side and whether loon chicks produced on Babb Beaver Pond alone can supply enough dispersing loons to maintain the population in that area. "If nesting pairs are lost, or are unsuccessful year after year, there will not be returning 3-yr olds to augment the population. Over time, this can cause local populations to disappear. But because adult mortality is low (perhaps 5%), annual occupancy of territories may mask this problem. It is essential, therefore, to document nesting success and take steps to protect occupied territories." (Casey 2000). In 2016, we will attempt to obtain better early-season coverage on east side lakes to locate possible nesting area and look for patterns of disturbance.

Literature Cited

Belant, J L., J.F. Olson and R.K. Anderson. 1993. Evaluation of the Single Survey Technique for Assessing Common Loon Populations. *Journal of Field Ornithology*, 64(1):77-83.

Casey, D. 2000. Montana Partners in Flight Bird Conservation Plan. Version 1.1.

Evers, D.C. 2007. Status assessment and conservation plan for the Common Loon (*Gavia immer*) in North American. BRI Report 2007- 20. U.S. Fish and Wildlife Service, Hadley, MA.

Hammond, C.A.M. 2009. Conservation Plan for the Common Loon in Montana. Montana Department of Fish, Wildlife and Park, Kalispell, MT.

McIntyre, J.W. and J.F. Barr. 1997. Common Loon (*Gavia immer*). In Birds of North American, NO. 313 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Rodenhouse, N.L., S. N. Matthews, K. P. McFarland, J. D. Lambert, L. R. Iverson, A. Prasad, T. S. Sillett, and R. T. Holmes. 2008. Potential effects of climate change on birds of the Northeast. Mitigation and Adaptation Strategies for Global Change. 13: 517-540.

Appendix 1: 2015 GLACIER NATIONAL PARK LOON OBSERVATION FORM

Lake Name _____ Observers _____ Date _____

Phone/Email _____ Avg weather during survey (temp, wind, precip) _____

Start/End of Day: _____ (Add'l Start/Stop) _____
 Start (military) Stop (military) Start (military) Stop (military)
 include driving/hiking and observation hours * For multi day trips, include only the time needed to access and survey lake and end of day*

Observation time: Start Time _____ Stop Time _____; Start Time _____ Stop Time _____
 (military) (military) (military) (military)

Summary

of Pairs _____ # of Singles _____ Total Adults _____ (young of the year) # of Chicks/Juveniles _____ (brown & white adult-sized bird) # of Subadults _____
 Chick Stage: Downy young Small young Large young

People (on shore) _____ # of Boats (in water) _____ Type of Boats: _____ Confirmed Nesting: Y / N
 Nest Status: Incubating Abandoned Hatched

Significant Observations: _____

GPS locations of nest site or other significant observations (in NAD 83) _____

BANDED BIRDS?

Color of Bands _____ Loon: (A1, C1...): _____

Left Leg

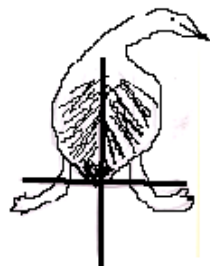
Right Leg

Closest to Body _____

Closest to Body _____

Closest to Foot _____

Closest to Foot _____



Space to sketch map (or include w/provided lake map): include locations of loon nests, chick/nursery areas, courtship and territorial behaviors, eagles/ravens, other important wildlife, landmarks, observation points, etc as to help us gain more concise data

Return form within one week of observation to:

Mailing address: GNP-CCRLC
 Citizen Science Loon Project
 P.O. Box 128
 West Glacier, MT 59936

Fax: (406) 888-7903

Phone: (406) 888-7986

Email: GLAC_Citizen_Science@nps.gov

INSTRUCTIONS: 1. On the other side, fill out the general information, the summary box, and sketch a map (or use an attached map). Locate and label loon locations, nesting areas, nursery areas, observation points and watercraft on the map. 2. Note significant observations of loon interactions, nesting, chick rearing, loon/human interactions, predators, eagles, ravens, and other waterfowl. Loon behaviors using timed intervals may also be indicated in the lower table. 3. Do not record behaviors in lower table if loons are reacting to your presence; record this on the Significant Observations line in the Summary box. 4. Note the presence of natural nests. 5. **If you don't observe any loons, please note the absence of loons.**

LOON BEHAVIOR KEY

B1 Adult/chick diving/feeding, self	B8 Call – wail	T4 Territorial – raised neck	M1 Courtship – mutual bill dipping/diving
B2 Adult diving/feeding a chick	B9 Call - hoot	T5 Territorial – upright wingflap	M2 Courtship – ashore nest test
B3 Swimming	B10 Call – flight tremolo	T6 Territorial - circling, bill dipping, diving	M3 Courtship – copulation
B4 Preening	B11 Chick riding on adult	T7 Territorial – penguin dance	N1 Nesting – nest building
B5 Sleeping/loafing	T1 Call – yodel (territorial)	T8 Territorial – surface rush	N2 Nesting – incubation
B6 Flying	T2 Call – tremolo/yodel	T9 Territorial – chasing/attack	N3 Nesting – left nest
B7 Call – tremolo	T3 Territorial – approach	T10 Territorial – harassment diving	

Time Interval (Start) (Stop)		Adult 1 (A1)	Adult 2 (A2)	Other Adults (A3, A4...)	Chick 1 (C1)	Chick 2 (C2)	# People (on Shore)	#/ type Boats in Water	Eagles/ Ravens in area?	Comments
10:15-10:25		B1, T2	N1				12	3 (canoe)	Y (2 eagles)	EXAMPLE

BEHAVIOR DEFINITION

T1) Territorial call given by the male loon, usually given when another male flies over the territory or in a territorial encounter.

T3) A pair approaching an intruder loon, other waterfowl or boat

T4) A heightened alertness and is an easy clue that something is disturbing the birds.

T5) The loons rise up out of the water and flap their wings with white breasts towards the intruder. This is a long distance signal to an intruder that the territory is occupied.

T6) Circling – The resident pair and the intruder loon move around each other in a circle.

Bill Dipping – A repeated sequence of raising the neck/head and a dipping of the face into the water. A nervous gesture, which occurs as the loons come within a close distance of the intruder.

Mutual Dive – Jerky head movements followed by **shallow dives by 1 or more loons**

T7) The birds raise up vertically out of the water, treading water with their feet. Sometimes they slap the water with their wings. This is the most aggressive territorial behavior.

T8) Usually follows Penguin Dance. The “dancing” bird falls forward into the water and continues the momentum as an underwater torpedo.

T9) Chasing- Occurs on the surface as the loon uses their wings in an “oaring” motion to chase off an intruder.

Attack – Loons will attack other birds, such as grebes.

T10) Harassment Diving– Loons will harass waterfowl by diving and resurfacing under the offending bird.

Appendix 2: Citizen Science for Common Loons in Glacier National Park

Observing Common Loon Chicks and Nursery Areas

Loon chicks typically hatch in Montana between late May and late June. Loon pairs that have re-nested due to a nest failure may hatch their chicks as late as mid-July.

- **Keep your distance to prevent disturbance when observing loons with chicks.**
- If you see chicks make sure to get an accurate count of the number of chicks- they can be difficult to detect especially when less than 6 weeks old or if away from adults. The raised tail of an adult loon (as seen during preening or distress) can often be mistaken for a back-riding chick.
- Document nursery areas. Note and photograph the location of loon chicks on the lake.
- Photograph the chicks from a distance, even if they will be difficult to see in the photo, and do so through a spotting scope if possible.
- Help us determine hatch dates by classifying chicks into one of the categories below.

Downy Young. Chicks are **less than 1/3 adult length** (including bill), have **dark grey down**, and may ride on the parents' backs. (They may be difficult to see without binoculars.)

These chicks are *less than three weeks old*.



Adult with downy young

Small Young. Chicks are **1/3 to 2/3 adult length**, have **lighter, brown/grey down**, and may have a few mottled light and dark grey contour feathers. They do not ride on the parents' backs.

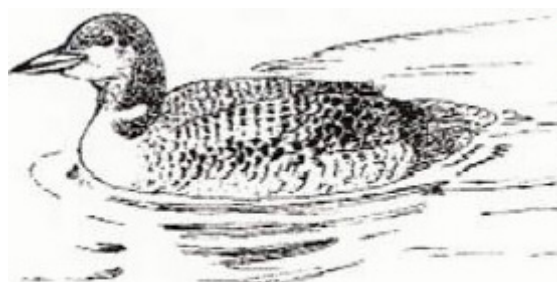
These chicks are *between three and six weeks old*.



Adult with small young

Large Young. Chicks are **2/3 adult length or longer** and have a **full coat of light and dark grey feathers** forming a "scalloped" pattern along the back. These chicks will still be attended to and largely fed by the parents, and will not fly until they are at least 10 weeks old.

Large young are *at least six weeks old*.



Large young

Classification of Loon Chicks

Adapted from Montana Common Loon Working Group

Downy Young (Common Loon Working Group Stages 1 and 2)

Stage 1- The chicks are small and have black downy feathers with a white belly. They keep these downy feathers only from hatch for approximately 7-10 days.



Stage 2- From 10 to 14 days (around 2 weeks), the black downy feathers are replaced with brownish or reddish-gray downy feathers. The chicks keep these feathers until they are approximately 4 weeks old.



Small Young (Common Loon Working Group Stage 3)

Stage 3- At about 4 weeks of age, the brownish (reddish) gray downy feathers are replaced by smoother contour feathers of the same color.



Large Young (Common Loon Working Group Stage 4)

Stage 4- At 10 to 11 weeks, juvenal plumage is complete and flight feathers have erupted enough to allow flight practice. They can fly when they are 11 to 13 weeks old. The chicks will retain this last set of feathers until the next summer when they will experience their first complete molt.



Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3295	AKOKALA	05/17/15	2	8:00	17:30	19.00
3528	AKOKALA	07/19/15	1	18:00	21:00	3.00
3605	AKOKALA	08/11/15	1			1.00
3614	AKOKALA	09/23/15	1	7:00	17:30	10.50
3296	ARROW	05/15/15	2	14:00	18:30	9.00
3297	ARROW	05/16/15	2	6:30	11:00	9.00
3407	ARROW	06/13/15	2	7:15	16:30	18.50
3441	ARROW	07/02/15	7	7:45	16:30	61.25
3492	ARROW	07/18/15	1	9:30	21:25	11.92
3494	ARROW	07/19/15	1	8:00	18:40	10.67
3541	ARROW	07/25/15	1	8:00	22:30	14.50
3298	AVALANCHE	05/06/15	1	10:00	16:00	6.00
3300	AVALANCHE	05/26/15	1	7:30	13:30	6.00
3299	AVALANCHE	06/05/15	1	12:00	16:30	4.50
3443	AVALANCHE	07/02/15	2	11:30	19:30	16.00
3481	AVALANCHE	07/18/15	2	10:30	17:30	14.00
3310	BABB BEAVER POND	04/21/15	1	8:15	19:00	10.75
3309	BABB BEAVER POND	04/22/15	1	8:15	14:10	5.92
3308	BABB BEAVER POND	05/05/15	3	8:45	13:45	15.00
3307	BABB BEAVER POND	05/08/15	2	14:30	16:50	4.67
3306	BABB BEAVER POND	05/14/15	1	6:15	17:10	10.92
3305	BABB BEAVER POND	05/18/15	1	15:20	17:20	2.00
3304	BABB BEAVER POND	05/31/15	2	17:50	19:40	3.67
3303	BABB BEAVER POND	06/05/15	2	8:00	21:00	26.00
3302	BABB BEAVER POND	06/06/15	1	17:10	20:30	3.33
3301	BABB BEAVER POND	06/10/15	2	7:00	17:50	21.67
3539	BABB BEAVER POND	07/18/15	4	9:30	15:30	24.00
3499	BABB BEAVER POND	07/19/15	1	7:40	18:00	10.33
3582	BABB BEAVER POND	08/14/15	1	8:15	14:30	6.25
3601	BABB BEAVER POND	09/02/15	1	7:30	19:55	12.42
3538	BIG SPRING LAKE	07/07/15	1	11:00	19:30	8.50
3610	BOWMAN	05/16/15	1	8:00	15:30	7.50
3609	BOWMAN	05/29/15	1	8:30	15:30	7.00
3294	BOWMAN	06/07/15	2	11:00	14:00	6.00
3293	BOWMAN	06/09/15	2	7:30	17:15	19.50
3511	BOWMAN	07/19/15	1	8:00	21:40	13.67
3512	BOWMAN	07/20/15	1	8:00	14:00	6.00
3580	BOWMAN	08/15/15	2	7:00	19:30	25.00
3311	BULLHEAD	06/09/15	2	8:10	14:50	13.33
3416	BULLHEAD	06/19/15	1	8:00	22:55	14.92
3480	BULLHEAD	07/16/15	1	8:47	17:50	9.05
3559	BULLHEAD	08/03/15	2	8:00	21:45	27.50
3450	COSLEY	07/04/15	1	7:00	21:00	14.00
3446	COSLEY	07/06/15	3	9:00	22:00	39.00
3447	COSLEY	07/07/15	3	7:00	16:30	28.50
3495	COSLEY	07/18/15	2	9:00	20:00	22.00
3496	COSLEY	07/19/15	2	7:00	20:00	26.00

Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3542	COSLEY	07/19/15	14	13:30	20:00	91.00
3545	COSLEY	07/20/15	14	8:00	12:30	63.00
3537	CROFFS LAKE	07/14/15	1	12:00	18:30	6.50
3536	DOG GUN LAKE	06/04/15	3	17:00	21:00	12.00
3313	DOVERSPIKE (ROUND PRAIRIE)	05/12/15	3	8:30	16:00	22.50
3312	DOVERSPIKE (ROUND PRAIRIE)	05/16/15	1	7:30	15:00	7.50
3485	DOVERSPIKE (ROUND PRAIRIE)	07/19/15	2	8:00	15:30	15.00
3591	DOVERSPIKE (ROUND PRAIRIE)	08/01/15	1	7:00	12:30	5.50
3592	DOVERSPIKE (ROUND PRAIRIE)	08/22/15	1	18:00	23:00	5.00
3399	DUCK LAKE	04/18/15	2	12:30	15:15	5.50
3400	DUCK LAKE	04/25/15	2	12:30	15:15	5.50
3534	DUCK LAKE	07/14/15	1	12:00	18:30	6.50
3449	ELIZABETH	07/04/15	1	7:00	21:00	14.00
3454	ELIZABETH	07/11/15	2	8:30	16:00	15.00
3475	ELIZABETH	07/19/15	1	6:00	16:00	10.00
3548	ELIZABETH	07/19/15	1	18:10	19:30	1.33
3546	ELIZABETH	07/23/15	14	9:00	22:00	182.00
3547	ELIZABETH	07/24/15	14	7:30	15:30	112.00
3575	ELIZABETH	08/15/15	1	7:20	19:45	12.42
3314	FISH	04/30/15	1	10:00	18:30	8.50
3455	FISH	07/10/15	1	8:05	15:30	7.42
3461	FISH	07/10/15	1	8:05	15:30	7.42
3473	FISH	07/16/15	1	10:00	15:00	5.00
3319	FISHERCAP	04/20/15	1	8:30	19:00	10.50
3316	FISHERCAP	04/22/15	1	8:15	14:10	5.92
3315	FISHERCAP	06/09/15	2	8:10	14:50	13.33
3487	FISHERCAP	07/19/15	1	16:10	21:40	5.50
3560	FISHERCAP	08/03/15	2	8:00	21:45	27.50
3460	FRANCES	07/09/15	1	7:00	21:00	14.00
3513	FRANCES	07/19/15	1	8:15	21:00	12.75
3586	FRANCES	08/13/15	1	8:10	19:52	11.70
3587	FRANCES	08/14/15	1	7:55	8:39	0.73
3444	GLENN'S	07/06/15	2	9:00	22:00	26.00
3483	GLENN'S	07/18/15	1	12:00	18:30	6.50
3544	GLENN'S	07/20/15	14	12:00	22:00	140.00
3543	GLENN'S	07/22/15	14	7:00	20:30	189.00
3398	GOOSE LAKE	05/24/15	2	17:00	20:00	6.00
3397	GOOSE LAKE	05/25/15	2	8:20	12:30	8.33
3396	GOOSE LAKE	05/27/15	2	17:00	20:30	7.00
3395	GOOSE LAKE	06/01/15	2	16:40	18:45	4.17
3394	GOOSE LAKE	06/07/15	2	18:20	20:30	4.33
3521	GOOSE LAKE	06/14/15	2	7:00	9:30	5.00
3437	GRACE	07/01/15	1	9:00	21:00	12.00
3438	GRACE	07/02/15	1	4:40	15:00	10.33
3527	GRACE	07/18/15	1	7:00	21:30	14.50
3526	GRACE	07/19/15	1	6:00	17:30	11.50
3569	GRACE	08/04/15	2	7:00	17:30	21.00

Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3570	GRACE	08/04/15	2	7:00	17:30	21.00
3535	GREEN LAKE	06/04/15	1	9:00	12:00	3.00
3417	GRINNELL	06/24/15	1	9:30	9:45	0.25
3439	GRINNELL	07/01/15	2	8:15	19:30	22.50
3452	GRINNELL	07/08/15	1	7:45	18:50	11.08
3478	GRINNELL	07/17/15	2	7:00	17:15	20.50
3603	GRINNELL	08/02/15	1	7:30	19:55	12.42
3565	GRINNELL	08/04/15	2	7:00	17:45	21.50
3326	HARRISON	06/03/15	1	8:00	20:45	12.75
3325	HARRISON	06/04/15	1	7:30	16:00	8.50
3432	HARRISON	07/04/15	1	6:30	16:30	10.00
3472	HARRISON	07/19/15	2	8:00	16:00	16.00
3579	HARRISON	08/17/15	2	7:30	18:45	22.50
3589	HARRISON	08/19/15	1	9:00	21:00	12.00
3590	HARRISON	08/20/15	1	7:00	11:00	4.00
3448	HELEN	07/04/15	1	7:00	21:00	14.00
3453	HELEN	07/11/15	1	8:30	19:30	11.00
3474	HELEN	07/18/15	1	9:00	21:30	12.50
3321	HIDDEN	06/13/15	1	12:00	17:00	5.00
3477	HIDDEN	07/19/15	1	7:45	15:00	7.25
3336	HIDDEN MEADOW	05/02/15	1	8:00	17:30	9.50
3334	HIDDEN MEADOW	05/03/15	2	10:30	14:30	8.00
3323	HIDDEN MEADOW	05/09/15	2	12:35	16:00	6.83
3322	HIDDEN MEADOW	06/07/15	2	14:30	15:30	2.00
3401	HIDDEN MEADOW	06/18/15	1	8:30	18:00	9.50
3409	HIDDEN MEADOW	06/18/15	13	13:00	18:00	65.00
3428	HIDDEN MEADOW	06/29/15	3	7:45	16:17	25.60
3462	HIDDEN MEADOW	07/13/15	13	12:30	17:30	65.00
3507	HIDDEN MEADOW	07/19/15	2	7:00	15:00	16.00
3551	HIDDEN MEADOW	07/29/15	2	12:00	20:00	16.00
3594	HIDDEN MEADOW	08/06/15	1	19:15	20:35	1.33
3330	HOWE (UPPER)	04/16/15	1	10:00	18:00	8.00
3329	HOWE (UPPER)	04/22/15	2	9:15	15:30	12.50
3328	HOWE (UPPER)	04/30/15	1	8:30	14:30	6.00
3327	HOWE (UPPER)	05/16/15	3	8:00	18:00	30.00
3414	HOWE (UPPER)	06/14/15	3	8:00	17:00	27.00
3522	HOWE (UPPER)	07/19/15	1	7:15	16:00	8.75
3595	HOWE (UPPER)	08/05/15	1	14:40	17:00	2.33
3593	HOWE (UPPER)	08/21/15	1	8:30	13:00	4.50
3459	JANET	07/09/15	1	7:00	21:00	14.00
3502	JANET	07/19/15	2	8:00	21:00	26.00
3556	JANET	07/31/15	1	8:30	18:30	10.00
3585	JANET	08/13/15	1	7:00	20:00	13.00
3331	JOHNS	04/16/15	1	10:15	16:30	6.25
3430	JOHNS	06/30/15	1	13:00	17:30	4.50
3476	JOHNS	07/18/15	1	10:00	14:30	4.50
3333	JOSEPHINE	05/12/15	1	8:15	17:30	9.25

Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3332	JOSEPHINE	06/10/15	2	7:00	17:30	21.00
3418	JOSEPHINE	06/24/15	1	8:45	9:00	0.25
3479	JOSEPHINE	07/17/15	2	7:00	17:15	20.50
3561	JOSEPHINE	08/03/15	2	8:00	21:45	27.50
3562	JOSEPHINE	08/04/15	2	7:00	17:45	21.50
3602	JOSEPHINE	09/02/15	1	7:30	19:55	12.42
3339	KINTLA	05/07/15	1	7:30	15:30	8.00
3338	KINTLA	05/17/15	1	7:45	15:30	7.75
3337	KINTLA	05/18/15	1	7:00	17:30	10.50
3422	KINTLA	06/24/15	1	8:30	18:30	10.00
3423	KINTLA	06/25/15	1	7:00	16:30	9.50
3514	KINTLA	07/17/15	1	7:15	18:00	10.75
3515	KINTLA	07/17/15	1	7:15	18:00	10.75
3555	KINTLA	08/03/15	1	10:00	18:30	8.50
3598	KINTLA	08/27/15	2	6:00	17:00	22.00
3529	KIPP LAKE	06/15/15	3	12:00	17:00	15.00
3458	KOOTENAI	07/10/15	1	5:00	16:00	11.00
3503	KOOTENAI	07/18/15	2	8:00	23:00	30.00
3584	KOOTENAI	08/13/15	1	7:00	20:00	13.00
3348	LAKE MCDONALD	05/12/15	1	12:45	14:25	1.67
3431	LAKE MCDONALD	06/30/15	1	13:00	17:30	4.50
3433	LAKE MCDONALD	07/02/15	1	16:00	20:00	4.00
3520	LAKE MCDONALD	07/18/15	1	11:00	14:30	3.50
3345	LOGGING	05/11/15	1	8:00	14:40	6.67
3344	LOGGING	05/13/15	1	7:00	17:30	10.50
3343	LOGGING	05/27/15	1	7:42	17:20	9.63
3342	LOGGING	06/02/15	4	8:00	17:30	38.00
3341	LOGGING	06/02/15	2	8:15	16:00	15.50
3340	LOGGING	06/03/15	2	8:00	17:15	18.50
3435	LOGGING	07/01/15	1	9:00	21:00	12.00
3436	LOGGING	07/02/15	1	4:40	15:00	10.33
3456	LOGGING	07/10/15	2	13:00	20:00	14.00
3457	LOGGING	07/11/15	2	6:00	13:00	14.00
3509	LOGGING	07/12/15	1	8:00	16:30	8.50
3510	LOGGING	07/13/15	1	7:00	17:30	10.50
3525	LOGGING	07/18/15	1	7:00	21:30	14.50
3524	LOGGING	07/19/15	1	6:00	17:30	11.50
3567	LOGGING	08/03/15	2	8:00	16:30	17.00
3568	LOGGING	08/05/15	1	8:00	16:30	8.50
3578	LOGGING	08/17/15	1	8:00	16:30	8.50
3596	LOGGING	08/28/15	2	8:30	19:50	22.67
3597	LOGGING	08/29/15	2	7:30	19:00	23.00
3607	LOGGING	09/07/15	1	10:00	19:00	9.00
3355	LOWER QUARTZ	05/13/15	1	8:30	14:30	6.00
3608	LOWER QUARTZ	05/30/15	1	7:00	15:00	8.00
3426	LOWER QUARTZ	06/27/15	1	7:00	18:30	11.50
3506	LOWER QUARTZ	07/18/15	1	8:30	17:00	8.50

Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3574	LOWER QUARTZ	08/11/15	1	7:30	18:00	10.50
3611	LOWER QUARTZ	09/23/15	1	7:00	17:30	10.50
3347	LOWER SAINT MARY (OUTSIDE PARK)	05/13/15	1	8:40	12:20	3.67
3531	LOWER SAINT MARY (OUTSIDE PARK)	06/05/15	4	17:00	22:00	20.00
3346	LOWER SAINT MARY (OUTSIDE PARK)	06/06/15	1	17:10	20:30	3.33
3465	LOWER SAINT MARY (OUTSIDE PARK)	06/16/15	2	12:10	15:30	6.67
3497	LOWER SAINT MARY (OUTSIDE PARK)	07/19/15	1	7:40	18:00	10.33
3410	LOWER TWO MEDICINE	06/19/15	1	8:45	16:00	7.25
3532	LOWER TWO MEDICINE	07/07/15	1	11:00	19:30	8.50
3469	LOWER TWO MEDICINE	07/18/15	2	9:00	20:00	22.00
3482	Medicine Grizzly	07/06/15	1	7:00	17:30	10.50
3354	MIDDLE QUARTZ	05/13/15	1	8:30	17:25	8.92
3352	MIDDLE QUARTZ	05/14/15	1	9:00	11:27	2.45
3353	MIDDLE QUARTZ	06/07/15	1	7:00	17:30	10.50
3467	MIDDLE QUARTZ	07/14/15	1	7:30	17:30	10.00
3504	MIDDLE QUARTZ	07/19/15	1	8:30	16:00	7.50
3573	MIDDLE QUARTZ	08/11/15	1	7:30	18:00	10.50
3613	MIDDLE QUARTZ	09/23/15	1	7:00	17:30	10.50
3519	MISSION LAKE	06/15/15	3	8:15	15:15	21.00
3530	MITTEN LAKE	07/13/15	1	9:00	13:00	4.00
3445	MOKOWANIS	07/06/15	2	9:00	22:00	26.00
3484	MOKOWANIS	07/18/15	1	15:30	16:30	1.00
3549	MOKOWANIS	07/21/15	14	8:45	16:30	108.50
3540	POIA	07/19/15	1			7.40
3588	POIA	08/11/15	1	7:00	19:00	12.00
3351	QUARTZ (UPPER)	05/13/15	1	8:30	18:30	10.00
3350	QUARTZ (UPPER)	05/14/15	1	6:00	8:05	2.08
3349	QUARTZ (UPPER)	06/06/15	1	8:00	16:30	8.50
3427	QUARTZ (UPPER)	06/27/15	1	7:00	18:30	11.50
3434	QUARTZ (UPPER)	07/06/15	1	7:00	17:30	10.50
3468	QUARTZ (UPPER)	07/14/15	1	7:30	17:30	10.00
3505	QUARTZ (UPPER)	07/18/15	1	8:30	17:00	8.50
3571	QUARTZ (UPPER)	08/10/15	5	7:00	17:30	52.50
3572	QUARTZ (UPPER)	08/11/15	1	7:30	18:00	10.50
3581	QUARTZ (UPPER)	08/15/15	1	11:00	20:00	9.00
3612	QUARTZ (UPPER)	09/23/15	1	8:00	16:30	8.50
3358	RED EAGLE	05/21/15	1	11:30	20:00	8.50
3357	RED EAGLE	05/24/15	2	8:05	20:30	24.83
3356	RED EAGLE	05/25/15	1	10:00	17:00	7.00
3424	RED EAGLE	06/21/15	2	5:00	12:00	14.00
3508	RED EAGLE	07/18/15	1	5:00	10:00	5.00
3318	RED ROCK	04/20/15	1	8:30	19:00	10.50
3317	RED ROCK	04/22/15	1	8:15	14:10	5.92
3359	RED ROCK	06/09/15	2	8:10	14:50	13.33
3486	RED ROCK	07/19/15	1	16:10	21:40	5.50
3558	RED ROCK	08/03/15	2	8:00	21:45	27.50
3553	ROGERS	04/08/15	2	7:15	16:00	17.50

Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3360	ROGERS	05/15/15	2	14:15	14:25	0.33
3406	ROGERS	06/13/15	2	5:30	16:30	22.00
3490	ROGERS	07/18/15	1	10:30	14:30	4.00
3367	SAINT MARY	04/18/15	1	10:00	12:10	2.17
3366	SAINT MARY	05/23/15	2	9:00	14:00	10.00
3498	SAINT MARY	07/19/15	1	7:40	18:00	10.33
3365	SHERBURNE	05/12/15	1	8:15	17:30	9.25
3364	SHERBURNE	05/30/15	1	17:00	19:30	2.50
3363	SHERBURNE	06/02/15	2	10:10	19:30	18.67
3362	SHERBURNE	06/04/15	1	18:25	20:20	1.92
3361	SHERBURNE	06/06/15	1	17:10	20:30	3.33
3489	SHERBURNE	07/18/15	2	16:20	21:15	9.83
3554	SHERBURNE	08/03/15	1	7:50	16:15	8.42
3616	SHERBURNE	10/06/15	1	0:00	0:00	0.08
3393	Spoon Lake	05/19/15	2	8:00	10:15	4.50
3413	Spoon Lake	05/22/15	3	13:00	15:00	6.00
3411	Spoon Lake	06/18/15	1	10:00	15:30	5.50
3412	Spoon Lake	06/18/15	4	12:50	16:20	14.00
3419	Spoon Lake	06/26/15	4	11:30	14:00	10.00
3451	Spoon Lake	07/09/15	6	10:00	14:30	27.00
3518	SWIFT RESERVOIR	06/10/15	2	15:00	21:00	12.00
3376	SWIFTCURRENT	04/22/15	1	7:00	17:30	10.50
3375	SWIFTCURRENT	04/22/15	1	8:15	14:10	5.92
3374	SWIFTCURRENT	05/12/15	1	8:15	17:30	9.25
3373	SWIFTCURRENT	05/12/15	1	8:15	17:30	9.25
3372	SWIFTCURRENT	05/14/15	1	6:15	17:10	10.92
3371	SWIFTCURRENT	05/17/15	2	7:30	16:11	17.37
3369	SWIFTCURRENT	06/02/15	1	15:15	19:15	4.00
3370	SWIFTCURRENT	06/02/15	2	15:15	19:15	8.00
3368	SWIFTCURRENT	06/05/15	2	8:00	21:00	26.00
3488	SWIFTCURRENT	07/18/15	2	16:20	21:15	9.83
3563	SWIFTCURRENT	08/03/15	2	8:00	21:45	27.50
3564	SWIFTCURRENT	08/04/15	2	7:00	17:45	21.50
3617	SWIFTCURRENT	09/30/15	1	9:25	9:30	0.08
3604	SWIFTCURRENT	09/02/15	1	7:30	19:55	12.42
3378	TROUT	05/15/15	2	6:00	18:30	25.00
3379	TROUT	05/16/15	2	7:00	15:30	17.00
3377	TROUT	06/02/15	1	10:00	20:00	10.00
3404	TROUT	06/13/15	2	5:30	16:30	22.00
3405	TROUT	06/14/15	2	7:30	17:00	19.00
3442	TROUT	07/01/15	7	9:30	18:20	61.83
3491	TROUT	07/18/15	1	9:30	21:25	11.92
3381	TWO MEDICINE	05/16/15	1	9:00	15:40	6.67
3380	TWO MEDICINE	06/11/15	2	9:00	17:30	17.00
3403	TWO MEDICINE	06/23/15	1	8:00	16:00	8.00
3466	TWO MEDICINE	07/08/15	2	14:30	17:30	6.00
3471	TWO MEDICINE	07/18/15	2	9:00	20:00	22.00

Appendix 3: 2015 Loon Citizen Science Surveys

Surv ID	Lake Name	Date	# of Observes	Day Start	Day End	Total Hours
3420	UPPER KINTLA	06/24/15	1	8:30	18:30	10.00
3421	UPPER KINTLA	06/25/15	1	7:00	16:30	9.50
3516	UPPER KINTLA	07/17/15	1	7:15	18:00	10.75
3517	UPPER KINTLA	07/18/15	1	7:37	18:30	10.88
3599	UPPER KINTLA	08/27/15	2	13:25	17:00	7.17
3600	UPPER KINTLA	08/28/15	2	8:30	8:45	0.50
3382	UPPER TWO MEDICINE	06/11/15	2	9:00	17:30	17.00
3415	UPPER TWO MEDICINE	06/20/15	2	10:00	16:00	12.00
3470	UPPER TWO MEDICINE	07/18/15	2	9:00	20:00	22.00
3464	WATERTON	07/09/15	1	5:00	16:00	11.00
3500	WATERTON	07/18/15	2	8:00	23:00	30.00
3501	WATERTON	07/19/15	2	8:00	21:00	26.00
3583	WATERTON	08/13/15	1	7:00	20:00	13.00
3392	WINONA/MUD	04/27/15	1	8:00	16:30	8.50
3391	WINONA/MUD	05/01/15	1	10:00	19:30	9.50
3390	WINONA/MUD	05/02/15	1	8:00	17:30	9.50
3335	WINONA/MUD	05/03/15	2	10:30	14:30	8.00
3389	WINONA/MUD	05/09/15	2	16:00	17:30	3.00
3388	WINONA/MUD	05/11/15	1	8:00	17:40	9.67
3387	WINONA/MUD	05/16/15	2	8:30	17:00	17.00
3386	WINONA/MUD	05/25/15	3			1.00
3385	WINONA/MUD	06/02/15	4	8:00	17:30	38.00
3384	WINONA/MUD	06/05/15	1	8:00	16:30	8.50
3383	WINONA/MUD	06/07/15	2	15:00	16:00	2.00
3402	WINONA/MUD	06/18/15	2	8:30	18:00	19.00
3408	WINONA/MUD	06/20/15	1	11:30	15:40	4.17
3429	WINONA/MUD	06/29/15	3	7:45	16:17	25.60
3463	WINONA/MUD	07/13/15	13	12:30	17:30	65.00
3523	WINONA/MUD	07/18/15	1	7:00	21:30	14.50
3577	WINONA/MUD	07/19/15	1	8:00	16:30	8.50
3552	WINONA/MUD	07/29/15	2	12:00	20:00	16.00
3566	WINONA/MUD	08/03/15	1	8:00	16:30	8.50
3576	WINONA/MUD	08/17/15	1	8:00	16:30	8.50
3606	WINONA/MUD	09/07/15	1	12:00	15:30	3.50
316 Surveys Completed						

Appendix 4: 2015 Common Loon Citizen Science Observer Involvement

Observer	Surveys Completed	# of People in Group	Group Members Participating in each Survey	Survey Hours	Volunteer Hours
Bate, Lisa	8	1	1	57.0	57.0
Benson, David	2	1	1	19.0	19.0
Bussing, Laura	1	1	1	2.5	2.5
Chief Moon, Krissey	12	1	1	47.0	47.0
Chinn, Bob	12	1	1	90.9	90.9
Clark, Carolyn	7	1	1	48.0	48.0
Clark, Jane	12	1	1	64.6	64.6
Clothier, Susan	44	1	1	121.9	121.9
Cotrell, Shauna	7	1	1	25.3	25.3
Crowder, Wayne	5	1	1	39.8	39.8
Donovan, Mary Ann	2	1	1	8.3	8.3
Downs, Chris	1	1	1	10.5	10.5
Ewert, Emily	12	1	1	65.5	65.5
Faist, Michael	4	1	1	22.5	22.5
Fisher, Karalea	1	1	1	4.5	4.5
Flesch, Elizabeth	14	1	1	99.6	99.6
Flick, Jo (Joann)	2	1	1	24.0	24.0
Fredenberg, Carter	1	1	1	10.5	10.5
Gniadek, Steve	8	1	1	42.7	42.7
Graves, Tabitha	3	1	1	24.4	24.4
Gritts, Carleton	6	1	1	52.5	52.5
Johnson, Brian	9	1	1	50.0	50.0
Kermath, Leslie	2	1	1	12.5	12.5
Kopec, Len	2	1	1	1.3	1.3
Krysa, Dustin	1	1	1	4.5	4.5
Kyle, John	10	1	1	48.5	48.5
Kyle, Diana	10	1	1	48.5	48.5
Ladyn, Lois	3	1	1	22.5	22.5
Lahr, Andrew	2	1	1	12.5	12.5
Larson, John	2	1	1	8.0	8.0
Liming, Katelyn	2	1	1	11.0	11.0
Lindstrom, Kim	2	1	1	19.0	19.0
Luikart, Gordon	1	11	11	5.0	55.0
Luther, Laura	34	1	1	158.0	158.0
Macleod, Amy	3	1	1	11.0	11.0
Madison, Alex	4	1	1	22.5	22.5
Marine, Marcea	5	1	1	6.4	6.4
Marine, Craig	5	1	1	6.4	6.4
Martin, Joshua	16	1	1	101.3	101.3
Mayes, Diane	3	1	1	11.3	11.3
McClelland, Pat	2	1	1	10.3	10.3
Montana Conservation Corps, Glacier Youth 2015	2	9	9	17.6	158.3
Moon, Debbie	1	1	1	6.0	6.0
Mullings, Cyndi	3	1	1	22.0	22.0
Murphy, Carole	5	1	1	31.8	31.8
Murphy, Rick	4	1	1	29.8	29.8
Murray, Matthew	20	1	1	68.1	68.1
Nelesen, Mary	5	1	1	24.0	24.0
Peterson, Chris	1	1	1	5.0	5.0
Peterson, Terry	12	1	1	64.1	64.1
Reeves (Loucks), Debra	2	1	1	17.8	17.8
Robbins, Dean	1	1	1	9.0	9.0
Ross, Kathy	6	1	1	44.6	44.6
Ryan, Sara	8	1	1	24.5	24.5
Scott, Melissa	2	1	1	0.3	0.3

Appendix 4: 2015 Common Loon Citizen Science Observer Involvement

Observer	Surveys Completed	# of People in Group	Group Members Participating in each Survey	Survey Hours	Volunteer Hours
Seaman, Amy	3	1	1	19.0	19.0
Smith, Sylvia	2	1	1	8.5	8.5
Smith, Paula	2	1	1	13.0	13.0
Smith, Bob	1	1	1	8.0	8.0
Steele, Theresa	12	1	1	68.0	68.0
Stroud, Lea	1	1	1	14.9	14.9
Summer, Barbara	6	1	1	40.3	40.3
Thornton, Sam	5	1	1	34.5	34.5
Waddell, James	13	1	1	64.7	64.7
West, Joan	11	1	1	69.3	69.3
Wheeler, Iree	4	1	1	36.0	36.0
Williams, Becky	2	1	1	10.3	10.3
Wilson, Leslie	1	1	1	2.0	2.0
Wirtz, Rita	1	1	1	8.5	8.5
Wolf, Cynthia	10	1	1	41.0	41.0
Woods Project, 2015	9	39	13	63.8	828.8
Zavadil, Anne	3	1	1	20.0	20.0
Zinn, Don	1	1	1	5.0	5.0
		129 Unique Loon Observers		2342.4	3298.0

Appendix 5: 2015 Loon Days vs. Season Long (Resident) Results

Priority 1 Lakes	Resident Population	Loon Day
* Babb Beaver Pond	1 Pair, 1 Chick, 1 Brood	1 Pair, 1 Chick, 1 Brood
Doverspike (Round Prairie)	2 Chicks, 1 Brood	2 Chicks, 1 Brood
Grace	1 Single	1 Single
Hidden Meadow	1 Pair	1 Single
Howe (Upper)	2 Single	2 Single
Kintla	2 Single	1 Pair, 1 Single
Logging	1 Pair, 1 Single, 1 Chick, 1 Brood	3 Pair, 4 Single
Lower Quartz	1 Single	0 Loons
* Lower Saint Mary	1 Single	1 Single
Middle Quartz	1 Pair, 1 Chick, 1 Brood	1 Pair, 1 Chick, 1 Brood
Quartz (Upper)	1 Pair	1 Single
Rogers	1 Pair	1 Pair
Swiftcurrent	1 Single	0 Loons
Trout	1 Pair	2 Single
Winona/Mud	1 Pair, 1 Chick, 1 Brood	1 Pair, 1 Chick, 1 Brood
Total	8 Pairs, 9 Singles, 6 Chicks, 5 Broods	8 Pairs, 13 Singles, 5 Chicks, 4 Broods

Priority 2 Lakes	Resident Population	Loon Day
Bowman	1 Pair	0 Loons
Elizabeth	1 Single	1 Pair
Glenn's	1 Single	2 Single
Harrison	1 Single	0 Loons
Total	1 Pair, 3 Singles	1 Pair, 2 Singles

Priority 3 Lakes	Resident Population	Loon Day
Akokala	0 Loons	0 Loons
Arrow	1 Pair	1 Pair
Cosley	0 Loons	1 Single
Josephine	0 Loons	0 Loons
Kootenai	2 Single	1 Single
Lake Mcdonald	0 Loons	0 Loons
Red Eagle	0 Loons	0 Loons
Saint Mary	1 Single	0 Loons
Sherburne	2 Single	2 Single
Two Medicine	0 Loons	0 Loons
Upper Kintla	1 Single	1 Single
Waterton	3 Single	1 Single
Total	1 Pair, 9 singles	1 Pair, 6 Singles

Priority 4 Lakes	Resident Population	Loon Day
Avalanche	1 Single	1 Single
Bullhead	0 Loons	0 Loons
Fishercap	0 Loons	0 Loons
Grinnell	1 Single	0 Loons
Helen	0 Loons	0 Loons
Janet	0 Loons	1 Single
Mokowanis	1 Single	0 Loons
Red Rock	0 Loons	0 Loons
Total	3 Singles	2 Singles

Priority 5 Lakes	Resident Population	Loon Day
Fish	0 Loons	0 Loons
Frances	1 Single	0 Loons
Hidden	0 Loons	0 Loons
Johns	0 Loons	0 Loons
Upper Two Medicine	0 Loons	0 Loons
Total	1 Single	0 Loons

