

STANDARD OPERATING PROCEDURES:

Mule Deer Population Monitoring

CRATERS OF THE MOON NATIONAL MONUMENT

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1.0 INTRODUCTION

This report contains standard operating procedures (SOP's) for mule deer population monitoring and permanent vegetation transect monitoring for Craters of the Moon National Monument (CRMO), Idaho.

The standard operating procedures were developed over a three-year period, 1980-1982, concurrent with a study of ecological characteristics of the mule deer herd which summers on CRMO. The results of the mule deer study are presented in Report B83-2 of the Cooperative Park Studies Unit, University of Idaho.

In the 1994 revision of the SOP's, the permanent vegetation transect monitoring has been removed, as this program has been incorporated into a vegetation trends monitoring program established in 1992. In addition, the section on census methods has been clarified and the section regarding Procedures for Data Analysis has been broken down and detailed to accommodate a fairly rapid turn-over of staff with varying mathematical skill levels.

2.0 CRATERS OF THE MOON NATIONAL MONUMENT - MULE DEER POPULATION MONITORING
STANDARD OPERATING PROCEDURES

A. PURPOSE

The deer monitoring program is designed to provide yearly indices to the Craters of the Moon mule deer population level, herd productivity, and over winter fawn survival. Since the Craters herd does not exclusively occupy national monument lands, the objective is to obtain information which will complement data obtained by Idaho Fish and Game (IDFG) and Bureau of Land Management (BLM) programs. To this end, representatives from IDFG and BLM should be invited to participate in the censuses each year.

B. SAMPLING FREQUENCY

The deer censuses are to be conducted in the spring (April-June) and in late summer (August-September) of each year. This is necessary in order to build an understanding of year-to-year variation in the population composition and to identify long-term changes that may occur.

C. SAMPLING METHOD

1. Spring classification

As soon as deer begin to arrive on the monument in spring, begin documenting the sex and age of all deer seen. Sampling should continue throughout the month of May and the first two weeks of June. Classify deer as adult males, adult females, yearlings, or unknown. Yearlings may be differentiated from adults based on body size and the ratio of the ear length to lower jaw length. Deer with ears longer than the lower jaw should be classed as yearlings and those with ears the same length or shorter than the lower jaw should be classed adult. Use a spotting scope or binoculars to obtain a profile view when ageing the deer. Continue documenting the sex and age of the deer until **at least 100 and preferably 200 animals** have been classified. To obtain the larger and more precise sample it may be necessary to conduct early morning walking censuses in the wilderness area and early morning roadside censuses in the north end of the monument. Attempt to obtain the sample from various areas of the monument rather than repeatedly classifying deer from one location (e.g., Inferno Cone). When data collection is complete, calculate the yearling:doe ratio as # yearlings/# does. The spring yearling:adult doe ratio can be compared to the fawn:doe ratio collected during the previous late summer to index over-winter fawn survival for the preceding winter. For example, in the late summer of 1982, there were 94 fawns per 100 does and in the spring of 1983 there was an estimated classification ratio of 73 yearlings per 100 does; over-winter survival is then indexed as $(73/94) \times 100 = 88$ percent. This convention will overestimate over-winter survival of fawns depending on the winter mortality of does. The more does that die in winter, the greater will be the overestimation.

The proportion of does that are adult may be estimated by first assuming that one-half of the yearlings are female, thus obtaining a doe total. Divide the # of adult does by the total # of does. Yearling:doe ratios for 1980-1982 are presented and analyzed by Griffith (1983, Coop. Park Studies Unit, Univ. of Idaho, Report B83-2). A worksheet for converting the

yearling:doe ratio to a yearling:adult doe ratio is located in the appendix 1 on the Overwinter Fawn Survival Worksheet.

2. Late summer census

The basic sampling method in late summer is an early morning roadside census from a vehicle. The total number of deer seen on such censuses during 1980-1982 was highly ($r = 0.99$, $P = 0.01$) correlated with the total population estimated by mark-recapture techniques (Griffith, 1983, CPSU, Univ. Idaho Rep.B83-2). Each year **between the 15th of August and 15th of September**, conduct **eight** (this has been changed from six in the original SOP's to eight in the 1994 revision to statistically eliminate anomalies) morning censuses from a vehicle along the 3.9 mile section of secondary road in one direction from Highway 93/20/26 north to the pullout just before the old Martin Mine site. During this period the majority of the Craters of the Moon herd should be residing in the north end of the monument, and fawns will be following their mothers.

