Colorado Parks and Wildlife

Furbearer Management Report

2016-2017 Harvest Year

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Furbearer Management Report - Executive Summary 2016-2017

In order to prioritize management and harvest data collection needs, CPW examined furbearer species for their relative reproductive potential, habitat needs and risks, as well as relative amounts of historic harvest. This examination resulted in development of management guidelines in 2012 for bobcat, swift fox, and gray fox harvest and efforts toward improving confidence in harvest survey results for swift fox, gray fox, and pine marten.

Management Guidelines

Bobcat – At all spatial scales bobcat are meeting the management thresholds. The available information suggests that bobcat populations are stable or increasing in most or all of Colorado. Mortality density was below thresholds at all scales. Female harvest composition stayed at high levels in most areas of the state, similar to last year, contrary to the notion of stabilized or increasing bobcat populations. However, it should be noted that while female proportions in hunting harvest (the least selective form of mortality) have risen to 50% or above at most monitoring scales, hunting comprises only about 40% of total bobcat mortality, second to trapping. Prey abundance appears to be at average levels. A 5-year baseline index was established for Harvest per unit effort (HPUE), which will be used in future evaluations.

Swift Fox – Surveys indicate no significant changes in habitat occupancy between 1995 and 2016. Occupancy surveys were completed in fall of 2016 and results indicate nearly identical swift fox occupancy rates to 2011. Harvest surveys were not conducted for swift fox in 2016-2017 so no harvest mortality density evaluation was done.

Gray Fox – Harvest surveys were not conducted for gray fox in 2016-2017 so no harvest mortality density evaluation was done.

Harvest Survey

Pine Marten – Harvest survey was not conducted in 2016-2017.

The extraordinarily wide confidence limits on harvest points to a problem with the harvest survey data and the way in which sampling is conducted. This problem calls into question the validity of any furbearer harvest estimates (including swift fox, gray fox, and pine marten) which are derived from the current harvest survey methods so we opted to not conduct the survey in 2016-2017 or 2017-2018 while we evaluate improvements.

Introduction

In July 2011, the Colorado Parks and Wildlife Commission directed staff to review the management priorities, data collection processes, and management approaches for furbearer species in a consultative process with interested stakeholders. Subsequent recommendations on priorities, processes, and management guidelines were forwarded to the Parks and Wildlife Commission in a 2 step public review process and were finalized in July 2012. The review process prioritized furbearer species for enhanced harvest data collection and for development of species specific management guidelines. Priority species identified for improved harvest data collection are: gray fox, swift fox, and pine marten. Priority species identified for development of management guidelines priority species are: bobcat, gray fox, and swift fox.

Colorado Parks and Wildlife (CPW) decided to use the Harvest Information Program (HIP) as a means of "pre-registering" fur harvester's intent to take these species. Doing so allows stratification of survey samples in an effort to improve the confidence in harvest estimates and the location of harvest. Despite these efforts survey results continue to be plagued by extremely large confidence limits, high variability, and lack precision. This is primarily due to the extremely small number of fur harvest participants within the very large pool of licensed small game hunters. In Colorado, a person with a small game license can harvest furbearers just as a person with a furbearer license can. Therefore, it is extremely difficult to obtain a sufficient sample size of individuals with a high likelihood of fur harvesting when conducting harvest surveys. Stratification of the survey sample based on fur harvesters HIP self-reported propensity to hunt/trap gray fox, swift fox, or pine marten did not improve the precision or accuracy of the harvest estimates (the 2015-2016 swift fox harvest estimate is exemplary of this sampling problem causing large variance in estimates). Given the highly imprecise harvest estimates CPW was obtaining, rather than continue surveying fur harvesters and producing harvest estimates with the described problems, the decision was made to not survey for gray fox, swift fox or pine marten harvest in 2016-2017 or 2017-2018. However, Colorado Parks and Wildlife will continue to assess and evaluate methods to improve sampling precision for harvest of gray fox, swift fox and pine marten in future years.

Bobcats were also identified as a high priority species for harvest data collection; fortunately the mandatory check process was deemed adequate for obtaining harvest data. Several years ago however, the mandatory bobcat check form was revised to include collection of information that would allow estimation of bobcat harvest per unit effort, which is one of the management guidelines developed for bobcats.

In July 2012, the Colorado Parks and Wildlife Commission approved the new data collection processes and new management guidelines for bobcat, gray fox, and swift fox. Those guidelines and their corresponding data results are summarized in specific sections of this report.

This report contains several sections:

Section I Historic and recent harvest data
Section II Bobcat management guideline analysis
Section III Swift fox management guideline analysis
Section IV Gray fox management guideline analysis
Section V Pine marten harvest data analysis
Section VI Summary and critique of harvest data collection, management guideline analysis and recommendations for improvement

SECTION I: Recreational Harvest Data

HISTORIC HARVEST DATA

	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17
Badger	158	159	110	n/s	135	n/s	n/s	225	n/s	102	550	n/s	n/s	n/s	n/s
Beaver	1576	896	238	n/s	1072	n/s	n/s	356	n/s	782	1147	n/s	n/s	n/s	n/s
Bobcat (Total Mortality)	644	766	796	1261	1708	1845	1783	1399	1578	1686	1917	2022	1695	1407	1924
Bobcat (Harvest Only)	562	680	717	1163	1605	1743	1668	1303	1489	1628	1854	1945	1634	1352	1811
Coyote	39610	45912	38211	n/s	34943	31204	42427	n/s	49974	64294	41337	n/s	28529	42513	37180
Gray Fox	CS	CS	CS	CS	CS	CS	CS	109	n/s	510	763	1047	164	1003	n/s
Red Fox	1517	997	457	n/s	n/s	n/s	n/s	1925	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Swift Fox	CS	CS	CS	CS	CS	CS	CS	153	n/s	107	381	416	609	11417	n/s
Mink	CS	CS	CS	CS	0	n/s	n/s	15	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Muskrat	1300	87	439	n/s	1230	1230	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Opossum	CS	CS	CS	CS	CS	CS	CS	45	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Pine Marten	CS	CS	CS	CS	175	n/s	n/s	52	n/s	139	940	1569	2018	993	n/s
Raccoon	2777	2153	293	n/s	n/s	n/s	n/s	5299	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Ring-tailed Cat	CS	CS	CS	CS	CS	CS	CS	0	n/s	9	74	n/s	n/s	n/s	n/s
Striped Skunk	2482	896	274	n/s	n/s	n/s	n/s	948	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Western Spotted Skunk	CS	CS	CS	CS	CS	CS	CS	0	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Long-tailed Weasel	CS	CS	CS	CS	CS	CS	CS	0	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Short-tailed Weasel	CS	CS	CS	CS	CS	CS	CS	0	n/s	n/s	n/s	n/s	n/s	n/s	n/s

CS = closed season n/s = not surveyed

2012 – 2013 Harvest Data

Species	Hunters	Hunters Low – High Confidence Range	Days Hunted	Days Hunted Low – High Confidence Range	Harvest	Harvest Low – High Confidence Range
Badger	285	182 – 445	3,301	2,162 – 5,039	550	278 – 1,091
Beaver	299	207 – 432	3,737	2,198 – 6,353	1,147	690 – 1,907
Bobcat	-		-		1,854	
Coyote	9,782	pending	156,768	pending	41,337	pending
Gray Fox	214	146 – 313	6,109	3,646 – 10,238	763	396 – 1,470
Swift Fox	318	106 – 956	1,980	901 – 4,355	381	116 – 1,248
Pine Marten	235	60 – 927	5,102	1,271 – 20,476	940	310 – 2,850
Ring-tailed Cat	23	4 – 115	45	9 – 231	0	0 – 0

