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A Comparison of the Part A and Part C Procedures

For Estimating Cattle Inventories on Public Lands

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A COMPARISON OF THE PART A AND PART C PROCEDURES FOR ESTIMATING CATTLE INVENTORIES ON PUBLIC LANDS. By Brad Pafford; Statistical Research Division, Statistical Reporting Service; U.S. Department of Agriculture; Washington, D.C. 20250; Staff Report Number SF&SRB91.

ABSTRACT

Statistical analyses on the Part A and Part C procedures for estimating Public, Industrial, and Grazing Association (PIGA) cattle were made in 11 Western States for the June and December Enumerative Surveys, years 1982-1984. These included univariate and multivariate difference tests, and analyses of segment and tract level data. In addition, nonsampling errors were studied and the greatest acreage estimate evaluated. The results indicated few differences between the Part A and Part C estimates in all States, except for Arizona and New Mexico. Differences in these two States cannot be explained from an inspection of the data. Nonsampling biases exist for each procedure and can partially explain their apparent differences. The Part A procedure is recommended, with some modification, over the Part C procedure, except in Arizona and New Mexico. The survey procedures should be evaluated in these two States to explain why there is a discrepancy in the levels of the estimates.

CONTENTS

1. INTRODUCTION

The Statistical Reporting Service (SRS) conducts national biannual area frame surveys called the June Enumerative Survey (JES) and December Enumerative Survey (DES). Special area frame procedures for estimating cattle inventories are used extensively in eleven 11 Western States containing large areas of public grazing lands. These States are Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The same methods are used in other States which occassionally have public lands crop up in sampled segments. These procedures were developed to minimize reporting problems when sampled segments contained some public grazing land.

The operational procedure utilizing the Part C questionnaire is completed during a JES or DES interview for such segments. A list of all ranchers (permittees) operating in the grazing unit associated with this tract is gathered and cattle inventories are made for a sample of permittees. A weighted estimator is constructed utilizing the ratio of grazing association acres inside the segment to total acres in the grazing association, and the ratio of total permittees to sampled permittees.

SRS has employed an alternative to the Part C procedure since 1981, primarily because of the cost inefficiencies in building and sampling a public land stratum for the tract cattle indication. This alternative or study procedure utilizes the Part A questionnaire. The estimator is the conventional tract weighted estimate.

This research rose out of concern that the levels of the Part A and Part C estimates were quite different, and the need for just one "operational" procedure. A reduced SRS budget and a recent redirection to eliminate parallel surveys provided additional motives.

This report first presents background information about the two survey methods. Definitions of commonly used terms are given in the background section. Next, the estimators for each procedure are given. Results of the author's analyses are then presented. This includes statistical comparisons for the JES and DES, analyses of segment and stratum estimates for selected States, a discussion of the use of an alternative weighted estimator, and of nonsampling issues. There is a summary of the results, followed by a discussion of recommendations for further research and operational procedures.

The objectives of this study are to:

(1) test for level differences in the Part C and Part A estimators, both univariately for total PIGA (Public, Industrial and Grazing Association) cattle and multivariately for the eight cattle inventory items;

(2) evaluate test results for 1982 thru 1984 for the JES and DES in the 11 Western States;

(3) try to explain why differences occur when identified by the test of hypotheses;

(4) study an alternative weight to the Part A estimator,

specifically the greatest acreage weight; and

(5) evaluate possible nonsampling errors for the Part C procedure.

2. BACKGROUND

It is well known that much of the West is public domain with vast areas of basically undeveloped land. Much land is in woods and rangeland. Area frame estimation is complicated in these areas because no easily identifiable boundaries are available. However, boundaries can still be found as these public lands are administered by controlling agencies (eg., U.S. Forest Service, Bureau of Land Management) and divided into administrative or management units. In the framework of estimating cattle inventories, SRS defines this public land as Public, Industrial and Grazing Association land, and these administrative units as grazing units. The June Enumerative Survey Interviewers Manual definition of public or industrial land is:

> Rangeland where use is generally administered through permits or grazing licenses which allow one or more ranchers to graze a specific number of animal units in a specified area called a grazing unit during a certain period of time, ranging from seasonal to year-round. Payment for use of this land is on an AUM or fee per head basis. Land may be controlled by Federal, State or local agencies of Government or by large industrial corporations, such as paper mills.