Do not conduct censuses during consistent rain or when winds consistently exceed 10 mph. Begin censuses 10 minutes after sunrise. It will take approximately 1-2 hours to complete each census. Drive slowly, stopping at a couple of good vantage points along the road, and search the terrain carefully to ensure that no deer are missed. Be sure to include the hill sides around the quick shot area, those west of the Little Cottonwood meadow and the Leach Creek drainage above the research camp. Record all deer visible from the road. At the pullout before Martin Mine, park the vehicle and step outside. Include in the census all deer which can be seen from this point. Throughout the census, use binoculars to scan distant hillsides and a spotting scope to classify the age and sex of each deer seen. Classify deer as either adult males, yearling males, females, or fawns. **Consider all two-point or spike bucks to be yearlings and larger bucks to be adults.** Do not distinguish between yearling and adult females.

Record the sex and age of the deer observed in groups as they are seen (e.g., 1 doe, 2 fawns, 2 yearling bucks, 1 adult male, etc.) on the Mule Deer Census Form (Appendix 2). A group is a number of deer which catches the observer's attention, not a social unit.

3. Road kills hunter kills

During 1980-1982, Griffith (1983, op cit.) documented significant ($p \leq .01$) direct relationships between the estimated total population and total number of deer killed on the highway within the monument boundaries, and total documented hunter kill around the boundaries of the north end of the monument. Since the road kills and hunter kills provide an estimate of population trend independent of the late summer censuses, they should be documented each year as a check on the roadside censuses.

At the summer orientation each year, alert the maintenance crew to report any road killed deer along U.S. Highway 93/20/26 to the ranger division. Rangers should record on the Mule Deer Road Kills Form (appendix 3) the date/time of death (estimate, if not known), sex and age (fawn, yearling, adult), size of antlers on males, location on highway, and date/time of collection of all deer killed on U.S. Highway 93/20/26 within the monument boundary.

During hunting season patrols each year, Rangers should record the number of hunter contacts and the date, number, sex, and age of deer killed by these hunters. Include in this documentation reliable reports of deer killed but not actually seen by the Rangers on hunting patrol and deer killed in the Big Cottonwood Creek area. All illegal kills should also be documented separately. Both the road kill and hunter kill reports should be turned over to the resource management division at the end of the hunting season, before the 1st of December.

D. PROCEDURES FOR DATA ANALYSIS

Of the eight total censuses conducted, drop both the census with the highest and the lowest total counts and use the data only from the remaining SIX censuses.

1. Calculating over-winter success rate - Overwinter Fawn Survival worksheet

Step 1: Record the **actual** number of adult does and yearlings from the most recent spring census in columns 4 and 5 of the Over-winter Fawn Survival Worksheet (Appendix). In the past, authors of the annual reports have used both the actual number of deer seen and the mean totals alternately. Both figures yield the same results, but to avoid any possible confusion in the future and to aid with consistency, it is recommended that actual numbers be used.

Step 2: Record in columns 1, 2 and 3 the actual # of fawns, does, and the fawn:doe ratio (F ratio) from columns 11, 12 and 13 of the previous year's Over-winter Fawn Survival Worksheet.

Step 3: In column 6, divide the # of yearlings in column 5 by the # of does in col 4 and multiply by 100 to obtain the yearling:doe ratio (Y ratio).

Step 4: In column 7, divide the Y ratio in column 6, by the F ratio in column 3 and multiply by 100 to obtain the over-winter survival rate.

Step 5: In column 8, multiply the # of yearlings from column 5 by 0.5 to obtain the number of yearlings that are female.

Step 6: In column 9, add the # of yearling females from column 8 to the # of adult does in column 4.

Step 7: In column 10, figure the adult doe ratio by dividing the # of adult does in column 4 by the total # of does in column 9.

Step 8: In column 11, record the total number (actual) of fawns observed in the **late summer census**.

Step 9: In column 12, record the total number (actual) of does observed in the **late summer census**.

Step 10: In column 13, divide the # of fawns in column 11 by the # of does in column 12 and multiply by 100 to obtain the present census year's fawn:doe ration (F ratio). Figures in columns 11, 12 and 13 will be used to help calculate the over-winter success rate for the upcoming year.

Step 11: In column 14, divide the F ratio in column 13 by the adult doe ratio in column 10 to obtain the fawn:adult doe ratio.