2013 – 2014 Harvest Data

Species	Hunters	Hunters Low – High Confidence Range	Days Hunted	Days Hunted Low – High Confidence Range	Harvest	Harvest Low – High Confidence Range
Bobcat	-		-		1,945	
Gray Fox	1,419	991– 2,032	not asked		1,047	610 – 1,798
Swift Fox	702	452 – 1,090	not asked		416	227 – 763
Pine Marten	979	627 – 1,530	not asked		1,569	769 – 3,202

2014– 2015 Harvest Data

Species	Hunters	Hunters Low – High Confidence Range	Days Hunted	Days Hunted Low – High Confidence Range	Harvest	Harvest Low – High Confidence Range
Bobcat	-		-		1,634	
Gray Fox	479	249– 920	not asked		164	82 – 329
Swift Fox	519	321 – 839	not asked		609	287 – 1,293
Pine Marten	802	510 – 1,263	not asked		2,018	812 – 5,020

SECTION I: Recreational Harvest Data

2015 – 2016 Harvest Data

Species	Hunters	Hunters Low – High Confidence Range	Days Hunted	Days Hunted Low – High Confidence Range	Harvest	Harvest Low – High Confidence Range
Bobcat	-		-		1,352	
Gray Fox	880	599– 1,293	not asked		1,003	496 – 2,027
Swift Fox	1,000	668 – 1,498	not asked		11,417	2,459 – 53,000
Pine Marten	1,156	820 – 1,629	not asked		993	398 – 2,479

2016 – 2017 Harvest Data

Species	Hunters	Hunters Low – High Confidence Range	Days Hunted	Days Hunted Low – High Confidence Range	Harvest	Harvest Low – High Confidence Range
Bobcat	-		-		1,811	

No furbearer harvest survey

Bobcat Mortality Summary

		Gender			Mortality Type						
	Total Mortality	Male	Female	Unk	Hunt	Live Trap	30-day Permit	Road Kill	Game Dmg	Misc	Unk
2016-17	1924	1065	831	28	784	1027	22	66	7	9	9
2015-16	1407	795	589	23	470	882	7	38	2	6	2
2014-15	1695	1000	682	13	472	1162	2	36	2	1	20
2013-14	2022	1127	868	27	595	1350	9	45	5	8	10
2012-13	1917	1052	839	26	648	1206	2	36	2	5	18
2011-12	1686	942	718	26	607	1021	13	26	4	4	11
2010-11	1578	851	700	21	676	813	8	43	5	2	25
2009-10	1399	727	644	28	782	521	18	42	15		21
2008-09	1783	952	797	34	884	784	14	56	16		29
2007-08	1845	1063	760	22	974	769	14	44	5		39
2006-07	1708	966	705	37	797	808	2	62	3		36
2005-06	1261	732	508	21	656	507	33	53	5		7
2004-05	796	457	334	5	469	248	32	33	13		1
2003-04	766	456	289	20	453	227	7	54	22		3
2002-03	644	369	258	17	439	123	1	28	48		14

From 1998 through 2005, about 60%-70% of bobcat harvest came through hunting methods of take. Since 2005, this proportion has completely switched and in the most recent bobcat seasons live trapping has represented approximately 60-70% and hunting methods 30-40% of all harvest. Aside from this change in harvest method proportion, the other obvious trend is increasing harvest and total mortality. Although not shown on the tables, this increasing harvest trend generally follows increases in prices for bobcat pelts. Given these increases, monitoring bobcat through established management guidelines is gaining importance.

A suite of management guidelines is used in evaluating the status of bobcats and general population trajectory. Data is analyzed at four increasing spatial scales (Fig. 1): bobcat management areas, Colorado Parks and Wildlife regions, east/west of the continental divide, and statewide.

Figure 1. Bobcat management areas and regional boundaries.

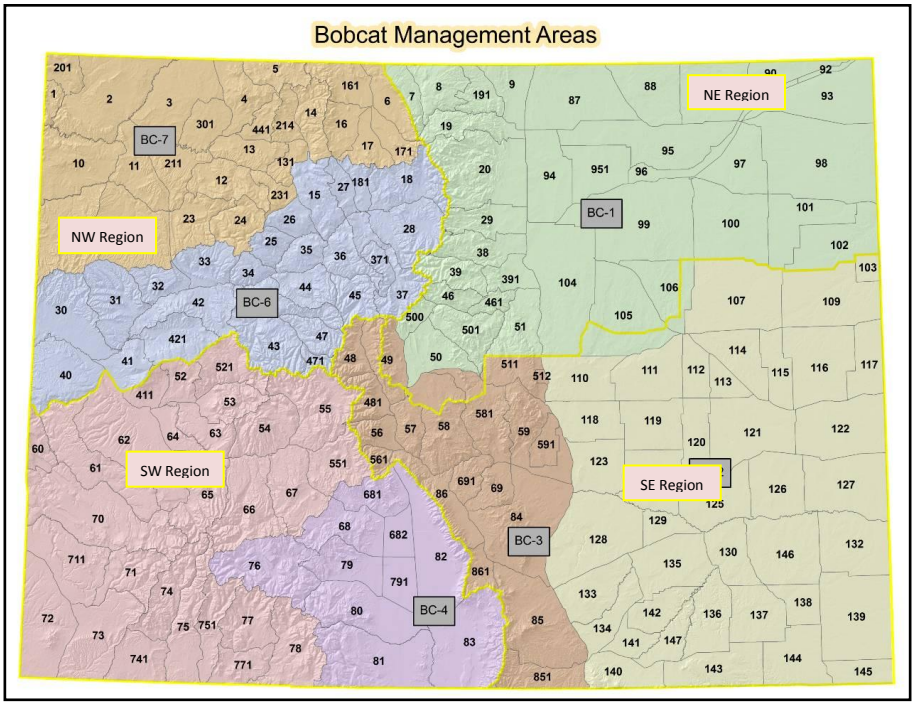
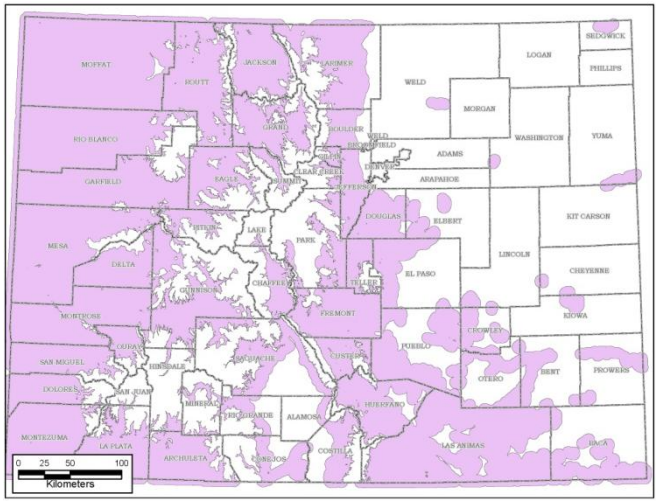


Figure 2. Modeled bobcat habitat used for mortality density analysis.



A habitat model was developed to represent core bobcat habitat within the state. While bobcat may occur anywhere in the state a core habitat model was considered more appropriate to conservatively represent essential bobcat habitat. Core habitat was constrained to less than 9,500 feet elevation; woodland and shrubland vegetation types identified in CPW Basinwide vegetation classifications buffered to about 7 km distance in order to smooth boundaries (Fig. 2).

Bobcat Mortality Thresholds

Annual Mortality Density

The mortality density threshold is to not exceed 2.55 bobcat mortalities per 100 km^2. This is derived assuming an average population density of not more than 15 bobcat/100 km^2 across modeled habitat and a mortality threshold of not more than 17%. These are examined at the 4 spatial scales previously mentioned: bobcat management areas, regions, east/west of the continental divide (except that the San Luis Valley shall be included with west of the divide), and statewide.