A grazing association is defined as:

> a member-owned, member-operated or member-managed nonprofit association of farmers and ranchers organized to acquire and develop grazing land to provide seasonal grazing for livestock belonging to its members.

These together constitute the acronym PIGA.

Lists of cattle operators on these PIGA lands, or permittees lists, are maintained by these controlling agencies. It is with this in mind that the Part C questionnaire was developed to estimate cattle on PIGA land.

The JES Part C procedures are summarized as follows. For any segment that contains PIGA land, a separate tract letter is assigned for each unique grazing unit. A permittee list is obtained from the administering or controlling agency that includes all permittees allowed to operate at any time during the year. This list is then screened for the "on-off" dates corresponding to our survey and checked against our cattle extreme operator (EO) list. On-off dates are the dates the permittees are allowed to graze their livestock on the designated land. Permittees on the list after screening are those with on-off dates corresponding to our survey period and are eligible for sampling. A systematic sample of five or fewer permittees is then selected per tract and matched against the EO list. No cattle data will be collected from permittees determined to be on the EO list and found to be operating as the unit which was selected. With the Part C instrument, enumerators collect information about the controlling agency, cattle inventory, on-off dates and operation description information of up to five permittees; total and sampled number of

permittees; and grazing unit acreage both inside and outside of the segment. These data are used to construct an estimate of cattle on PIGA land.

The Part C procedure has been adequate, but has come under critical scrutiny for a number of reasons. Most important is the cost of obtaining current lists of permittees from controlling agencies and interviewing permittees. Enumerator work outside of the normal JES or DES data collection period is normally required to obtain these lists, and, therefore, added costs are incurred. In addition, there is a concern over the survey procedures. First, while the State Statistical Office (SSO) Supervisor's and the Interviewers Manual discuss updating procedures for permittee lists, there may be inconsistencies across States. Permittee lists should be CURRENT, and may not be adequately updated prior to our area frame surveys. This is crucial since the selected names are used to determine overlap/nonoverlap (OL/NOL) with the EO cattle lists. Second, there is a concern over office editing procedures. Specifically, manual editing out of data for EO overlap operations is required on the Part C instrument, while a computer edit is used for the Part A questionnaires. There is room for human error with the manual edit process. Finally, the SRS area frame concept is built around enumeration of land area segments, not list frame maintenance and sampling.

These shortcomings led to evaluation beginning in the 1981 JES of a new procedure called the Part A or study procedure. This method is entirely different. It assumes a "base" of private land must be operated before a permit can be obtained. Each tract operator, resident farm operator (RFO), or non-RFO, is asked to report their cattle on PIGA land by completing an additional section of the Part A questionnaire. In this manner, their total cattle on public land can be weighted by the ratio of tract acreage to total farm acreage to arrive at an estimate of PIGA cattle in the tract. In contrast to the operational procedure, tracts containing PIGA land do not contribute to the Part A estimate. All land in a segment in public ownership, therefore, is "ignored" in the sense that all farm operators had a chance of being selected who had cattle on this land.

This procedure seemed advantageous since no list needed maintaining, and there was only a slight modification to the questionnaire. However, problems with this method have also surfaced. Recall that weights are derived as the ratio of tract acreage to entire farm acreage. The reporting of entire farm acreage has been found to be more difficult than reporting other land or livestock items (2). Also, entire farm acres or total land in farm has been shown to be underestimated in past research (11). This will bias the tract cattle estimates upward. Additional biases are known to occur in the handling of AUM (animal unit per month) land. Farm acres reported may or may not include some grazing area paid on an AUM basis. Cattle operators many times cannot destinguish between private and public land, and simply cannot reliably provide this type of information. Small private landholdings often exist, and grazing privileges have been in place for so long that ownership boundaries are often very fuzzy. Field observations made by Thiessen (16) indicate that respondents are often unable to exclude all PIGA land from entire farm acres. This would bias the estimates downward.

As a result of these known biases, alternative weights have been evaluated by Nealon (14) (cropland weight) and Bethel (1) (greatest acreage weight). While having some advantages over the operational weight, Nealon (14) noted

reporting biases for the cropland weight. The greatest acreage weight minimizes reporting bias, but has not been evaluated extensively.