2. Late Summer Summary Worksheet

a. Calculating sex and age ratios and percent change over the previous year's census figures

Step 1: Record on the Late Summer Summary Worksheet (see Table 1), the number of deer observed in each of the sex and age groups (adult males, yearling males, females [includes yearling females], fawns and unknown) for the six censuses (after the highest and lowest of the 8 censuses is eliminated) and total the number of deer for each individual census at the bottom.

Table 1a. Late Summer Summary Worksheet for the Mule Deer Census at Craters of the Moon National Monument

Censuses -----	1 st	2 nd	3 rd	4 th	5 th	6 th	mean	SE	95% CI
Adult males #									n/*
Ratio									
Yrlg males #									n/*
Ratio									
Females #									n/*
Ratio									
Fawns #									n/*
Ratio									
Unknown #									n/*
Ratio									
TOTALS									

n/* = n - not significant, * - significant

Table 1b. Late Summer Summary Worksheet for 1993 Mule Deer Census at Craters of the Moon National Monument

		08/17	08/19	08/?	08/31	09/25	09/14	mean	stnd error	95% CI
Adult Males	#	0	1	0	0	0	0	.17	.448	*
	ratio	0	13	0	0	0	0	2.2		
Yrlg Males	#	0	0	0	0	0	0	0	0	*
	ratio	0	0	0	0	0	0	0		
Females	#	11	8	2	0	7	6	5.7	1.65	*
	ratio	100	100	100	100	100	100	100		
Fawns	#	6	9	2	0	7	4	4.7	3.49	*
	ratio	98	58	59	87	76	50	71		
Unknown	#	0	0	0	0	0	0	0		
TOTALS		17	18	4	0	14	10	10.5		

Step 2: Calculate each age/sex class:doe ratio for each of the censuses by dividing the # of deer in that class by the number of females observed during that same census and multiply by 100 (i.e. 3 adult males in 1st census/36 females in first census x 100 = 8 adult males:100 does). Disregard deer of unknown sex and age class.

Step 3: Calculate the mean (average) for both the actual # of deer observed and the ratios for all six censuses for each of the deer age/sex classes. i.e.:

Census	1	2	3	4	5	6	Mean
Adult Males #	3	2	7	6	8	4	5.0
Ratio	8	8	35	29	38	13	21.8

Step 4:

Subtract the previous census year's mean # from the present census year's mean # for each of the age/sex classes. Divide the sum by, again, the last census year's mean # for that age/sex class and multiply by 100. i.e.:

1990 mean #	1991 mean #
Adult Males 6.67	7.83

$$\% \text{ chg in adult males} = 7.83 - 6.67 = 1.16 / 6.67 = .1739 \times 100 = 17.39$$

b. Calculating 95% confidence intervals for percent change figures - late

summer summary worksheet.

The following is the calculation used to obtain the confidence intervals for each of the age/sex class percent change figures.

$$95\%CI = \Sigma x^2 - [(\Sigma x)^2/n]$$

x = number of deer within an age/sex class that were observed on a census

n = number of censuses = 6

Step 1: Working through one age/sex class at a time sum the total number of deer observed at each of the six censuses. The Sum of the totals is represented by Σx . i.e.:

Census	# deer
1	50
2	53
3	57
4	48
5	52
6	60
$\Sigma x =$	320

Step 2: Square the sum total you arrived at in step 1. This figure is represented by $(\Sigma x)^2$.

i.e. $(\Sigma x)^2 = (320)^2 = 102,400$

Step 3: Divide the sum of the totals squared $((\Sigma x)^2)$ by the number of observations (n).

i.e.: $[(\Sigma x)^2/n]$

Step 4: Now take each of the census totals in the age/sex class and square them. This figure is represented by x^2 .

Step 5: Sum all of the x^2 s. This figure is represented by Σx^2 .

Step 6: Subtract the figure obtained in step 3 above from the sum of the squared census totals (Σx^2) from step 4.

i.e. $\Sigma x^2 - [(\Sigma x)^2/n]$
 $= 17,166 - 17066.7 = 99.33$

Step 7: CALCULATING THE Standard deviation (SD)

Divide the sum from step 6 (Σx^2) by the number of observations (n) minus 1.

$$\begin{aligned}\text{i.e.} \quad (SD) &= \Sigma x^2 / n - 1 \quad (n - 1 = 6 - 1 = 5) \\ &= 99.33 / 5 \\ &= 19.87\end{aligned}$$

The higher the variance value, the greater the difference in the # of deer seen from one daily census to another.