The Bobcat Mortality Density Analysis table below indicates that the current 3-year average mortality density (2014-2016) increased at all 4 spatial scales from the preceding year's 3-year average (2013-2015), but was still below the longer-term 3-year data averages (2011-2013 and 2012-2014).

The established mortality thresholds have not been exceeded at any of the spatial scales upon which analysis is performed.

Bobcat Mortality Density Analysis

Management Threshold: 3-Year Average Mortality Should Not Exceed 2.55 bobcat/100 km^2

Region	Bobcat Mgmt Area	Bobcat Core Habitat	2014-15 Mortality	2015-16 Mortality	2016-17 Mortality	3-Yr Average Mortality	2016-17 3-Yr Average Mortality Density	2011-12, 2012-13, 2013-14 3-yr density	2012-13, 2013-14, 2014-15 3-yr density	2013-14, 2014-15, 2015-16 3-yr density
NE	BC-1	12101	113	115	150	126	1.04	1.09	1.01	0.94
NE Region Total		**12101**	**113**	**115**	**150**	**126**	**1.04**	**1.09**	**1.09**	**0.94**
NW	BC-6	19988	333	293	364	330	1.65	1.73	1.72	1.57
	BC-7	28044	227	174	285	229	0.82	0.96	0.91	0.71
NW Region Total		**48032**	**560**	**467**	**649**	**559**	**1.16**	**1.28**	**1.28**	**1.07**
SE	BC-2	22212	229	196	251	225	1.01	1.43	1.35	0.96
	BC-3	15779	232	250	353	278	1.76	1.56	1.7	1.53
SE Region Total		**37991**	**461**	**446**	**604**	**504**	**1.33**	**1.49**	**1.49**	**1.19**
SW	BC-4	6785	99	85	142	109	1.60	1.59	1.52	1.36
	BC-5	33193	462	294	379	378	1.14	1.37	1.47	1.14
SW Region Total		**39978**	**561**	**379**	**521**	**487**	**1.22**	**1.41**	**1.41**	**1.18**
East Slope		50092	574	561	754	630	1.26	1.39	1.39	1.13
West Slope		88010	1121	846	1170	1046	1.19	1.32	1.32	1.12
Statewide		**138103**	**1695**	**1407**	**1924**	**1675**	**1.21**	**1.36**	**1.36**	**1.12**

Harvest Gender Composition

As with other wild felids, data suggest males are more vulnerable to harvest and are usually more prevalent in harvest records. Thus, increasing proportions of females in harvest has been suggested as a means of monitoring population impacts. Colorado's management threshold on female harvest is that the female harvest composition should not equal or exceed 50% for more than two consecutive years.

The table on the following page indicates that this management threshold is not exceeded at any of the spatial scales that monitoring is performed. Trapping remains a noticeably more selective method of take than does hunting harvest. If not for the selection for males in trapping harvest, most spatial scales would have exceeded management thresholds if hunting harvest were the only harvest considered.

2016-2017 Bobcat Harvest Gender Composition Management Threshold: Females Should Not Exceed 50% of Harvest at Monitoring Scales for > 2 years										
Region	Bobcat Mgmt Area	Method	Female	Male	Unk	Grand Total	2016-17 % Female and Unknown in Harvest Mortality	2013-14 % in Harvest Mortality	2014-15 % in Harvest Mortality	2015-16 % in Harvest Mortality
NE	BC-1	Hunt	38	46	2	86	47%	57%	40%	59%
		Live Trap	23	27	0	50	46%	53%	36%	38%
NE Region Total			**61**	**73**	**2**	**136**	**46%**	**54%**	**38%**	**49%**
NW	BC-6	Hunt	51	64	1	116	45%	42%	47%	63%
		Live Trap	90	130	1	221	41%	41%	36%	37%
	BC-6 Total		**141**	**194**	**2**	**337**	**42%**	**41%**	**38%**	**44%**
	BC-7	Hunt	63	64	2	129	50%	44%	45%	42%
		Live Trap	57	88	1	146	40%	37%	36%	38%
	BC-7 Total		**120**	**152**	**3**	**275**	**45%**	**40%**	**38%**	**40%**
	Region	Hunt	114	128	3	245	48%	43%	46%	53%
		Live Trap	147	218	2	367	41%	39%	36%	38%
NW Region Total			**261**	**346**	**5**	**612**	**43%**	**41%**	**38%**	**42%**
SE	BC-2	Hunt	51	55	0	106	48%	49%	44%	44%
		Live Trap	58	76	1	135	44%	50%	48%	43%
	BC-2 Total		**109**	**131**	**1**	**241**	**46%**	**50%**	**47%**	**43%**
	BC-3	Hunt	77	69	2	148	53%	47%	55%	49%
		Live Trap	67	108	1	176	39%	41%	38%	43%
	BC-3 Total		**144**	**177**	**3**	**324**	**45%**	**43%**	**46%**	**46%**
	Region	Hunt	128	124	2	254	51%	48%	52%	47%
		Live Trap	125	184	2	311	41%	46%	44%	43%
SE Region Total			**253**	**308**	**4**	**565**	**45%**	**47%**	**47%**	**44%**
SW	BC-4	Hunt	33	33	6	72	54%	49%	37%	52%
		Live Trap	22	42	0	64	34%	30%	37%	44%
	BC-4 Total		**55**	**75**	**6**	**136**	**45%**	**38%**	**37%**	**48%**
	BC-5	Hunt	63	63	1	127	50%	43%	41%	48%
		Live Trap	86	148	1	235	37%	42%	38%	37%
	BC-5 Total		**149**	**211**	**2**	**362**	**42%**	**43%**	**39%**	**40%**
	Region	Hunt	96	96	7	199	52%	45%	40%	50%
		Live Trap	108	190	1	299	36%	41%	38%	38%
SW Region Total			**204**	**286**	**8**	**498**	**43%**	**42%**	**38%**	**42%**
East Slope		Hunt	166	170	4	340	50%	50%	49%	50%
		Live Trap	148	211	2	361	42%	47%	43%	42%
East Slope Total			**314**	**381**	**6**	**701**	**46%**	**48%**	**45%**	**45%**
West Slope		Hunt	210	224	10	444	50%	44%	42%	52%
		Live Trap	255	408	3	666	39%	40%	37%	38%
West Slope Total			**465**	**632**	**13**	**1110**	**43%**	**41%**	**38%**	**42%**
Statewide		Hunt	376	394	14	784	50%	46%	45%	51%
		Live Trap	403	619	5	1027	40%	43%	39%	39%
Statewide Grand Total			**779**	**1013**	**19**	**1811**	**44%**	**44%**	**40%**	**43%**

Harvest per unit effort (HPUE)

This Harvest per unit effort (HPUE) metric quantifies the amount of effort put forth to harvest each bobcat. Increasing or decreasing effort per bobcat harvested should be related on a broad scale to the relative abundance of bobcats. Colorado has collected this information only since 2012-13. It is anticipated that with the inclusion of this year's 2016-2017 data, the initial baseline HPUE data from which future benchmarks can be established will be complete. The data in 2016-2017 represents the fifth year of data collection.