Non-Priority Lakes	Resident Population	Loon Day
* Big Spring Lake	0 Loons	Not Surveyed
* Croffs Lake	0 Loons	Not Surveyed
* Dog Gun Lake	0 Loons	Not Surveyed
* Duck Lake	1 Pair	Not Surveyed
* Goose Lake	1 Pair	Not Surveyed
Green Lake	0 Loons	Not Surveyed
* Kipp Lake	0 Loons	0 Loons
Lower Two Medicine	0 Loons	0 Loons
Medicine Grizzly	0 Loons	Not Surveyed
* Mission Lake	0 Loons	Not Surveyed
* Mitten Lake	0 Loons	0 Loons
Poia	1 Single	1 Pair
* Spoon Lake	1 Pair	Not Surveyed
* Swift Reservoir	1 Pair	Not Surveyed
Total	4 Pairs, 1 Single	1 Pair

Grand Total	14 Pairs, 26 Singles, 6 Chicks, 7 Broods	11 Pairs, 23 Singles, 5 Chicks, 4 Broods
--------------------	--	--

* Lakes outside Glacier National Park

Legend

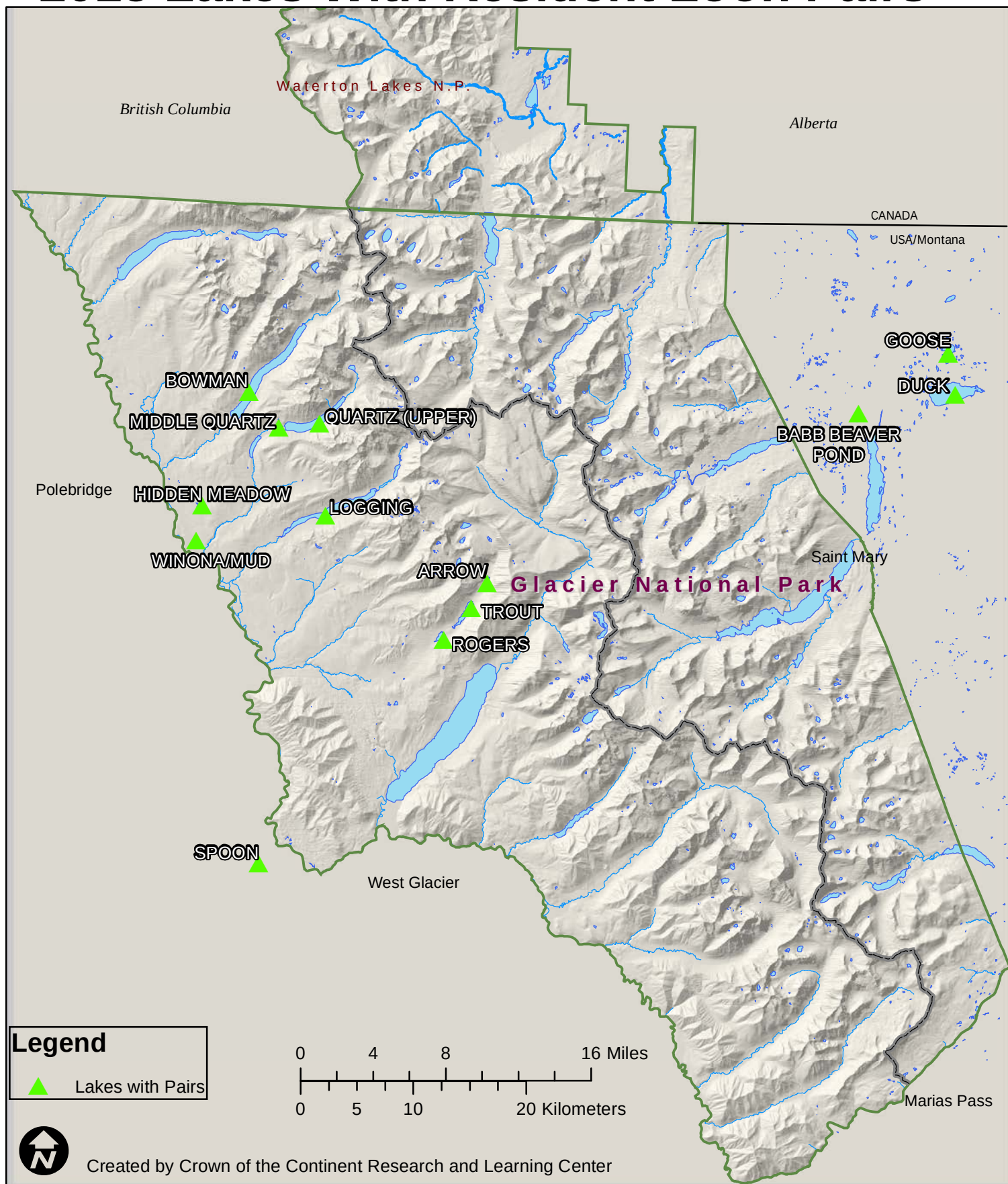
- Lakes with Chicks
- Lakes with Pairs
- Lakes with Singles
- No Resident Loons

0 4 8 16 Miles
0 5 10 20 Kilometers

Created by Crown of the Continent Research and Learning Center

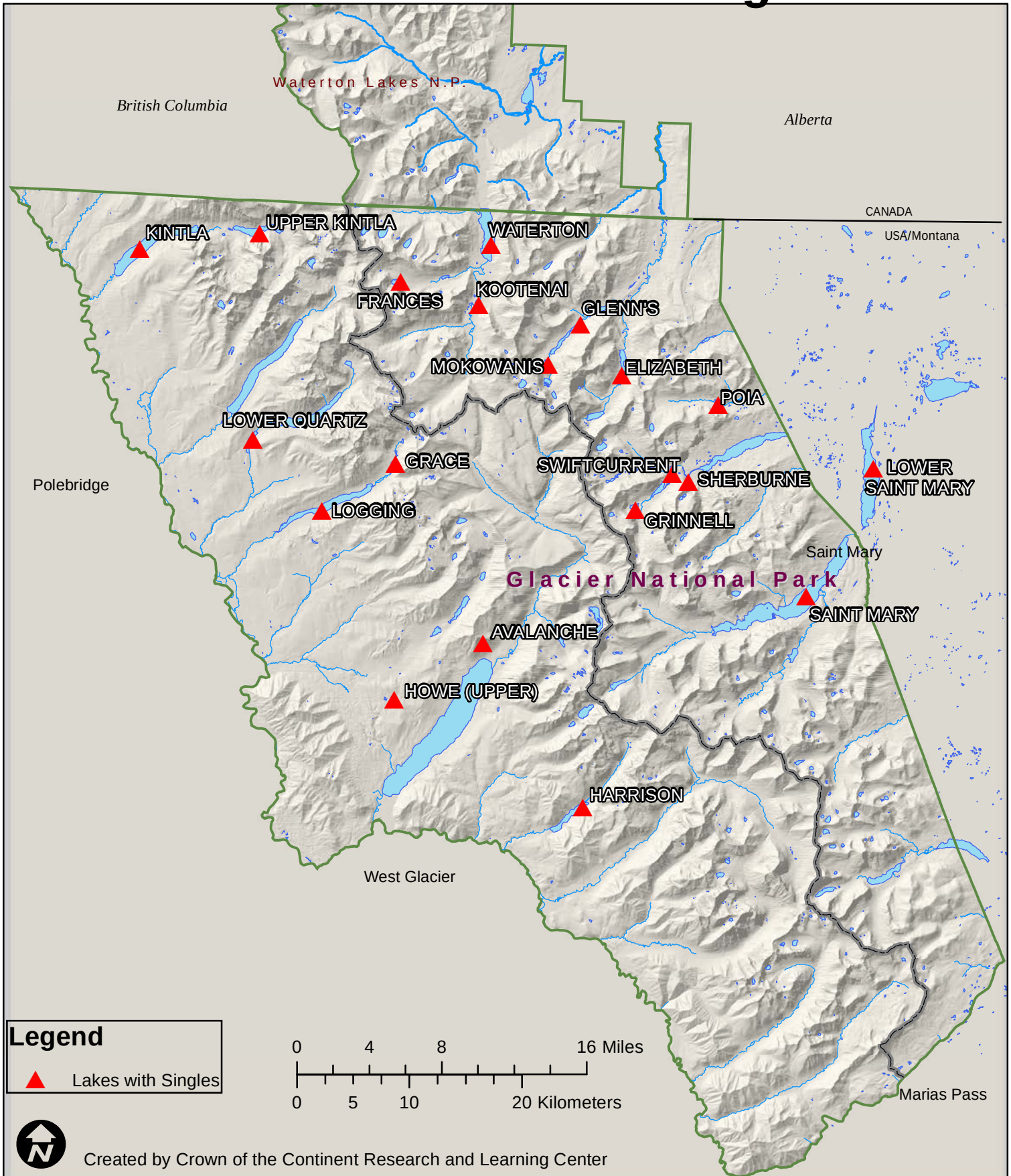


2015 Lakes With Resident Loon Pairs



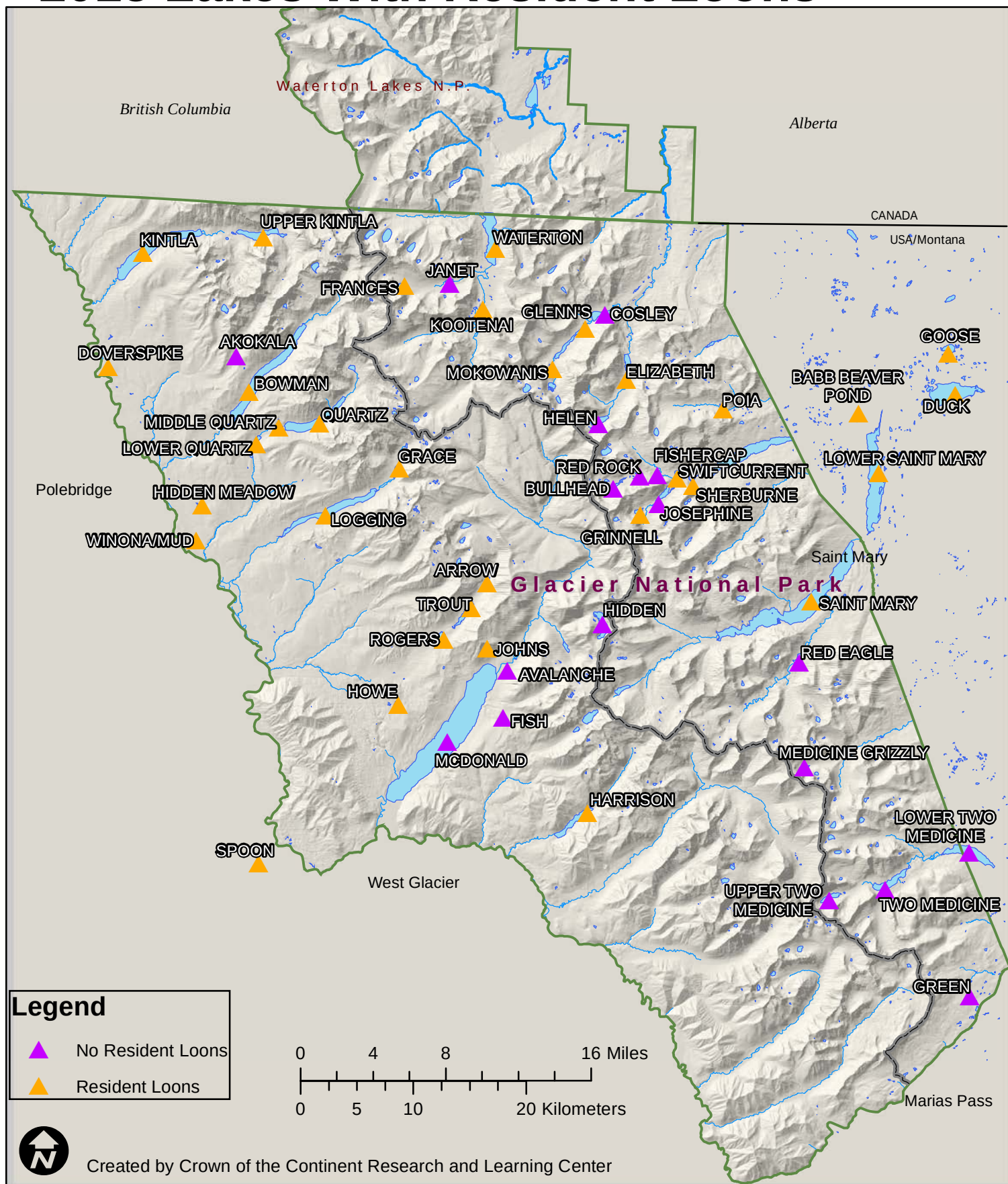


2015 Lakes With Resident Single Loons





2015 Lakes With Resident Loons



Appendix 11: 2015 Loon Days Results

Priority 1	Summary	Observer
Doverspike	2 Chicks	Anne Zavadil, Mary Nelesen
Grace	1 Single	Brian Johnson
Hidden Meadow	1 Single	Barbara Summer, Cyndi Mullings
Howe	2 Singles	Kathy Ross
Kintla	1 Pair, 1 Single	Elizabeth Flesch
Logging	3 Pair, 4 Singles	Brian Johnson
Lower Quartz	No Loons	Carolyn Clark
Middle Quartz	1 Pair, 1 Chick	Carolyn Clark
Quartz	1 Single	Carolyn Clark
Rogers	1 Pair	Bob Chinn
Swiftcurrent	No Loons	Susan Clothier, Matt Murray
Trout	2 Singles	Bob Chin
Winona/Mud	1 Pair, 1 Chick	Brian Johnson
Babb Beaver Pond	1 Pair, 1 Chick	Theresa Steele, Krissy Chief Moon
Lower St. Mary Lake	1 Single	Theresa Steele
Priority 2		
Bowman	No Loons	Elizabeth Flesch
Elizabeth	1 Pair	Josh Martin
Glenns	2 Singles	Sam Thornton
Harrison	No Loons	Andrew Lahr, Iree Wheeler
Priority 3		
Akokala	No Loons	Cynthia Wolf
Arrow	1 Pair	Bob Chinn
Cosley	1 Single	Jo Flick, Sam Thornton
Josephine	No Loons	Becky Williams, Pat McClelland
Kootenai	1 Single	Laura Luther, Carleton Gritts
McDonald	No Loons	Michael Faist
Sherburne	2 Singles	Susan Clothier, Matt Murray
St. Mary	No Loons	Theresa Steele
Two Medicine	No Loons	Terry Peterson, Amy Macleod
Red Eagle	No Loons	Chris Peterson
Upper Kintla	1 Single	Elizabeth Flesch
Waterton	1 Single	Laura Luther, Carleton Gritts
Priority 4		
Avalanche	1 Single	Richard Murphy, Carole Murphy
Bullhead	No Loons	Shauna Cotrell
Fishercap	No Loons	Susan Clothier
Grinnell	No Loons	Becky Williams, Pat McClelland
Helen	No Loons	Josh Martin
Janet	1 Single	Laura Luther, Carleton Gritts
Mokowanis	No Loons	Sam Thornton
Redrock	No Loons	Susan Clothier
Priority 5		
Fish	No Loons	Don Zinn
Frances	No Loons	Elizabeth Flesch
Hidden	No Loons	Wayne Crowder
Johns	No Loons	John Larson
Upper Two Medicine	No Loons	Terry Peterson, Amy Macleod
Other		
Lower Two Medicine	No Loons	Terry Peterson, Amy Macleod
Poia	1 Pair	Ken Lopek
Totals	11 Pairs, 23 Singles, 5 Chicks in 4 broods	