Step 8: CALCULATING THE STANDARD ERROR OF MEAN (SE)

$$(SE) = \sqrt{SD/n}$$

Divide the standard deviation by the number of observations.

$$\text{i.e.} \quad SD/n = 19.87/6 = 3.31$$

Now take the square root of this sum.

$$\text{i.e.} \quad \sqrt{SD/n} = SQ3.31 = 1.82$$

Add these figures to the standard error column on the summary Worksheet for each of the age/sex classes.

Step 9: DETERMINING CONFIDENCE LEVELS (C.I.) FOR EACH AGE/SEX CLASS USING A T-TEST

The constant value used for a sample size of 6 is 2.751. If there are a different number of samples used, this value will change. See a statistics table for the value if this is the case.

i.e. where $\bar{X}$ = mean and the mean is equal to $\Sigma x/n = 320/6 = 53.33$, then:

$$\begin{aligned}\text{C.I.} &= \bar{X} \pm 2.571 (SE) \\ \text{C.I.} &= 53.33 \pm 2.571 \times 1.82\end{aligned}$$

multiply the constant (2.571) by the standard error of mean figure for that age/sex class (SE).

$$\begin{aligned}&= 53.33 \pm 2.57 \times 1.82 = 53.33 \\ &= 53.33 \pm 4.68\end{aligned}$$

$$\begin{aligned}\text{CI hi} &= 53.33 + 4.68 = 58.01 \\ \text{CI lo} &= 53.33 - 4.68 = 48.65 \\ \text{95\% CI range} &= 48-58\end{aligned}$$

now add and then subtract this figure (4.68) from the mean ($\bar{X}$) to obtain the 95% C.I. range. You can then say that you are 95% sure that the true mean number of deer seen on the censuses lies between the range given.

Step 10: You can now compare the C.I. range from the present year to the previous years mean total of deer for each age/sex class. If the figure falls within the range, the change is not significant. If the figure falls outside of the range, then the change is significant. Note whether the change is or is not significant in the last column of the Late Summer Summary Worksheet to be turned in with the report.

3. Calculating population estimates and the 95% Confidence Interval

Step 1: To establish the deer population estimate:

$$Y = (7.295) (X) + 19.056$$

Where Y = the total number of deer in the herd, and X = the mean total from the six censuses. the numbers 7.295 and 19.056 are constants

Step 2: To establish the 95% Confidence Interval (CI)

$$Y \pm 12.706 \times \sqrt{43.22(1.33 + (X - 58.8)/277.26)}$$

Where X = mean total number of deer and Y = the estimated population figure. All other figures are constant.

ie:

$$Y = 96$$

$$X = 10.5$$

$$96 \pm 12.706 \times \sqrt{43.22(1.33 + (10.5 - 58.8)/277.26)}$$

$$96 \pm 261$$

$$96 - 261 = -165 \text{ (0)}$$

$$96 + 261 = 357$$

The 95%CI for the population estimate is 0-357.

If the CI from the present year overlaps with the previous year, significant change has not occurred. On the other hand, if they do not overlap, then significant change HAS occurred.

E. COMPLETING THE ANNUAL REPORT

Enter the data on to a Mule Deer Annual Summaries table (Table 2), listing the spring census data (actual number (not means) of adult does, yearlings, yearling:100 doe ratio, overwinter survival rate, approximate doe total, and adult doe ratio), the fall census data (the # of adult males and percent change, mean # of yearling males and percent change,

mean # of adult females and percent change, mean # of fawns and percent change, the mean total, fawns:100 does ration, and fawns:100 adult doe ratio), and the vehicle, hunter and illegal kills (adult male, yearling males, adult females, fawns, unknown and totals). At the bottom, record the fall population estimate for the year and the 95 % confidence interval. It is helpful when comparing data from year to year to list at least the data from the four years previous on this table also.

The draft report for the mule deer census should be completed by the end of December and should include both the Mule Deer Annual Summaries (Table 2) and the Late Summer Summary Worksheet (Table 1). Route the draft report to the chief of resource management, Gerry Wright at the University of Idaho in Moscow, and the monument superintendent. Final copies of the report should be sent to those names listed on the mailing list in

Table 3. Summaries for the Craters of the Moon National Monument Annual Mule Deer Census from 1989-1993.