2016-17 Bobcat Harvest Effort Analysis

Management Threshold: pending 5 year data set

Region	Bobcat Mgmt Area	Method	Cats Sealed	Days Hunted	No. of Traps Set	Days Traps Set	Hunt Days Per Bobcat Harvested	Trap Days Per Bobcat Harvested
NE Total	BC-1	Hunt	86	274			3.19	
		Live Trap	50		140	705		1974
NW	BC-6	Hunt	116	277			2.39	
		Live Trap	221		589	2568		6844
	BC-7	Hunt	129	317			2.46	
		Live Trap	146		341	1413		3300
NW Total		Hunt	245	594			2.42	
		Live Trap	367		930	3981		10088
SE	BC-2	Hunt	106	386			3.64	
		Live Trap	135		342	974		2467
	BC-3	Hunt	148	720			4.86	
		Live Trap	176		485	1049		2891
SE Total		Hunt	254	1106			4.35	
		Live Trap	311		827	2023		5379
SW	BC-4	Hunt	72	234			3.25	
		Live Trap	64		218	537		1829
	BC-5	Hunt	127	464			3.65	
		Live Trap	235		616	2567		6729
SW Total		Hunt	199	698			3.51	
		Live Trap	299		834	3104		8658
East Slope		Hunt	340	1380			4.06	
		Live Trap	361		967	2728		7307
West Slope		Hunt	444	1292			2.91	
		Live Trap	666		1764	7085		18766
Statewide		Hunt	784	2672			3.41	
		Live Trap	1027		2731	9813		26095

The following table displays HPUE for the five years data has been collected.

Region	Bobcat Mgmt Area	2016-17		2015-16		2014-15		2013-14		2012-13		**5-year Average**	
		Hunt Days/ Harvest	Trap Days/ Harvest	Hunt Days/ Harvest	Trap Days/ Harvest	Hunt Days/ Harvest	Trap Days/ Harvest	Hunt Days/ Harvest	Trap Days/ Harvest	Hunt Days/ Harvest	Trap Days/ Harvest	**Hunt Days/ Harvest**	**Trap Days/ Harvest**
NE (BC-1) Total		3.2	1,974	5.7	1,387	5.3	2,572	5.1	4,209	4.2	3,468	**4.7**	**2,722**
NW	BC-6	2.4	6,844	4.1	4,752	2.1	6,308	4.0	14,426	6.0	10,099	**3.7**	**8,486**
	BC-7	2.5	3,300	2.5	1,783	1.5	3,891	3.0	4,703	2.0	2,879	**2.3**	**3,311**
NW Total		2.4	10,088	3.2	6,665	1.8	10,217	3.4	18,977	3.4	13,037	**2.9**	**11,797**
SE	BC-2	3.6	2,467	3.6	1,740	2.4	3,197	3.8	5,406	2.7	10,947	**3.2**	**4,751**
	BC-3	4.9	2,891	4.5	3,709	3.7	2,937	5.2	5,943	3.7	3,530	**4.4**	**3,802**
SE Total		4.4	5,379	4.1	5,372	3.3	6,108	4.6	11,285	3.3	6,108	**3.9**	**6,850**
SW	BC-4	3.3	1,829	4.7	1,693	4.2	2,464	4.0	2,040	5.6	2,416	**4.3**	**2,088**
	BC-5	3.7	6,729	2.9	7,204	3.2	8,408	2.7	11,959	4.3	8,570	**3.4**	**8,574**
SW Total		3.5	8,658	3.5	8,949	3.4	10,816	3.1	13,965	4.6	16,989	**3.6**	**11,875**
East Slope		4.1	7,307	4.5	6,762	3.8	8,513	4.7	15,108	3.5	18,479	**4.1**	**11,234**
West Slope		2.9	18,766	3.4	15,356	2.8	20,990	3.2	32,620	3.9	24,007	**3.2**	**22,348**
Statewide		3.4	26,095	3.8	22,309	3.2	29,694	3.8	47,735	3.7	44,665	**3.6**	**34,100**

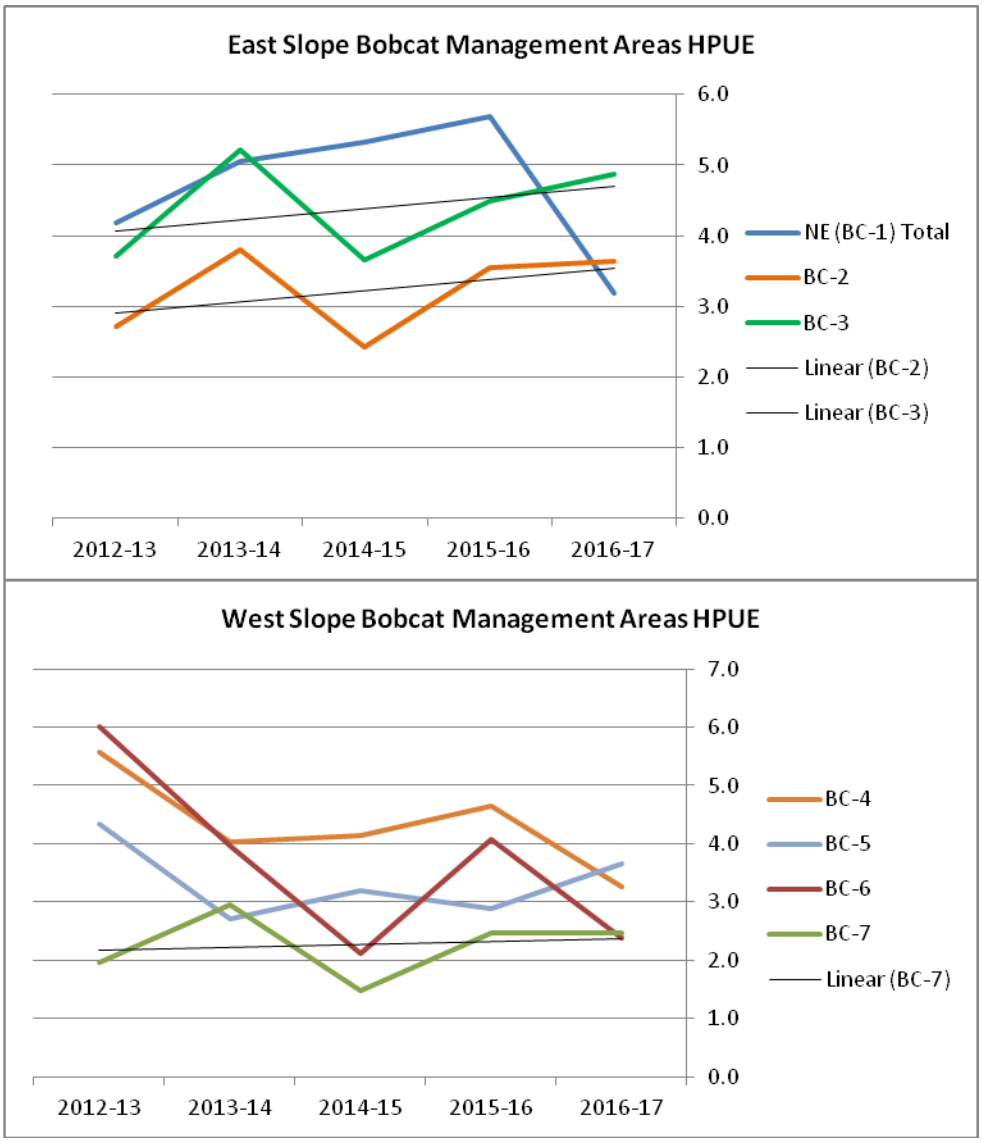
It is evident that there is a high degree of variability in this dataset. There may be reporting errors and data analysis errors that create some of this variation. Also, trappers have a choice to take an animal caught in a trap or to release that animal, which creates an added variable in the meaning of trap days per harvest. Consequently, the hunt days per bobcat harvest may be a more sensitive index of bobcat abundance because it is more a product of hunter encounter probabilities than harvest by subjective choice, as could happen in trapping. In light of this, we expect the number of hunt days per harvest in the west slope is fewer than those required in the east slope because of the lower bobcat densities found in plains habitats.