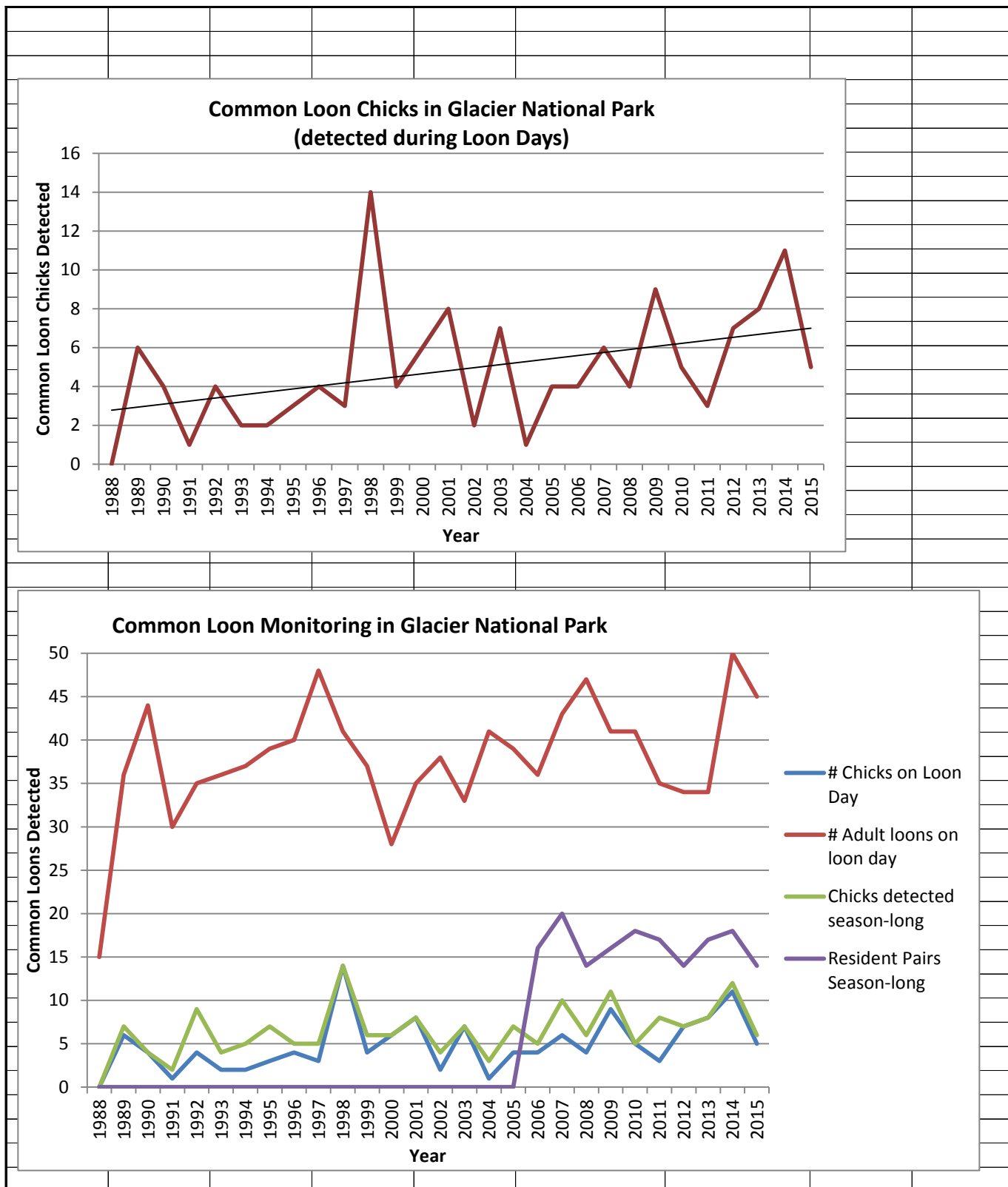
Unique Volunteers and Staff: 38

Total Volunteer Hours: 369

Appendix 12: Common Loon Trends 1988 - 2015

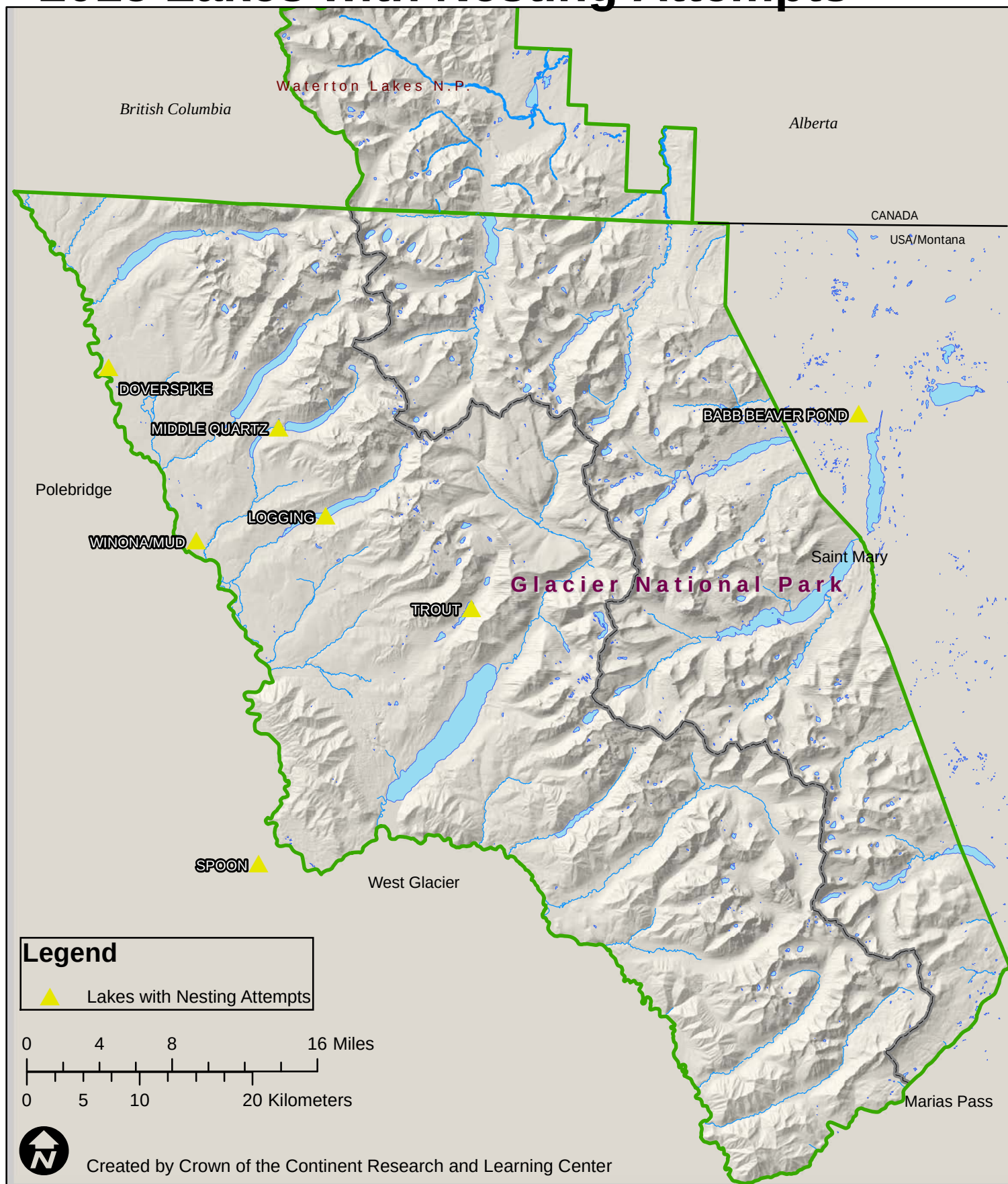
[illegible]

Appendix 12: Common Loon Trends 1988 - 2015





2015 Lakes with Nesting Attempts



Appendix 16: Loon Lakes in Glacier NP – 2015

Priority 1 Lakes

Babb Beaver Pond
Doverspike
Grace
Hidden Meadow
Howe
Kintla
Logging
Lower St. Mary Lake
Lower Quartz
McDonald
Middle Quartz
Quartz
Rogers
Swiftcurrent
Trout
Winona/Mud

Priority 2 Lakes

Bowman
Elizabeth
Glenns
Harrison

Priority 3 Lakes

Akokala
Arrow
Cosley
Josephine
Kootenai
Sherburne
St. Mary
Two Medicine
Red Eagle
Upper Kintla
Upper Two Medicine
Waterton

Priority 4 Lakes

Avalanche
Bullhead
Fishercap
Grinnell
Helen
Janet
Lower Two Medicine
Mokowanis
Redrock

Priority 5 Lakes

Fish
Francis
Hidden
Johns

Priority Definitions

Priority 1: Nesting occurred or attempted in the last five years, as evidenced by presence of brood or observation of nesting behavior.

Priority 2: Nesting records exist **and** lake occupied by resident pair in the previous 5 years, **or** historic nesting records exist but lake has not been occupied by resident pair in previous 5 years.

Priority 3: Lake has been occupied during the nesting season sometime in the previous 5 years by a pair.

Priority 4: Additional lakes with potential breeding habitat (over 10 acres in size and at elevations less than 5200 feet).

Priority 5: Additional lakes under 10 acres and/or at elevations over 5200 feet.

Procedures for Conducting Common Loon Surveys

Before you head out to a lake:

- Familiarize yourself with Park Visitor regulations in the Waterton/Glacier Guide and follow them.
- Please contact the project coordinator in advance to confirm that the lake you want to go to needs to be monitored and get updates about nesting locations etc. (888-7986 or glac_citizen_science@nps.gov)
- Things to bring with you:
 - Loon Observation Forms
 - field guide
 - camera for verification purposes (recommended)
 - trail maps and compass
 - first aid kit, knife, signaling device and matches
 - Lake Map
 - binoculars or spotting scope
 - Bear pepper spray
 - water and food
 - rain gear and extra clothes
- Visit the GNP website at <http://www.nps.gov/glac/planyourvisit/trailstatusreports.htm> or contact the Park information desk at (406)888-7800 to get trail status updates, closure information etc.
- Notify a friend or relative of your hiking locations, itinerary and return time for safety purposes.

When you get to the lake:

- Approach lake with caution and keep quiet so that you **do not disturb loons**.
- **Stay awhile** – Plan to spend an hour or more. You may see loons right away, or it may take up to an hour to confirm presence or absence of loons. Take your time and be sure. Try to view lake from several observation points to ensure you are not missing anything.
- Follow instructions on “Glacier Loon Observation Form” and **complete one form for each lake and one per visit even if you do not see loons**. *Data collected when not seeing loons is just as valuable.*
- **If you identify a nest site** or chicks– keep your distance, photograph and mark location on map.
- **Note other wildlife sightings** at the lake and along the trail on R-10 Wildlife Observation Reporting Form.
- Suggestion: Monitoring lakes during early morning is best –or when winds are light.

When you complete your survey:

- Contact the project coordinator to report your observations (888-7986 or glac_citizen_science@nps.gov)
- **Turn in Loon Observation Form as soon as possible** to the Research Learning Center in person, by email, fax (888-7903) or mail to: GNP-CCRLC-Loon Project, P.O. Box 128, West Glacier, MT 59936

If your survey includes overnight backcountry travel:

- **Get backcountry permit** before going to trail head at backcountry permit offices, if you plan to stay over night in backcountry. Identify yourself as a Glacier National Park Citizen Science Loon Observer and take a copy of your signed participation letter.
- It may be possible to reserve sites if you make a backcountry plan at least 1 week in advance for days of surveys only (if available) with advance reservation fees waived. The rest of the trip can be scheduled when the permit is picked up - not more than 24 hrs in advance of departure date. Please do this by stopping in person at their offices in Apgar, St. Mary, Many Glacier or Two Medicine. For sites in high demand or during busy weekends, you may be asked to change your choice of location or dates.
- If you will be hiking into a backcountry campsite, please do not park in a front-country campsite.