	1989	1990	1991	1992	1993
SPRING					
Adult Doe	49	42	52	MD	10
Yearlings	13	31	50	MD	7
Yearling: 100 Doe	26.05	73.80	96.15	MD	70
Overwinter Survival	34.50%	86.00%	72.64 %	MD	96.50%
Appr. Doe Total	56	57	77	MD	13.50
Adult Doe Ratio	0.88	0.74	0.68	MD	0.74
FALL					
Mean # Adult Males	3.33	6.67	7.83	2.30	0.17
Percent change	-10.00%	100.00%	17.39%	-70.62%	-92.60%
Mean # Yearling Male	1.83	2.83	2.83	1.50	0
Percent change	-70.00%	54.64%	0.00%	46.99 %	-100.00%
Mean # Adult Females	28.83	23.67	37.67	20	5.70
Percent change	-10.75%	-0.67%	59.15%	-46.91 %	-71.50%
Mean # Fawns	20.33	31.33	41	14.50	4.70
Percent change	-0.83%	54.11 %	30.86%	-64.63 %	-67.59
MEAN TOTAL	49.33	64.50	89.33	38.30	10.50
Fawns: 100 Does	85.30	13 2.40	108.80	72.50	82.50
Fawns: 100 Adult Does	96.50	178.90	161.11	MD	111.50
VEHICLE KILLS					
Adult males	0	1	1	2	1
Yearling males	0	0	0	0	0
Adult females	3	3	4	3	2
Fawns	2	1	1	1	2
Unknown	0	0	0	3	1
TOTALS	5	5	5	9	6
HUNTER KILLS					
Adult males	9	20	7	17	7
Yearling males	13	6	3	0	0
Adult females	18	9	0	8	0
Fawns	1	4	0	0	0
Unknown	0	0	4	0	0
TOTALS	41	39	14	25	7
ILLEGAL KILLS					
Adult males	4	0	1	3	0
Yearling males	0	0	0	0	0
Adult females	1	3	0	0	0
Fawns	0	3	0	0	0
Unknown	0	0	1	0	0
TOTALS	5	6	2	3	0
FALL POP'N ESTIMATES	379	490	671	298	96
95 % CI	272-486	389-591	490-852	157-439	0-357

MD = missing data

F. INTERPRETIVE GUIDELINES

Some year-to year variation in data obtained from the censuses is to be expected. This will be due to actual changes in population characteristics and to variance in observers' abilities to accurately detect deer. For example, the total number of deer seen on comparison censuses conducted by two observers in 1982 differed by 20 percent even though the censuses were conducted on the same days at the same time of day, from the same vehicle. Between-year variations on the order of 20-40 percent from a long-term, 3-5 year average should cause little concern.

A consistent year-to-year decrease or consistent increase of the same magnitude over a period of 3-5 years would suggest that real changes in the total number of animals or proportions in the various sex and age classes were occurring. If real changes are suspected under these guidelines, consult the confidence intervals to determine if a statistically significant change has occurred.

The adult female segment of the population is the key to the long-term stability of the herd and trends in this segment are particularly important. The adult females will be combined with yearling females (which generally do not produce fawns) in the late summer, however. Multiply the estimated proportion of does that are adult (obtained from spring classification data) times the number of does seen on the late summer censuses.

It is important to remember that the estimates of classification ratios and numbers of deer may be a function of factors influencing the deer herd which are not directly related to Craters of the Moon. For example, an especially severe winter may cause high fawn mortality on winter ranges. During the following August, fewer of the deer classed as females would be unproductive yearlings. As a result, given constant fecundity of adult females, an increased fawn:doe ration might be observed. The same conditions might produce a lower proportion of yearling bucks. Conversely, a mild winter may result in a increased proportion of yearlings and a lower fawn:doe ration the following August. Use the year-to-year variation in spring yearling:adult doe ratios to estimate the direction of bias in the late summer fawn:doe ratios.

Since no previous long-term monitoring of deer has been conducted at Craters of the Moon, it will take a few years to determine if the herd is stable, decreasing or increasing. One year of data in itself is of limited usefulness. Therefore, it is essential that the spring classification, censuses, and documentation of road kills and hunter kills be conducted each year so no gaps in future knowledge will exist.

CREATORS OF THE MOON NATIONAL MONUMENT'S OVERWINTER FAWN SURVIVAL WORKSHEET

PREVIOUS FALL CLASSIFICATIONS

SPRING CLASSIFICATION SUMMARIES

(female only)

LATE SUMMER CLASSIFICATIONS

[illegible]

Total number of deer observed