Evaluation of 5 year baseline reveals that on average:

- In the NE Region it takes 4.7 days of hunting per bobcat harvested.
- In the NW Region it takes 2.9 days of hunting per bobcat harvested, although there is considerable variability in the NW Region between the two bobcat management zones. In the Yampa basin it takes 2.3 days per harvest, whereas in the Colorado basin it takes almost twice that at 3.7 days per harvest.
- In the SE Region it takes 3.9 days of hunting per bobcat harvested. Interestingly, the plains bobcat management zone requires fewer days per bobcat harvest (3.2 days) compared to 4.4 days per harvest in the mountainous bobcat management zone. The explanation of the apparent incongruity may be because most of the bobcat taken in BC-2 occurs in the canyons and mesas of the Purgatoire River and the riparian habitat of the lower Arkansas River. Both of these areas are high quality bobcat habitat.
- In the SW Region it takes 3.6 days of hunting per bobcat harvested. But the San Luis Valley hunters use about 4.3 days, compared to about 3.4 days in the rest of the SW Region.

On average, SE Region bobcat management areas demonstrate an equal or greater number of days needed per hunter harvest compared to the combined west slope. The NE Region's single bobcat management area requires the highest number of days needed to harvest of any monitoring scale. On the west slope the NW Region continues to have the shortest number of days needed per hunter to harvest. In fact, the Yampa basin continues to have among the fewest days (2.5) needed per hunter to harvest this year, which is similar to the 5-year average (2.3).

Our intent is to continue monitoring bobcat harvest per unit effort and evaluate whether using a 5-year average metric is a valuable management benchmark for the following seasons.


East Slope Bobcat Management Areas HPUE
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2012-13
2013-14
2014-15
2015-16
2016-17
NE (BC-1) Total
BC-2
BC-3
Linear (BC-2)
Linear (BC-3)
West Slope Bobcat Management Areas HPUE
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2012-13
2013-14
2014-15
2015-16
2016-17
BC-4
BC-5
BC-6
BC-7
Linear (BC-7)

Prey Abundance

Cottontail Rabbit Harvest – Prey Abundance Index			
Year	**Hunters**	**Harvest**	**Harvest per Hunter**
2001-02	10,029	45,633	4.6
2002-03	10,912	39,629	3.6
2003-04	10,000	52,299	5.2
2004-05	10,938	58,057	5.3
2005-06	11,233	81,415	7.2
2006-07	10,112	69,263	6.8
2007-08	9,365	65,468	7.0
2008-09	8,869	38,693	4.4
2009-10	n/s	n/s	n/s
2010-11	7,442	30,580	4.1
2011-12	13,305	57,859	4.3
2012-13	8,706	52,851	6.1
2013-14	n/s	n/s	n/s
2014-15	11,000	54,083	4.9
2015-16	11,202	42,513	3.8
2016-17	9,452	58,002	6.1
3 Yr Avg	10,551	51,533	4.9
15 Yr Avg	10,183	53,310	5.2

Cottontail rabbits are a primary prey item for bobcat. Although a wide variety of factors can influence cottontail rabbit harvest amounts in Colorado, there is a moderate correlation between rabbit harvest, rabbit harvest per hunter and bobcat harvest. Rabbit harvest may provide an additional piece of information regarding food availability for bobcats and therefore some indication of influences on bobcat populations. The cottontail rabbit harvest estimate is collected annually through the small game survey. If rabbit harvest declines in a given year and the other 4 annual management guidelines are below established thresholds as well, this would tend to corroborate a possible decline in bobcat populations.

The former threshold (cottontail harvest less than 80,000 on a 3-year running average indicate negative stress on bobcat populations) is rejected and will no longer be used. This threshold was highly conservative in that during the past 15 years, cottontail rabbit harvest has only exceeded 80,000 in a single year. Prior to 1999, cottontail rabbit harvests and hunter numbers were considerably greater on average than in more recent years.

Harvest per hunter has been more consistent with perceived rabbit cycles. Therefore, two aspects of cottontail harvest shall be used to provide an indicator to bobcat prey abundance. We will evaluate total cottontail harvest and the harvest per hunter in the most recent 3 years compared to the 15-year average. Three-year total rabbit harvest and harvest per hunter greater or lesser than 10% of the 15-year average suggests a change in prey abundance that would be sufficient to produce increases or decreases in on bobcat populations, respectively.

Incorporating the 2016-17 data pushes the 3-year average cottontail rabbit harvest to just below the 15-year average, while the harvest per hunter is 6% below the 15-year average. Therefore, cottontail rabbit abundance appears to be average in comparison to the longer term data and likely not strongly impacting bobcat populations in either direction.

CPW Manager Knowledge-Professional Judgment

During the course of work activities, wildlife managers and biologists gain anecdotal information about the status of bobcat populations based upon their own observations and the observations of landowners, hunters, trappers, other agency personnel, and other recreationists that CPW staff have contact with. On an annual basis, CPW managers and biologists are polled regarding their perceptions of bobcat population status.

Responses are converted to numeric values for averaging and analysis at the different geographic scales. The agency survey was conducted during the 4 years from 2012-2016 but due to staffing changes was not conducted in 2016-2017. Bobcat population surveys of CPW staff will resume in 2017-2018.

Through 2016, in the NE and NW Regions, bobcats were strongly perceived as being on an increasing population trajectory. In the SE Region, bobcat populations are perceived to be increasing over the past four years. For 4 consecutive years, area BC-5 in the SW Region has been perceived to be in decline. Albeit, the decline is easing in the last 2 surveyed years.

2016-2017 Bobcat Population Status – Professional Assessment						
		Scale				
		2	Increasing			
		1	Somewhat Increasing			
		0	Stable			
		-1	Somewhat Decreasing			
		-2	Decreasing			
Region	**Bobcat Mgmt Area**	**2012-13 Numeric Assessment Value**	**2013-14 Numeric Assessment Value**	**2014-15 Numeric Assessment Value**	**2015-16 Numeric Assessment Value**	**2016-17 Numeric Assessment Value**
NE	**BC-1**	**1.00**	**1.00**	**0.33**	**0.80**	**NA**
NW	BC-6	-0.80	-0.40	0.00	0.05	NA
	BC-7	-0.25	0.00	0.00	1.00	NA
NW Region Total		**-0.56**	**-0.25**	**0.00**	**0.71**	**NA**
SE	BC-2	1.00	0.00	0.67	0.50	NA
	BC-3	0.75	0.00	0.25	0.40	NA
SE Region Total		**0.88**	**0.00**	**0.43**	**0.43**	**NA**
SW	BC-4	-1.00	-1.00	0.00	0.00	NA
	BC-5	-0.50	-0.50	-0.33	-0.33	NA
SW Region Total		**-0.67**	**-0.60**	**-0.25**	**-0.25**	**NA**
East Slope		0.94	0.50	0.40	0.58	NA
West Slope		-0.62	-0.38	-0.10	0.36	NA
Statewide		**0.14**	**0.04**	**0.15**	**0.48**	**NA**

Bobcat Monitoring Summary

Analysis of all monitoring information is conducted annually and uses a preponderance of evidence standard. Not more than 2 bobcat management areas at any time may exceed more than half of the monitoring thresholds. If so, then the regulations governing bobcat seasons, harvest methods, and/or bag limits will be reexamined and adjustments to constrain harvest may be proposed. If adjustments are made in response to exceeding monitoring thresholds, they should be implemented for 3 consecutive years before returning to prior regulatory conditions.

- The mortality density threshold is not exceeded in any locations in Colorado.
- The harvest composition index threshold is not exceeded in any locations in Colorado.
- The harvest per unit effort index has obtained applicable data 5 consecutive years; this 5-year average therefore will be applied as the baseline rate for comparison to 2017-2018 data.
- The prey abundance index indicates that there was an average abundance of prey in 2016-17.
- The manager's assessment index was not collected in 2016-2017; therefore, that information is not available to inform the overall analysis.