Appendix 17: Loon Lakes in Glacier NP – 2016

Priority 1 Lakes

Babb Beaver Pond
Doverspike
Grace
Hidden Meadow
Howe
Kintla
Logging
Lower St. Mary Lake
Lower Quartz
McDonald
Middle Quartz
Quartz
Rogers
Swiftcurrent
Trout
Winona/Mud

Priority 2 Lakes

Bowman
Elizabeth
Glenns
Harrison

Priority 3 Lakes

Akokala
Arrow
Cosley
Josephine
Kootenai
Sherburne
St. Mary
Two Medicine
Red Eagle
Upper Kintla
Upper Two Medicine
Waterton

Priority 4 Lakes

Avalanche
Bullhead
Fishercap
Grinnell
Helen
Janet
Lower Two Medicine
Mokowanis
Redrock

Priority 5 Lakes

Fish
Francis
Hidden
Johns

Priority Definitions

Priority 1: Nesting occurred or attempted in the last five years, as evidenced by presence of brood or observation of nesting behavior.

Priority 2: Nesting records exist **and** lake occupied by resident pair in the previous 5 years, **or** historic nesting records exist but lake has not been occupied by resident pair in previous 5 years.

Priority 3: Lake has been occupied during the nesting season sometime in the previous 5 years by a pair.

Priority 4: Additional lakes with potential breeding habitat (over 10 acres in size and at elevations less than 5200 feet).

Priority 5: Additional lakes under 10 acres and/or at elevations over 5200 feet.

Raptor Migration Citizen Science Project: 2015

Introduction

Glacier National Park (GNP) hosts one of the most important Golden Eagle migration routes in North America. Nearly 2000 Golden Eagles were recorded migrating past Mt. Brown annually from 1994 through 1996. Recent trend data from outside GNP, however, indicate significant declines in their numbers, attributed to environmental contaminants, habitat loss, prey declines, and climate change. Golden Eagles and other raptors are top predators and migration counts are a cost-effective and efficient approach to detect changes in their numbers and aid in their conservation. Prompted by concerns about Golden Eagles declines and a lack of consistent data in GNP, we piloted a Raptor Migration Citizen Science Project between 2011- 2015 to determine the best location for establishing a Hawk Watch International (HWI) site. Hawk Watch International sites are a network of prime monitoring locations, where observers follow standardized protocols. We used counts of Golden Eagles from Lake McDonald Lodge to calibrate data from pilot sites. Volunteer observers have used Lake McDonald Lodge as a vantage point for documenting distant Golden Eagles overhead since 1994.

Most people catch only fleeting glimpses of raptors soaring overhead. Observing raptors from a HWI site is a life-changing event for many people as they look a falcon in the eyes as it dive bombs a plastic Great-horned Owl that is “perched” on a nearby tree, see the sun lighting up the saffron- golden feathers on an eagle’s wings, or watch raptors riding thermals rising off Glacier’s peaks. The close proximity facilitates reliable identification, enabling volunteers to contribute to a scientifically-sound record of the raptor species that use GNP as a migration corridor. Citizen science volunteers can channel their passion for raptor watching into data that will allow GNP biologists to detect declines and respond to changes in our raptor populations.

Therefore the objectives of the Raptor Migration Citizen Science pilot project are to

- Enlist the help of volunteers and GNP staff to gather baseline information about spatial and temporal distribution of migrating raptors
- Gather baseline data about numbers of migrating Golden Eagles and other raptors
- Determine patterns that influence migration routes and timing
- Monitor trend of raptor numbers over time

In 2014 a grant was applied for to provide the needed resources (i.e. propane, owl decoy, binoculars, stock support, and per diem) to house volunteer primary observers overnight in an NPS cabin near Swiftcurrent Pass, in order to monitor raptors each day from 10 am to 4 pm and teach and assist citizen scientists who hike up to the site each day. Because funding was not received, staff and volunteers continued to hike to the site approximately once per week on September and October to monitor.

Methods

Site Selection

In previous years, test observations were conducted at various sites to find the most optimal HWI site that captured the largest number of migrating eagles, as well as had close enough proximity to migrating raptors to ensure reliable identification. Lisa Bate and Jami Belt led surveys at vantage points near Scalplock Lookout, Mt. Brown, Swiftcurrent Pass, Mt. Stanton, and Looking Glass Ridge. Swiftcurrent Pass has a unique combination of visibility in most directions and proximity to migrating raptors flying

over the pass, and had the highest number of observed species and the highest number of bird seen per hour in 2014 surveys. It was selected as the location for raptor migration monitoring in 2015. Monitoring was also conducted from Lake McDonald Lodge.

Citizen scientist involvement

In 2015, citizen scientists and staff engaged in the Raptor Migration project contributed 190 hours for weekly surveys. Surveys were conducted at Lake McDonald Lodge (LML) on October 1st, 9th, and 16th. Surveys were conducted at Swiftcurrent Pass (SCP) on September 11th and 25th, and October 1st, 9th, and 16th. Survey schedule was dictated primarily by weather and staff availability; if the forecast called for rain, poor visibility or weather that would impede migration or ability to survey, a survey was re-scheduled. A total of 5 citizen scientists and three staff conducted 8 raptor surveys.

Raptor Migration surveys

Surveys were conducted from noon until 4 PM following HWI protocol. Surveys were led by Lisa Bate (Wildlife Biologist), James Waddell (Bio Tech), or VIPs with training in raptor identification. Participants completed the HWI observation data (Appendix 1) form following HWI survey form instructions (Appendix 2) to document all observed raptors during each one hour period and to summarize counts of each species for the four-hour period. Participants also recorded data about weather every hour on the half hour and data about flight conditions at the top of every hour on the HWI Flight and weather form (Appendix 3). Raptors that circled the observation point or did not show conclusive evidence that they were migrating were not counted in totals.

Golden Eagles were seen in the largest numbers followed by Sharp-shinned Hawks and Northern Harriers. A total of 370 migrating raptors, including 313 Golden Eagles, were observed at the two sites (Table 1).

	9/11/15	9/25/15	10/1/15		10/9/15		10/16/15		Total
Species	SCP	SCP	LML	SCP	LML	SCP	LML	SCP	
Sharp-shinned Hawk (SS)	3	0	0	4	0	3	0	1	11
Cooper's Hawk (CH)	2	0	0	3	0	1	0	0	6
Northern Goshawk	0	0	0	0	0	1	0	0	1
Unknown accipiter	1	0	0	0	0	3	0	2	6
Golden Eagle (GE)	2	5	12	3	154	71	16	50	313
Red-tailed Hawk (RT)	1	0	0	3	0	0	0	0	4
Bald Eagle	0	0	0	0	0	1	1	1	3
Northern Harrier (NH)	2	1	0	4	0	0	0	1	8
Large falcon	1	0	0	0	0	0	0	0	1
Rough-legged Hawk	0	0	0	0	0	0	0	1	1
Unknown Eagle	0	0	1	0	0	0	1	1	3
Unknown Buteo	0	0	0	0	0	0	0	1	1
Unknown raptor (UU)	0	1	0	3	0	4	0	4	12
Daily Totals	12	7	13	20	154	84	18	62	370

* Most of these are assumed to be Golden Eagles

Table 1: Raptor observation totals by day and species

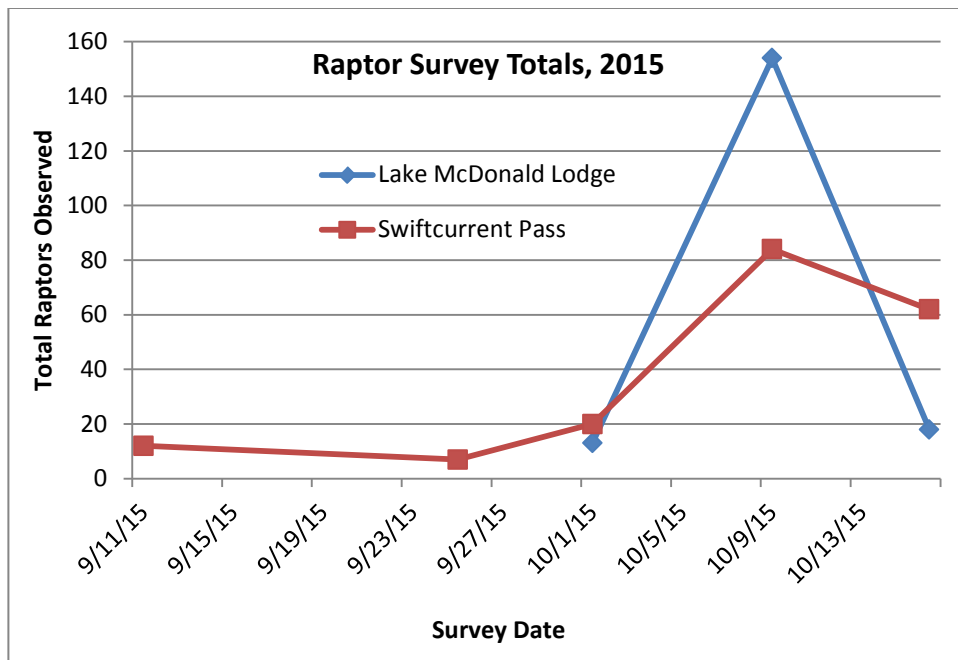


Figure 1. Migrating raptors observed from Lake McDonald Lodge and Swiftcurrent Pass by date.

HAWKWATCH INTERNATIONAL OBSERVATION DATA FORM (Western sites)

Return completed forms to: *Hawk Watch International*, 2240 S. 900 E., Salt Lake City, UT 84106

Form date 2/04/02

SITE: _____

Goshutes use Mountain Standard Time (MST)

Page _____ of _____

DATE: _____

All other sites use local standard time

TOTALS: SS _____ CH _____ SA _____ LA _____ UA _____ RT _____ SW _____

OFFICIAL OBSERVERS:

START TIME: _____ END TIME: _____

UB AK TV GE NH OS UU

#1 _____

START TIME: _____ END TIME: _____

OTHER: Falcons: AF ML PG PR GY SF LF UF

#2 _____

START TIME: _____ END TIME: _____

Buteos: BW FH RL RS ZT

#3 _____

TOTAL OBS TIME (HRS) _____

Accipiters:	NG	Eagles:	BE	UE	TOTAL
1	1	1	1	1	4
2	1	1	1	1	4
3	1	1	1	1	4
4	1	1	1	1	4
5	1	1	1	1	4
6	1	1	1	1	4
7	1	1	1	1	4
8	1	1	1	1	4
9	1	1	1	1	4
10	1	1	1	1	4
11	1	1	1	1	4
12	1	1	1	1	4
13	1	1	1	1	4
14	1	1	1	1	4
15	1	1	1	1	4
16	1	1	1	1	4
17	1	1	1	1	4
18	1	1	1	1	4
19	1	1	1	1	4
20	1	1	1	1	4
21	1	1	1	1	4
22	1	1	1	1	4
23	1	1	1	1	4
24	1	1	1	1	4
25	1	1	1	1	4
26	1	1	1	1	4
27	1	1	1	1	4
28	1	1	1	1	4
29	1	1	1	1	4
30	1	1	1	1	4
31	1	1	1	1	4
32	1	1	1	1	4
33	1	1	1	1	4
34	1	1	1	1	4
35	1	1	1	1	4
36	1	1	1	1	4
37	1	1	1	1	4
38	1	1	1	1	4
39	1	1	1	1	4
40	1	1	1	1	4
41	1	1	1	1	4
42	1	1	1	1	4
43	1	1	1	1	4
44	1	1	1	1	4
45	1	1	1	1	4
46	1	1	1	1	4
47	1	1	1	1	4
48	1	1	1	1	4
49	1	1	1	1	4
50	1	1	1	1	4
51	1	1	1	1	4
52	1	1	1	1	4
53	1	1	1	1	4
54	1	1	1	1	4
55	1	1	1	1	4
56	1	1	1	1	4
57	1	1	1	1	4
58	1	1	1	1	4
59	1	1	1	1	4
60	1	1	1	1	4
61	1	1	1	1	4
62	1	1	1	1	4
63	1	1	1	1	4
64	1	1	1	1	4
65	1	1	1	1	4
66	1	1	1	1	4
67	1	1	1	1	4
68	1	1	1	1	4
69	1	1	1	1	4
70	1	1	1	1	4
71	1	1	1	1	4
72	1	1	1	1	4
73	1	1	1	1	4
74	1	1	1	1	4
75	1	1	1	1	4
76	1	1	1	1	4
77	1	1	1	1	4
78	1	1	1	1	4
79	1	1	1	1	4
80	1	1	1	1	4
81	1	1	1	1</	


$$l=10$$
[illegible]

Species Totals-->

```
<--Totals: Rows\Totals: Columns-->
```

OTHER: Total each species by class codes

Record comments about subspecies, specific age, sex or morph, unusual behavior, unusual plumages, etc. on other side on line with same number.

Record comments about subspecies, unusual behavior, unusual plumages, etc.on line with same number as record on other side.

Line#	COMMENT
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

HawkWatch International: Instructions for Observation Data Form

SITE: Record the field site, such as Goshutes, Sandias, Bridgers, etc.

DATE: Record month/day/year (08/22/01, etc).

OFFICIAL OBSERVERS: Record full names of all **official** observers for that day (volunteer observer information goes on the Flight Information and Weather Data form).

START & END TIMES: Record start and end times for observation periods that day. Note interruptions in observations as appropriate. All start and end times should be on a 5 minute time mark (i.e. 8:00, 8:05, 8:10, etc); the only exception being if you must stop immediately for your personal safety, such as lightning. Start observing on a 5 minute time mark and do not include in the official count any birds seen before the official start time (even your favorite rare spp), although a note in the comments would be appropriate. If you must end before a 5 minute time mark for safety reasons, record the next 5 minute mark as the end time. Record total observation time for the day in the space provided, in hours, to 2 decimal places. Example - 6 hours 40 minutes = 6.67 hrs (to get minutes to 2 decimal places, divide the number of minutes by 60 and round to the nearest .01).

HOURLY TIME PERIODS: Record time in hourly time periods (i.e. 12:00-13:00, 13:00-14:00) using 24 hour time and always use local standard time, not daylight savings time (Goshutes are on the time zone border and use Mountain Standard Time (MST)). You are strongly urged to set your watch to the appropriate standard time at the beginning of the season and leave it there, regardless of any daylight savings time that may occur during the season. If you have a digital watch, setting it to the 24 hr (military) time option will help avoid confusion in time entries.

RECORDING THE COUNT: Use one dot for one bird (.), 2 dots for 2 birds (:), etc. After 4 birds, begin connecting the dots: (: :) denotes 5 birds, () denotes 10 birds, () denotes 20 birds and () denotes 40 birds. Use large, dark dots that are conspicuous without running together. Use more rows on the data form rather than crowding a lot in one square. For large flocks or when counting with clickers, numbers are acceptable, but circle the number. Label (or otherwise note) with a direction (N,S,E,W) birds which are purposefully migrating in a non-standard direction for the migration season. Do not record any trapped birds or other birds seen only by the trappers on this page, except in the Comments.

AGE, SEX AND PLUMAGE CLASSES: Acceptable age, sex, and plumage classes for the commonly seen species are specified in the column headers on the data form. A complete list of abbreviations and acceptable classes and codes for all species is on the back of this instruction sheet. Please only use the codes listed. If you are able to further classify a species (such as from trapping information), but there is no appropriate code for age, sex and/or morph, write the information in the comments.

OTHER: Record raptor species not specified with a column header on the data form in the "OTHER" column. Use the two-letter species codes listed on the back of this instruction sheet. Put the class designator in parenthesis, i.e. BE(A), BW(ID). Please be sure to always include the appropriate standard age-sex-morph code, then add extra age-sex or subspecies information if relevant; e.g., RL(UL-adult female) or ML(AF-taiga). Also, please remember to double-check similar species codes, i.e., Peregrine Falcon (PG) and Prairie Falcon (PR).

NON-RAPTOR SPECIES, COMMENTS, ETC: Record all other comments concerning raptors (such as behavioral or odd plumage observations) or non-raptors (such as flocks of migrating cranes, ravens, geese, etc) on the back of the observation data sheet on the line with the same number as the relevant record on the front. Also clearly note that a comment is included on the back by checking the box at the end of the relevant line on the front.

TOTALS: Summarize totals for each column accurately in the last row at the bottom of the observation data form. Be sure to summarize birds in the OTHER column by class codes. Record the total number of raptors for each hour at the left edge of the form. To verify accuracy, total the birds in the left vertical column; find the total for the last row at the bottom; and the two totals should agree. If the two totals do not agree, correct your arithmetic. When the totals are completed, record the daily totals for each species in the space provided at the top right of the form.

(OVER)

Acceptable species and age-sex-morph class codes for computer entry of observation data

SPECIES	SPECIES CODE	AGE-SEX-PLUMAGE-SIZE CLASS CODES									
FALCONS											
American Kestrel (sex):	AK	M	F	U							
Aplomado Falcon (sex):	AF	A	I	U							
Merlin (age and sex)	ML	AM	BR	U							
Peregrine Falcon (age):	PG	A	I	U							
Prairie Falcon (age):	PR	A	I	U							
Gyrfalcon (morph):	GY	W	G	D							
Unknown Small Falcon (AK or ML):	SF	U									
Unknown Large Falcon (PR, PG, or GY)	LF	U									
Unknown Falcon	UF	U									
EAGLES											
Bald Eagle (plumage-based age):	BE	I = Immature, juvenile or first-year bird, dark breast and tawny belly. S1 = Young subadult, Basic I and II plumages, light belly or upside-down white triangle on the back. S2 = Older subadult, Basic III plumage, head mostly white with osprey-like dark eye line and dark band on tail. NA = Not adult, unknown age immature/subadult (can't be categorized as I, S1 or S2 but definitely not an adult). A = Adult, includes near-adult with dark flecks in head and dark tip to tail (may be hard to see in field) and adult with pure white head and tail. U = Plumage not adequately observed to make an age determination.									
Golden Eagle (plumage-based age):	GE	I = Immature, juvenile or first-year bird, bold white wing patch visible below (small patch may be visible above), bold white in the tail, no molt. S = Subadult, white wing patch variable or absent, obvious white in the tail, molt or tawny bar on upper wing visible. NA = Not adult, unknown age immature/subadult (can't be categorized as I or S but definitely not a full adult), obvious white in wing or tail, but rest of plumage not adequately observed. A = Adult, no obvious white on wing or tail (underside view alone not sufficient). U = Plumage not adequately observed to make an age determination, even if sure bird is not an immature (but include comment).									
Unknown Eagle:	UE										
VULTURES											
Black Vulture:	BV	U									
Turkey Vulture:	TV	U									
Unknown Vulture:	UV	U									
BUTEOS											
Broad-winged Hawk (age and morph):	BW	AD	AL	AU	ID	IL	IU	UD	UL	UU	
Common Black Hawk (age):	CB	A	I	U							
Ferruginous Hawk (age and morph):	FH	AD	AL	AU	ID	IL	IU	UD	UL	UU	
Red-shouldered Hawk (age):	RS	A	I	U							
Red-tailed Hawk (age and morph):	RT	AD	AL	AU	ID	IL	IU	UD	UL	UU	
Rough-legged Hawk (morph):	RL	UD	UL	UU							
Swainson's Hawk (morph):	SW	UD	UL	UU							
Short-tailed Hawk (morph):	ST	UD	UL	UU							
White-tailed Hawk (age):	WT	A	I	U							
Zone-tailed Hawk (age and sex):	ZT	AM	AF	AU	I	U					
Harris' Hawk (age):	HH	A	I	U							
Unknown Buteo:	UB	U									
ACCIPITERS											
Sharp-shinned Hawk (age):	SS	A	I	U							
Cooper's Hawk (age):	CH	A	I	U							
Northern Goshawk (age):	NG	A	I	U							
Unknown Small Accipiter (SS or CH):	SA	U									
Unknown Large Accipiter (CH or NG)	LA	U									
Unknown Accipiter	UA	U									
KITES											
Mississippi Kite (age):	MK	A	I	U							
Swallow-tailed Kite (age):	SK	A	I	U							
White-tailed Kite (age):	WK	A	I	U							
Unknown Kite:	UK	U									
HARRIERS, OSPREY, AND OTHERS											
Northern Harrier (age and sex):	NH	AM	AF	BR	I	U					
Osprey:	OS	U									
Crested Caracara:	CC	A	I	U							
Unknown Raptor:	UU	U									

CODES: **Age:** A = adult, S= subadult (may include numbers 1 and 2 for plumage distinctions), I = immature, meaning juvenile or first-year bird (second-year for spring migrants), NA = not adult, unknown age immature (S or I), but not adult plumage, U = unknown; **Sex:** M = male, F = female, U = unknown; **Plumage:** BR = brown (for indistinguishable immature and adult female harriers and Merlins), L = light morph, D = dark morph (rufous birds are considered dark morphs but can be noted in comments), U = unknown morph; **Gyrfalcon plumages:** W = white phase, G = gray phase, D = dark phase.

During computer entry of data, other more difficult or detailed age, sex or subspecies distinctions noted on the observation data sheet (such as Prairie Merlin, adult Swainson's Hawk or non-juvenile Golden Eagle) will be entered, but only in the Comments field.

HawkWatch International Flight Information and Weather Data Form

Return completed forms to: *Hawk Watch International*, 2240 S. 900 E., Salt Lake City, UT 84106

form date 08/10/08

SITE: _____ LOOKOUT (LO): _____

DATE: (mm/dd/yr) _____

START TIME 1: _____

END TIME 1: _____

START TIME 2: _____ LO: _____

END TIME 2: _____

START TIME 3: _____ LO: _____

END TIME 3: _____

TOTAL OBSERVATION HRS: _____

Record start and stop times and total hours of active observation for each observer

START	END	START	END	START	END	TOTAL HOURS
-------	-----	-------	-----	-------	-----	-------------

HOURLY OBSERVATION & FLIGHT INFORMATION

Col. 1 is an hourly time period beginning on the hour. Record an hourly summary in col. 1 thru 4 for every hour from the 1st obs start time to the last end time. Record summary flight info in col. 5-7 for hourly periods in which birds were counted. Leave col. 5-7 blank if no birds that hour. Record cols. 1-7 at the end of the time period (i.e., for 1100 to 1200, record at 1159).

[illegible]

WEATHER DATA FORM

Record weather data in col. 8 thru 16 at the start time, every hour on the half hour, and at the end time. Record additional weather for changes in conditions, especially when observation is interrupted. For example, for observation started at 0845, interrupted at 1025 for rain, restarted at 1140, and ended for the day at 1400, record weathers at 0845, 0930, 1025, 1140, 1230, 1330, and 1400.

[illegible]

FLIGHT ALTITUDE

Col.5	Record HMANA code 0 through 7. (See Weather Form Instructions for code definitions)
--------------	--

HORIZONTAL DIRECTION

Col.6	E	mostly passing on the <u>E</u> ast
	W	mostly passing on the <u>W</u> est
	O	passing mostly directly <u>O</u> verhead
	M	<u>M</u> ixed
	Z	Non-standard direction (rarely used, include explanation in comments)
Note: Smith Point uses unique codes (N, S, E, O, M, Z). (See Weather Form Instructions for details)		

HAWKWATCH INTERNATIONAL (HWI) DISTANCE CODE

Enter HWI code 1, 2, 3, 4, or M (mixed) (See Weather Form Instructions for code definitions)	
---	--

SKY CONDITION

Col.9	0 Clear, 1-15%	5 Fog
	1 Partly Cloudy, 16-50 %	6 Haze
	2 Mostly Cloudy, 51-75%	7 Rain or Drizzle
	3 Overcast, 76-100%	8 Snow
	4 Wind-driven sand, dust, snow	9 Thunderstorms (with or w/out rain)
(Always use codes 0-3 first, then up to 2 other codes in order of prevalence)		

CLOUD TYPE

Col.10	C Cumulus	NS Nimbo-stratus
	CN Cumulo-nimbus	F Fog (not haze)
	R Cirrus	0 (zero) Clear (none of above)
	S Stratus	
	(Use up to 3 codes in order of prevalence, and use commas between codes)	

THERMAL LIFT

Col.11	1	Excellent	3	Fair
	2	Good	4	Poor
	(See Weather Form Instructions for code definitions)			

WIND VELOCITY CODES (use codes only if Sherpa malfunctions, then clearly indicate on data form that codes and not actual speeds were used)

0	Less than 1 km/hr	5	29-38 km/hr (19-24 mph)
1	1-5 km/hr (1-3 mph)	6	39-49 km/hr (25-32 mph)
2	6-11 km/hr (4-7 mph)	7	50-61 km/hr (32-38 mph)
3	12-19 km/hr (8-12 mph)	8	62-74 km/hr (39-46 mph)
4	20-28 km/hr (13-18 mph)	9	Greater than 75 km/hr (47 mph)

(Use only of anemometer not available, see Weather Form Instructions for details)

COMMENTS: (Indicate any info regarding change in conditions here.)

Citizen Science Quotes 2015

“We had such a great time doing goat surveys with Citizen Science! The members enjoyed hiking to so many beautiful locations and it was a wonderful way to close out our session. We hope that our work provided valuable information for the park. Thanks so much for the opportunity!” *Sam and Trevor, Glacier Youth Conservation Corps group #2 leaders*

“Thank you for another great schedule of surveys – we got to see parts of the park we would never have seen, and the crew really enjoyed both the hikes and the surveys (especially on the occasions we had wildlife sightings). I hope the rest of the season is productive for you and all the citizen scientists you work with!” *Tricia Rossettie and Luke Dovre, Glacier Youth Conservation Corps #1 leaders*

“Thanks for letting us see & experience the loons. It was really interesting and the sites are really beautiful.” *Woods Project 2015 student*

“Thank you for letting us experience & see the beautiful views with the lakes. Watching loons was really relaxing & an experience that will probably never happen again. Once again thank you!” *Woods Project 2015 student*

“Thank you for giving us the opportunity to survey loons, and hike around Glacier National Park. I saw so many beautiful sights that I’d probably never see in my life again. They were all amazing, and I’m hoping to come back!” *Woods Project 2015 student*

“Thank you for supporting the Woods Project and giving me this great opportunity to go and explore!” *Woods Project 2015 student*

Citizen Science VIP Hours, FY 2015

Observer	Pika Survey Count	Goat Survey Count	Loon Survey Count	Weed Survey Count	Raptor Survey Count	Pika Volunteer hours	Goat Volunteer Hours	Loon Volunteer Hours	Weed Survey Hours	Raptor Survey Hours	Total Surveys	Total Hours
Chinn, Bob	3	4	12			25	37	117			19	179
Clark, Carolyn		4	7				49	57			11	106
Clark, Jeffery		1					9				1	9
Clothier, Susan	3	12	42			16	78	213			57	307
Crowder, Wayne		1	5				11	40			6	51
Faist, Michael	3	5	4			11	26	34			12	71
Gritts, Carleton	1	4	6			4	44	81			11	128
Johnson, Brian		12	9	5			136	119	54		26	308
Mayes, Diane	1	8	3	4		9	71	15			16	95
Murphy, Carole	1	2	5	4		9	21	35	34		12	100
Murphy, Rick	1	4	4			9	32	30	34		9	105
Murray, Matthew		6	20				44	84			26	128
Steele, Theresa		2	12				18	135			14	153
Summer, Barbara		8	6				67	40			14	107
West, Joan		9	11				95	81			20	177
Williams, Becky	1	2	2		5	4	15	21		50	10	89
Totals	14	84	148	13		85	753	1100	122	50	264	2110

Outreach Group Volunteer Hours, FY 2015

Observer	Pika Survey Count	Goat Survey Count	Loon Survey Count	Weed Survey Count	Members	Pika Volunteer hours	Goat Volunteer Hours	Loon Volunteer Hours	Weed Survey Hours	Total Surveys	Total Hours
Boy Scouts, Pittsburg				1	12	0	0	0	48	1	48
Flathead High School, 2015	4	21			15	30	111	0	0	25	141
MCC Glacier Youth 2015	7	6	2		8	355	318	141	0	15	813
MCC Glacier Youth 2015 #2		4		1	6	0	171	0	0	5	171
Sierra Club, 2015	6	6			12	86	132	0	0	12	218
Wildlife Society, University of Montana	1	1			25	200	150	0	0	2	350
Woods Project, 2015			9		39	0	0	949	0	9	1016
Totals	18	38	11	2	117	670	882	1090	48	69	2756