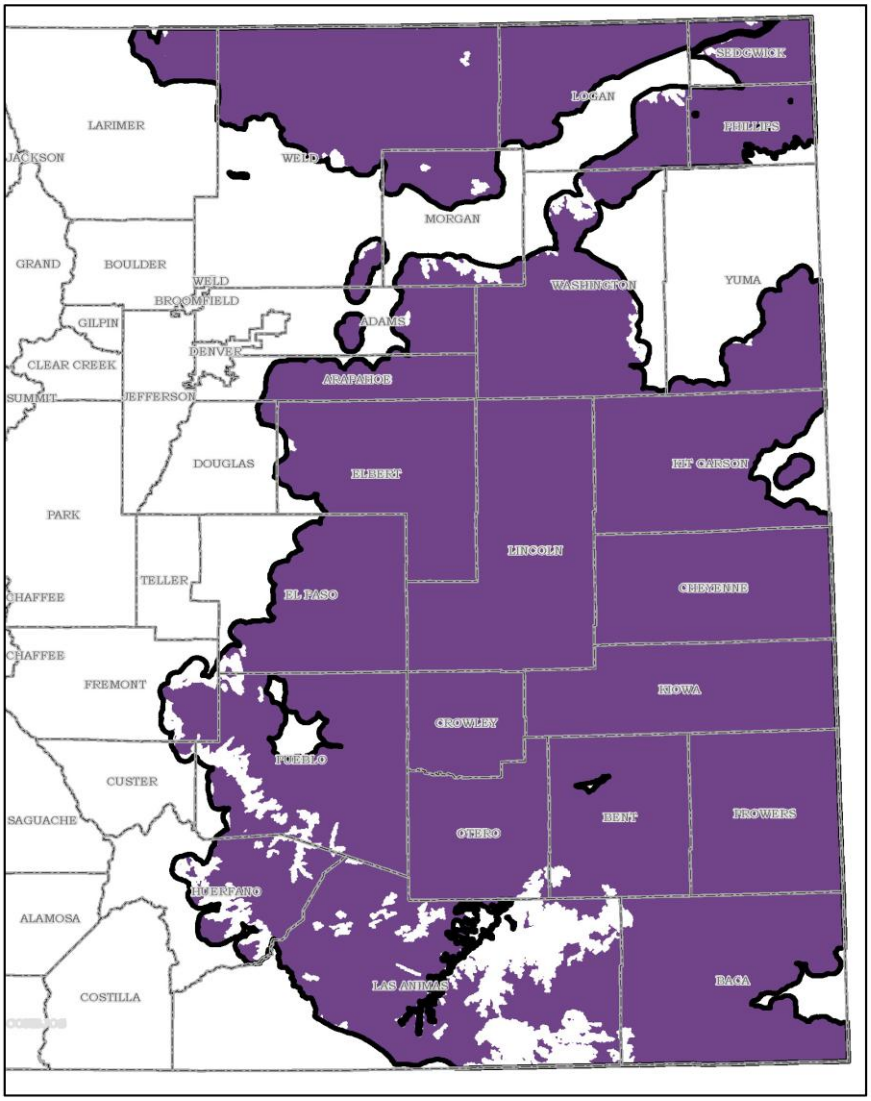
Bobcat Mgmt Guideline Analysis 2016-2017					
		Guideline			
Region	Bobcat Mgmt Area	**Mortality Density**	**Harvest Composition**	**Prey Abundance**	**Manager Assessment**
NE	**BC-1**	+	+	+	na
NW	**BC-6**	+	+	+	na
	BC-7	+	+	+	na
SE	**BC-2**	+	+	+	na
	BC-3	+	+	+	na
SW	**BC-4**	+	+	+	na
	BC-5	+	+	+	na
East Slope		+	+	+	na
West Slope		+	+	+	na
Statewide		+	+	+	na

+ Meets the guideline
- Does not meet the guideline.

When examined on a preponderance of evidence basis, statewide bobcat populations are likely stable and potentially increasing. Bobcat harvest intensity has increased in 2016-17. It is possible that annual production exceeded human and natural mortality in 2015-2016, leading to a somewhat increased abundance in 2016-2017.

Management guidelines for swift fox include monitoring habitat occupancy rates in the plains short grass prairie habitats. The other guideline is to annually monitor harvest density by county and range wide with provisions to reduce the frequency of harvest data collection to every other or every third year if harvests remain substantially below thresholds. To conduct harvest density analysis, CPW developed a more conservative swift fox habitat model than that used in formulating occupancy survey grids (Fig. 3).

Figure 3. Modeled swift fox habitat for harvest density analysis (purple) compared to boundaries of swift fox habitat for occupancy monitoring (heavy black line).



<u>Swift Fox – Shortgrass Prairie Habitat Occupancy</u>

Occupancy surveys were conducted in swift fox habitat during the summer and fall of 2016. Along with core habitat occupancy, the 2016 survey effort sampled fringe and smaller patch sizes of habitat to assess occupancy in areas adjacent to core areas but which are considered less optimal swift fox habitat. Sample partitioning of shortgrass prairie habitat based on patch size greatly improved estimates of swift fox distribution and occupancy across the landscape. Overall Colorado swift fox habitat occupancy in 2016 was 85% (Stratman 2017), virtually unchanged from the 2011 survey (Stratman 2012) (87% occupied habitat) on surveys of the standard >12.9 km^2 grids. Swift fox were detected in habitat patch sizes down to areas as small as 2.6 km^2, but as one would expect, the probability of occupancy increased with shortgrass prairie patch size. This suggests habitat fragmentation and isolation of shortgrass prairie patches reduces swift fox presence. Swift fox occupancy rates across suitable habitat in eastern Colorado have remained stable with no change being detected in the last 20 years.

Previous occupancy surveys in Colorado (Martin et al. 2007, Finley et al. 2005) conducted detection efforts in shortgrass prairie habitats but used different methods than applied in our 2011 and 2016 survey effort. By comparison, the 2011 occupancy survey was more efficient and yielded an occupancy estimate in > 50% shortgrass prairie habitat in eastern Colorado at 77%. Martin et al. (2007) estimated occupancy in > 50% shortgrass prairie habitat at 71%. Just examining occupancy in the survey grids Finley et al. (2005) estimated occupancy in 1995 at 82%. By comparison, Martin et. al (2007) estimated the survey grid occupancy rate at 78%, whereas the recent CPW surveys estimated occupancy at 87% in 2011 (Stratman 2012) and 85% in 2016 (Stratman 2017). Thus, occupancy does not appear to have changed in shortgrass prairie habitats since 1995, and the increases noted in the 2011 and 2016 surveys are likely a result of the increased efficiency of the methods used. It is interesting to note the very similar grid-based occupancy estimates between 2011 and 2016 were only 2% apart.

Although not relevant to shortgrass prairie occupancy monitoring, we note that CPW personnel confirmed the presence of swift fox at the extreme southern end of the San Luis Valley in habitat that has similar structure as short grass in eastern Colorado. Further survey efforts were conducted in the fall of 2013 and 2014. Trail cameras were set for 100 trap nights at 4 separate plots in the fall of 2013 and 93 trap nights at 5 separate plots in the fall of 2014. Results of those survey efforts found swift fox presence in the same area they were found in 2012, but in other areas of similar habitat swift fox were not detected.

Annual Harvest Density

The harvest density threshold we developed is to not exceed more than 3.6 swift fox harvested per 100 km^2. This harvest density is derived from an assumed swift fox population density of not more than 24/100 km^2 and an upper off-take rate of not more than 15% annually. This will be monitored on county and range wide scales.