Observer	Number in Group	Number on each Survey	High Country	Loons	Weeds	Pika Survey Count	Goat Survey Count	Loon Survey Count	Pika Survey Hours	Goat Survey Hours	Loon Survey Hours	Weed Survey Hours	Raptor Survey Hours	Total Volunteer Hours
Andrews, Kirstan	1	1	TRUE	FALSE	FALSE	1	1		7					7
Barrus, Nancy	1	1	TRUE	FALSE	FALSE	1			10					10
Bate, Lisa	1	1	TRUE	TRUE	TRUE			8			57.0		30	87
Bennett-Hudel, Julie	1	1	FALSE	FALSE	TRUE									0
Benson, David	1	1	TRUE	TRUE	FALSE			2			19.0			19
Boy Scouts	12	12	FALSE	FALSE	TRUE							6		72
Bussing, Laura	1	1	FALSE	TRUE	FALSE			1			2.5			3
Chickering, Karen	1	1	TRUE	TRUE	TRUE		1			8			40	48
Chief Moon, Krissy	1	1	FALSE	TRUE	FALSE			12			47.0			47
Chinn, Bob	1	1	TRUE	TRUE	TRUE	3	4	12	25	37	90.9			153
Chinn, Mary	1	1	TRUE	FALSE	FALSE	2	1		15	9				24
Clarín, Sam	1	1	TRUE	FALSE	FALSE		1			3				3
Clarín, Sara	1	1	TRUE	FALSE	FALSE		1			7				7
Clark, Carolyn	1	1	TRUE	TRUE	FALSE		4	7		49	48.0			97
Clark, Jane	1	1	TRUE	TRUE	TRUE		1	12		7	64.6	9		81
Clark, Jeffery	1	1	FALSE	FALSE	FALSE		1			9				9
Clothier, Susan	1	1	TRUE	TRUE	FALSE	3	12	42	16	78	121.9			216
Cotrell, Shauna	1	1	FALSE	TRUE	FALSE			7			25.3			25
Cronk, Virginia	1	1	TRUE	FALSE	FALSE		4			27				27
Crowder, Wayne	1	1	FALSE	TRUE	FALSE		1	5		11	39.8			51
Donohue, Adelle	1	1	TRUE	FALSE	FALSE	2			7					7
Donovan, Mary Ann	1	1	TRUE	TRUE	FALSE			2			8.3			8
Dow, Nancy	1	1	TRUE	FALSE	FALSE		1			1				1
Downs, Chris	1	1	FALSE	TRUE	FALSE			1			10.5			11
Ewert, Emily	1	1	FALSE	TRUE	FALSE		1	12		7	65.5			73
Faist, Michael	1	1	TRUE	TRUE	FALSE	3	5	4	11	21	22.5			54
Fisher, Karalea	1	1	FALSE	TRUE	FALSE			1			4.5			5
Flathead High School, 2015	15	1	TRUE	FALSE	FALSE	4	2		9	25				34
Flesch, Elizabeth	1	1	TRUE	TRUE	TRUE	10	18	14	50	147	99.6			297
Flick, Jo (Joann)	1	1	FALSE	TRUE	FALSE			2			24.0			24
Fredenberg, Carter	1	1	FALSE	TRUE	FALSE			1			10.5			11
Freniere, Mary	1	1	FALSE	FALSE	TRUE							17		17
Gniadek, Steve	1	1	TRUE	TRUE	FALSE			8			42.7			43
Gratch, Alan	1	1	FALSE	FALSE	TRUE									0
Graves, Tabitha	1	1	TRUE	TRUE	FALSE	1	1	3	0	6	24.4			31
Gritts, Carleton	1	1	TRUE	TRUE	FALSE	1	4	6	4	44	52.5			100
Harada, Sumio	1	1	TRUE	TRUE	FALSE		1			11				11
Harkness, Sam	1	1	TRUE	FALSE	FALSE	1			9					9
Hathaway, Donna	1	1	TRUE	FALSE	FALSE	4	5		32	38				70
Igoe, Bill	1	1	TRUE	FALSE	FALSE	2	2		18	12				30
Igoe, Kate	1	1	FALSE	FALSE	TRUE	2	2		18	12				30

Ryan, Sara	1	1	TRUE	TRUE	FALSE	4	3	8	23	34	24.5			82
Scott, Melissa	1	1	FALSE	TRUE	FALSE			2			0.3			0
Seaman, Amy	1	1	FALSE	TRUE	FALSE			3			19.0			19
Shogren, Randal	1	1	FALSE	FALSE	TRUE							54		54
Shors, Ann	1	1	FALSE	TRUE	FALSE		1			6				6
Siegler, Chris	1	1	TRUE	FALSE	FALSE		2			9		4		13
Siegler, Jeannie	1	1	TRUE	FALSE	TRUE	8	6		41	31		11		83
Sierra Club, 2015	12	4	TRUE	FALSE	TRUE	6	6		12	27				157
Sloan, Joshua	1	1	TRUE	FALSE	FALSE		3			23				23
Sloan, W	1	1	TRUE	FALSE	FALSE		1			13				13
Smith, Bob	1	1	FALSE	TRUE	FALSE			1			8.0			8
Smith, Paula	1	1	FALSE	TRUE	FALSE			2			13.0			13
Smith, Sylvia	1	1	FALSE	TRUE	FALSE			2			8.5			9
Sohl, Ned (Edward)	1	1	FALSE	FALSE	TRUE									0
Steele, Gail	1	1	TRUE	TRUE	FALSE		2			20				20
Steele, Theresa	1	1	TRUE	TRUE	TRUE		2	12		18	68.0			86
Stroud, Lea	1	1	FALSE	TRUE	FALSE			1			14.9			15
Summer, Barbara	1	1	TRUE	TRUE	FALSE		8	6		61	40.3			101
Thomas-Rosszog, Beth	1	1	FALSE	FALSE	TRUE									0
Thornton, Sam	1	1	TRUE	TRUE	TRUE			5			34.5			35
Vaninetti, Angela	1	1	TRUE	FALSE	FALSE		2			9				9
Waddell, James	1	1	FALSE	TRUE	FALSE			13			64.7		10	75
West, Joan	1	1	TRUE	TRUE	FALSE		9	11		95	69.3			165
Wheeler, Iree	1	1	FALSE	TRUE	FALSE			4			36.0			36
Wildlife Society, University of Montana	25	25	FALSE	FALSE	FALSE	1	1		8	6				350
Williams, Becky	1	1	TRUE	TRUE	TRUE	1	2	2	4	15	10.3		40	69
Wilson, Leslie	1	1	FALSE	TRUE	FALSE			1			2.0			2
Wirtz, Rita	1	1	FALSE	TRUE	FALSE			1			8.5			9
Wolf, Cynthia	1	1	FALSE	TRUE	FALSE			10			41.0			41
Wollner, Dave	1	1	TRUE	FALSE	FALSE		3			16				16
Wollner, Sue	1	1	TRUE	FALSE	FALSE		3			16				16
Woods Project, 2015	39	13	TRUE	TRUE	TRUE			9			63.8			829
Zavadil, Anne	1	1	TRUE	TRUE	TRUE		1	3		8	20.0		40	
Zinn, Don	1	1	TRUE	TRUE	TRUE		1	1		5	5.0			10
Weed Blitz members excluding the groups listed seperately	9	9	FALSE	FALSE	FALSE							6		54
Totals	247								497	1694	2342	234	170	7150.0

2015 Citizen Science Training and Outreach

Date	Loon sessions	High Country sessions	Invasive Plant sessions	Raptor Migration Session	Duration (hours)	New CS attendees	Returning CS attendees	VIP attendees	Outreach group attendees	GNP/ USGS Staff attendees	Total Hours of training	Location	Citizen Science staff (Leading)	Citizen Science Staff hours	Outreach program name	Students	Adults	Teachers/ group leaders
5/22/15	1	0	0	0	6	5	0	0	0	1	36	CCRLC	2	12	Loon Training	0	6	
6/26/15	1	0	0	0	6	2	0	1	0	0	18	CCRLC	2	12	Loon Training	0	3	
7/9/15	1	0	0	0	6	2	0	0	0	2	24	CCRLC	2	12	Loon Training	0	4	
6/18/15	1	0	0	0	6	3	0	0	11	0	84	CCRLC	2	12	Loon Training	10	4	1
6/12/15	0	1	0	0	9	5	0	2	0	4	99	CCRLC	3	27	High Country Training	0	11	
6/19/15	0	1	0	0	9	2	0	1	8	1	108	Glacier Park Lodge	1	9	High Country Training	0	12	2
7/2/15	0	1	0	0	9	4	0	3	0	1	72	CCRLC	1	9	High Country Training	0	8	
7/21/15	0	0	1	0	6	2	3	2	12	7	156	Community Building	4	24	Weed Blitz	11	26	1
9/19/15	0	1	0	0	8	0	0	0	25	0	200	Community Building	1	8	High Country Training	25	25	1
8/11/15	0	1	0	0	9	0	0	0	6	0	54	CCRLC	1	9	High Country Training	0	6	2
8/3/15	0	1	0	0	9	0	0	0	12	0	108	CCRLC	1	9	High Country Training	0	12	1
7/20/15	1	0	0	0	9	0	0	0	39	0	351	Big Creek	2	18	Loon Training	36	3	3
6/30/15	0	0	0	0	2	0	0	0	14	0	28	Glacier Institute Field Camp	2	4	Citizen Science Program Overview	0	14	1
multiple days	0	1	0	0	9	0	0	0	15	0	135	Flathead HS	1	9	HC Training for Flathead HS IB Class	14	1	1
ongoing	0	0	1	0	2	2	0	1	0		6	Online	0	0	Invasive Plant on-line training attendees	0	3	0
Totals	5	7	2	0	99	22	3	10	142	15	1479		23	174		96	132	13

outreach group participants (excluding leaders)	Comments	Total CS loon attendees	Total new and outreach loon attendees	Total CS HC attendees	Total new and outreach HC attendees	Total CS Inv Plant attendees	Total new and outreach Inv Plant attendees
		6	6	0	0	0	0
		3	2	0	0	0	0
		4	4	0	0	0	0
10	Gordon Luikart's U of M group	14	14	0	0	0	0
		0	0	11	9	0	0
7	MCC Group of 9 including 2 leaders	0	0	12	11	0	0
		0	0	8	5	0	0
11	Boy Scout group from Pittsburgh - 11 kids and leader	0	0	0	0	26	21
24	University of Montana Wildlife Society group. 25 students including group leader	0	0	25	25	0	0
4	MCC group of 6 with 2 leaders	0	0	6	6	0	0
11	Sierra Club	0	0	12	12	0	0
36	Woods Project	39	39	0	0	0	0
13	Master Naturalist Program	0	0	0	0	0	0
14	Flathead HS IB Class	0	0	15	15	0	0
0	Attendees who notified us- John Rosswog, Diane Mayes, Randy Shogren	0	0	0	0	3	2
130		66	65	89	83	29	23

2015 Glacier Youth Conservation Corps Citizen Science Surveys

Crew Leaders	Survey Completed	Type	Date	Day Start	Day End	Crew Members	Effort Hours	Findings
Tricia Rossettie & Luke Dovre	Dry Fork Creek	Ungulate	6/19/2015	13:02	17:30	9	40	No Detection
Tricia Rossettie & Luke Dovre	Dry Fork 31	Pika	6/19/2015	11:00	17:30	9	59	Sighting, fresh and old sign
Tricia Rossettie & Luke Dovre	Autumn Creek	Ungulate	6/29/2015	9:00	16:00	9	63	6 adult and 2 young goats
Tricia Rossettie & Luke Dovre	Hidden Lake	Ungulate	6/30/2015	8:00	14:30	9	59	1 adult and 5 young goats
Tricia Rossettie & Luke Dovre	Hidden Lake 45	Pika	6/30/2015	8:00	16:30	9	77	Old sign
Tricia Rossettie & Luke Dovre	Trout Lake	Ungulate	7/1/2015	9:30	19:00	9	86	No Detection
Tricia Rossettie & Luke Dovre	Trout Lake	Loon	7/1/2015	9:30	18:20	9	80	1 Pair
Tricia Rossettie & Luke Dovre	Arrow Lake	Loon	7/2/2015	7:45	16:30	9	79	No Detection
Tricia Rossettie & Luke Dovre	Snyder Lake 36	Pika	7/3/2015	9:15	13:00	9	34	Old sign
Tricia Rossettie & Luke Dovre	Otokomi Lake	Ungulate	7/9/2015	10:01	17:30	9	67	No Detection
Tricia Rossettie & Luke Dovre	Otokomi Lake 30	Pika	7/9/2015	10:01	17:30	9	67	Fresh and old sign
Tricia Rossettie & Luke Dovre	Apikuni Falls	Ungulate	7/10/2015	9:07	13:55	9	43	No Detection
Tricia Rossettie & Luke Dovre	Apikuni Falls 01	Pika	7/10/2015	9:07	13:55	9	43	Sighting, call, fresh and old sign
Tricia Rossettie & Luke Dovre	Hidden Lake 47	Pika	8/2/2015	8:00	16:30	9	77	Call, fresh and old sign
Samantha McKeachnie & Trever Walters	Cut Bank Creek	Ungulate	8/11/2015	7:30	16:00	6	51	No Detection
Samantha McKeachnie & Trever Walters	Scenic Point	Ungulate	8/12/2015	8:30	16:00	6	45	No Detection
Samantha McKeachnie & Trever Walters	Preston Park	Ungulate	8/13/2015	8:30	15:30	6	42	2 adult and 1 young goat
Samantha McKeachnie & Trever Walters	Avalanche Lake	Ungulate	8/14/2015	8:00	13:30	6	33	No Detection
Totals	18 Surveys						1043	