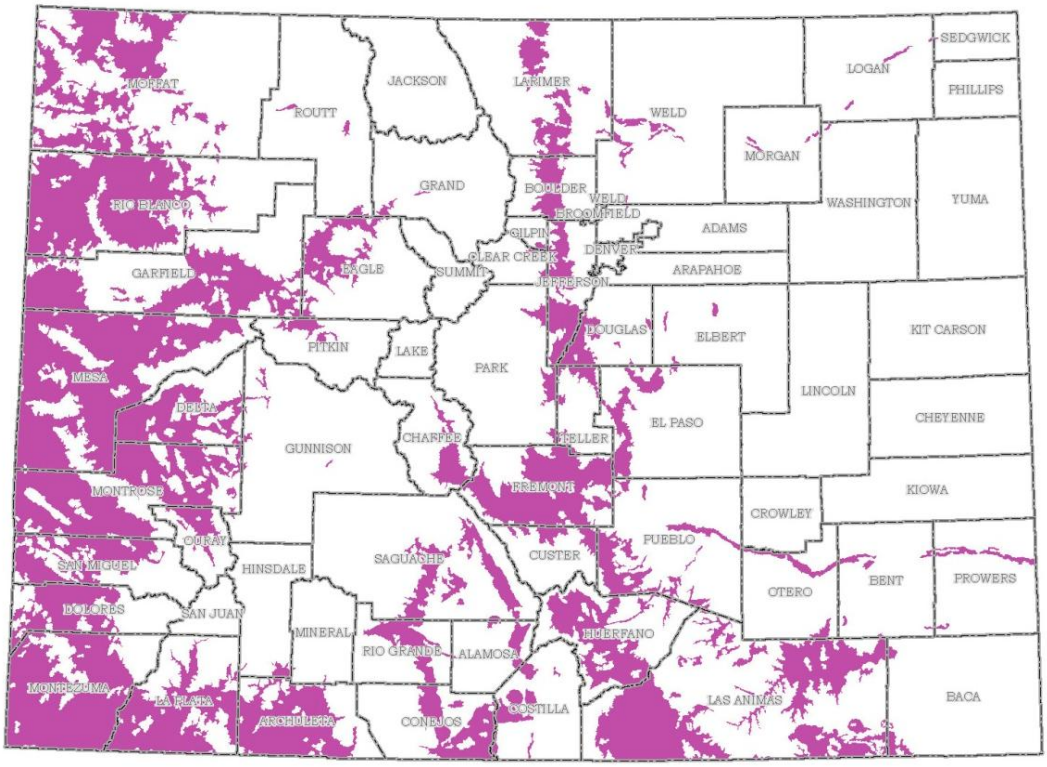
After the 2013-14 surveys, CPW biologists determined that the quality of data provided at the county scale had such broad confidence intervals that they weren't useful for management analysis. Therefore, harvest survey data analysis at regional scales is the smallest geographic scale that CPW will apply for swift fox.

The results of past harvest surveys point out the ongoing problems in obtaining sample sizes of likely fur harvesters that produce reasonable harvest estimates. In Colorado, a small game license and a furbearer license both allow a person to harvest furbearers. Since it is impractical to survey all small game and furbearer licenses holders, to estimate swift fox harvest, CPW randomly selects survey participants from the combined pool of furbearer and small game license holders, of which only a very small proportion are actually like to have harvested swift fox. Currently, we have no way to identify and balance our survey sample to correctly represent those small game and furbearer license holders most likely to harvest swift fox so harvest estimates are statistically unreliable. A practical solution requires a systematic way of identifying the people that are most likely to harvest swift fox from the larger pool of small game hunters so these users can be surveyed at a higher intensity relative to all 60,000 small game hunters. With limited financial resources and given the choice between highly variable, highly unreliable harvest survey estimates and not conducting swift fox surveys in 2016-2017, the decision was made to exclude swift fox from the annual harvest survey this year and next.

During 2018, CPW will continue to evaluate the options available for designing a survey program that produces relatively precise harvest estimates for swift fox.

The management guideline for gray fox is to annually monitor harvest density by county and range wide with provisions to reduce the frequency of harvest data collection to every other year or every third year if harvests remain substantially below thresholds. To conduct harvest density analysis, CPW developed a conservative model of gray fox habitat (Fig. 4). The harvest density threshold is to not exceed more than 4.5 gray fox harvested per 100 km^2. This harvest density is derived from an assumed gray fox population density of not more than 30/100 km^2 and an upper off-take rate of not more than 15% annually.

Figure 4. Gray fox modeled habitat (magenta).



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No management guidelines were developed for pine marten management. However, there is the potential for rapid landscape scale habitat alteration in subalpine forests from disease and insect infestations. After the 2013-14 surveys, CPW biologists determined that the quality of data provided at the county scale had such broad confidence intervals that they weren't useful for management analysis. Therefore, all harvest survey data analysis will be at regional scales, which is the smallest geographic scale that CPW will apply for marten.

The results of past harvest surveys point out the ongoing problems in obtaining sample sizes of likely fur harvesters that produce reasonable harvest estimates. In Colorado, a small game license and a furbearer license both allow a person to harvest furbearers. Since it is impractical to survey all small game and furbearer licenses holders, to estimate pine marten harvest, CPW randomly selects survey participants from the combined pool of furbearer and small game license holders, of which only a very small proportion are actually like to have harvested pine marten. Currently, we have no way to identify and balance our survey sample to correctly represent those small game and furbearer license holders most likely to harvest pine marten so harvest estimates are statistically unreliable. A practical solution requires a systematic way of identifying the people that are most likely to harvest pine marten from the larger pool of small game hunters so these users can be surveyed at a higher intensity relative to all 60,000 small game hunters. With limited financial resources and given the choice between highly variable, highly unreliable harvest survey estimates and not conducting pine marten surveys in 2016-2017, the decision was made to exclude pine marten from the annual harvest survey this year and next. During 2018, CPW will continue to evaluate the options available for designing a survey program that produces relatively precise harvest estimates for pine marten.

Colorado Parks and Wildlife investigated how pine marten use changes over time in lodgepole pine and spruce -fir forests damaged by beetles (Ivan and Seglund 2015). This occupancy investigation did not attempt to estimate changes in marten abundance or density. Following data collection in 2013 and 2014, final analyses and interpretation suggests there is no difference in marten occupancy between lodgepole pine and spruce-fir forests. Marten appear to use forest stands largely independent of the extensive damage inflicted on forest stands by insects. Marten occupancy over the 11 years following a beetle outbreak in both lightly (10% dead) and heavily (90% dead) subalpine forests didn't change significantly over time or vary between beetle impact conditions in each forest. This suggests that marten may not be as vulnerable to forest alteration resulting from insect damage as previously thought.

Harvest Survey

The harvest survey methods applied in 2012-13 using the Harvest Information Program (HIP) sought to improve the precision of estimates. The concept was to stratify the survey based on the respondents self-reported propensity to take select furbearer species. This process coupled with very small sample sizes at the County scale still resulted in wide confidence intervals. The relatively small number of fur harvesters in the state coupled with further small sizes used to generate county-level harvest estimates even with stratification, resulted in inevitably biased results and impractically wide harvest confidence intervals on harvest.

In 2014-15, the harvest surveys were modified to examine harvest results at regional scales. Since agency regional boundaries are largely internal CPW landmarks, which the public largely isn't familiar with, we will mainly use Interstates 25 and 70 to divide the state into quadrants and we examined harvest at scales no finer than those quadrants for all surveyed species. The stratification was used to test if sample size is sufficient at this scale. Confidence intervals remained very broad and, as expected wider at smaller scales than at larger scales. The wide confidence limits, however, strain the value of harvest data collection using such an insensitive mechanism as the Harvest Information Program (HIP) registration and survey process.

In 2014-15 terrestrial staff recommended that managers should revisit data collection methods and refine the mechanisms and/or the regulatory requirements on fur harvesters to improve the quality of harvest data. As of 2017, changes have not yet been put in place. However, following the results of the 2015-16 swift fox harvest survey, addressing the deficiencies of the harvest survey mechanism for estimating swift fox, gray fox, and pine marten harvest is now unavoidable. In that regard, staff prepared a white paper (below) and referred the matter to the agency Leadership Team. In the fall of 2016 the Leadership Team assembled a working group of Wildlife Managers, Terrestrial Biologists, and License Services staff to examine the furbearer harvest survey as well as harvest data collection for several other upland game bird species. The mandate of this working group was to recommend solutions to these issues. That working group has not yet determined a course of action for the longer term. However, the decision was made to abandon surveys for swift fox, gray fox and pine marten for the 2016-2017 and 2017-2018 seasons for reasons of both cost savings and sampling deficiency. CPW will continue to explore survey design and sampling methods that will allow us to clearly delineate small game license holders with a high likelihood of trapping or hunting these 3 species and sample that group more intensely during the harvest survey.

Furbearer Harvest Data Problem - White Paper 2016

Problem Statement

Despite efforts to improve the accuracy and precision of all furbearer harvest data (except bobcat), the survey results are plagued by extremely wide confidence limits to the point of rendering them useless for making management decisions.

Background

In 2012, CPW concluded a furbearer analysis resulting in some changes by ranking and prioritizing furbearer species for management criteria and harvest data collection. Coyote, gray fox, swift fox, and pine marten are to have harvest estimated annually. Beaver, red fox, raccoon, and ring-tailed cats are to have harvest estimated every three years (these latter species are supposed to be surveyed after the upcoming 2016/2017 season).

During the 2012 analysis, alternatives were considered to improve harvest data collection; including mandatory check, furbearer or species specific permits, or incremental improvements to the existing small game/furbearer telephone harvest survey. The decision was made to implement incremental efforts to improve the results of the small game/furbearer telephone harvest surveys. We made the following changes to improve pine marten, swift fox, and gray fox harvest data.

We used the Harvest Information Program (HIP) to document a fur harvester's intent to take marten, swift fox, or gray fox in the forthcoming year. We then used this level of intent to stratify the sample of fur harvesters that would be surveyed by phone. However, the resulting stratification did not improve the harvest survey results over the previous poor results without stratification.

Examples

Pine marten harvest for the 2015/16 season is estimated at 993 with a 95% CI of 398 - 2479 and a CV of 49. The marten estimate was based on an extrapolation derived from about 59,000 hunters/trappers that were segmented into 4 strata on degree of likelihood to hunt/trap marten. Of them a sample of 3,500 was sought to respond. Of them about 1,500 responded. Of them 42 claimed to have actually attempted to take one or more marten. And of them 10 actually killed. So, in fact we estimate statewide harvest of about 1,000 on the basis of 10 marten harvesters.

Swift fox, a species that carries a higher degree of social/political sensitivity, the 2015/16 harvest estimate is 11,417 with a 95% CI of 2,459 - 53,000 and a CV of 92. Here again the potential sample stratified on degree of likelihood to hunt/trap swift fox = about 59,000. A sample of 3,500 sought to respond. Of them a bit over 1,500 responded. Of them 57 said they hunted and of them 18 claimed to have killed. Of note, the five previous harvest estimates from the preceding six years (one year not surveyed) range from ~100 to ~600. However, it is just as unlikely for CPW to comfortably depend on these results as it is to depend on the most recent estimate.

The large increase in swift fox harvest estimate in 2015/16 could have occurred in any of the previous years because despite stratification sample sizes remain incredibly small. If any single responding fur harvester were to report a large harvest (>5 animals) or if a fur harvester in the "unlikely to harvest" strata reports taking more than just one animal it will greatly inflate the harvest estimate.

Alternatives

- No Change: Continue obtaining harvest estimates via the small game/furbearer telephone survey. Results will continue to be unreliable. The current process overtaxes and stretches the integrity of HIP which may have implications to its original intent, which is to obtain reliable harvest data for waterfowl.

- Revise how harvest estimates are obtained:
  - Require a mandatory check and marking/sealing of pelts for all or some of the harvested fur species. Harvest results would be firmly accounted and assuming fur harvesters reasonably complied with reporting requirements, harvest estimates would be as accurate as reporting compliance.
  - Require a fur harvest permit or a species specific permit to take one or more or all furbearers. This would allow the telephone survey to select from the population of people that are regularly and directly involved in furbearer harvest.

- Cease attempts to estimate any furbearer harvest (excluding bobcat) for all currently surveyed species (coyote, gray fox, pine marten, and swift fox annually) (beaver, red fox, raccoon, and ring-tailed cat tri-annually).

Timeline

If action is taken to require mandatory reporting, time is needed to develop a reporting database and related processes, along with necessary regulatory changes. Likewise, if a form of permit is required (either species specific or furbearer generic), then the regulation cycle is:

Informal internal discussions & with external interests:	February – March (not later than)
Regulation Review:	April
Issues – Parks and Wildlife Commission:	May
Final Adoption – Parks and Wildlife Commission:	July

The risk of harming any of these species populations by current presumed levels of recreational harvest is quite low. However, in the absence of any reliable harvest estimates that could be interpreted as quite a reckless statement. The social/political risk is probably the greater issue and the perception of the non-hunting public about CPW credibility of harvesting species and caring little or not at all about the amount of harvest must be considered.

Furbearer species harvest survey

In 2012, we reassessed the appropriate scale and frequency for harvest surveys for all furbearer species. We concluded that no harvest surveys were necessary until management considerations change for the following species: badger, mink, muskrat, opossum, striped skunk, western-spotted skunk, long-tailed and short tailed weasels. Scale, survey frequency, type of survey, and rationale are presented as follows:

Species	Harvest Survey Method					Scale
	Mandatory Check of Harvest	Single Species Survey (Annual)	Multi-Species Survey (Bi or Tri Annual)	Small Game Survey (Annual)	No Survey	
Badger					X	
Beaver			X			I-25 & I-70
Bobcat	X					GMU
Coyote				X		County
Gray Fox		X				I-25 & I-70
Red Fox			X			I-25 & I-70
Swift Fox		X				E of Mtns & I-70
Mink					X	
Muskrat					X	
Opossum					X	
Pine Marten		X				I-25 & I-70
Raccoon			X			W of I-25 & I-70
Ring-tailed Cat			X			I-25 & I-70
River Otter	X (if reclassified in the future)					GMU
Striped Skunk					X	
Western-spotted Skunk					X	
Long-tailed Weasel					X	
Short-tailed Weasel					X	
Cottontail Rabbit*				X		

- Cottontail rabbit harvest levels are an indicator of bobcat prey abundance and bobcat reproductive success, and is one of the bobcat management guidelines.
- Coyote harvest should be surveyed annually due to real or perceived damage concerns and socio-political influences. In the absence of survey data we risk unsupported opinions and allegations relative to harvest levels, species jeopardy, and agriculture impacts.
- Species listed for no survey have the following characteristics: high reproductive potential and/or high levels of natural annual mortality-- thus harvest would be highly compensatory and/or have very low levels historic and most recently documented harvest. Placement in the non-survey category may be reconsidered if the number of pelts sold at local annual fur markets markedly increases.
- Species listed for the periodic survey have relatively lower reproductive potential and/or harvest may be less compensatory and/or have higher conflict potential to human structures.

SECTION VI: **Summary**

- Species listed for the annual single species survey were identified in the 2012 furbearer program review as high priority species. Swift and gray fox have management guidelines that require harvest monitoring. Pine marten were designated for increased harvest monitoring due to potential for habitat changes. If harvest remains persistently low; however, they may be moved to another category.
- If river otter are reclassified as game species at some point in the future, harvest should be limited and documentation should be mandatory.