Finally, there are problems with refusals. Visual observation of cattle on PIGA land asked in the Part A questionnaire is impossible. Research has shown that nonrespondents have different characteristics than respondents (5) (6), and multiple frame livestock estimates are generally biased downward because nonrespondent means tend to be larger than respondent means for corresponding livestock inventory items (10). This will tend to downward bias the Part A estimates. Refusals with the Part C may also be a problem. However, more data on permittees are available since they must register with the controlling agencies.

Biases aside, the two estimates have been computed since 1981, and the levels look quite different before statistical testing. The following table gives these estimates for PIGA cattle in the 11 Western States, their difference, and percentage of the total cattle inventory from 1982 through 1984. Data in 1981 are not evaluated in this paper, as there were problems with implementating the Part A procedure in its first year.

Table 1. Total Cattle on PIGA Land--11 Western State Total.

Year	Part C PIGA Total Cattle	% of All Cattle	Part A PIGA Total Cattle	% of All Cattle	Difference 1/
June Enumerative Survey					
1982	3,002,108	11.3	1,394,347	5.6	-1,607,761
1983	3,092,382	12.2	1,627,325	6.8	-1,464,957
1984	3,249,006	12.4	2,489,079	9.8	-759,927
December Enumerative Survey					
1982	693,178	3.2	526,722	2.4	-166,456
1983	920,841	4.0	501,505	2.2	-419,336
1984	1,280,732	5.9	612,658	2.9	-668,074

1/ Difference = (Part A - Part C).

The Part C PIGA estimates in all cases are higher than the Part A estimate at the aggregate level. The difference is larger for the JES compared with the DES. Statisticians must assess the probability that these differences are zero, or alternatively, that the differences are greater than zero. If a lot of variability exists in the difference for the segment totals, we may not be able to reject the hypothesis of no difference with any degree of certainty.

3. WEIGHTED ESTIMATORS

The estimators under consideration are the Part A and Part C weighted estimators, and the greatest acreage estimator given by Bethel (1). Appendix A presents more detailed formulas for the estimated totals and variances.

3.1. PART C ESTIMATOR OF PIGA CATTLE

The form of the equation is:

$$\text{PIGA CATTLE INVENTORY ITEM} \times \left(\frac{\text{JES OR DES EXPANSION FACTOR}}{1}\right) \times \left(\frac{\text{TRACT ACRES}}{\text{GRAZING UNIT ACRES}}\right) \times \left(\frac{\text{TOTAL PERMITTEES}}{\text{SAMPLED PERMITTEES}}\right)$$

For each unique grazing unit within a sampled segment with PIGA land, a separate tract code is assigned and a Part C questionnaire completed. Up to five permittees are interviewed for their cattle located on the PIGA land in the tract and all adjoining land under this same operating arrangement (grazing unit). The estimate is computed by totalling the cattle value for all non-EO sampled permittees, multiplying by the ratio of tract PIGA land to total grazing unit PIGA land, and by the ratio of total permittees to sampled permittees. This estimate is added to the tract expansion of non-PIGA cattle from the Part A questionnaire and to the EO expansions from the list frame for the State-level tract cattle estimate.

3.2. PART A ESTIMATOR OF PIGA CATTLE

The form of the equation is:

$$\text{PIGA CATTLE INVENTORY ITEM} \times \left(\frac{\text{JES OR DES EXPANSION FACTOR}}{1}\right) \times \left(\frac{\text{TRACT ACRES}}{\text{LAND-IN-FARM ACRES}}\right)$$

For each tract operation, the PIGA cattle inventory item from the Part A questionnaire is multiplied by the ratio of tract acreage to total farm acreage. Total farm acreage includes owned acreage and land rented from others, while excluding land rented to others and that used on an AUM basis. For hired manager operations, land-in-farm is defined as acreage operated as a hired manager minus acreage used on an AUM basis. This estimate is, again, added to the tract expansion of non-PIGA cattle from the Part A questionnaire and to the EO expansions from the list frame for a State-level tract cattle estimate.

3.3. GREATEST ACREAGE ESTIMATE

This estimator is the same as in section 3.2, except the weight is now defined as:

$$\text{WEIGHT} = \begin{cases} \dfrac{\text{tract acreage of largest crop}}{\text{farm acreage of largest crop}} & \text{if farm contains crop acreages} > 0, \\ \dfrac{\text{tract hogs}}{\text{entire farm hogs}} & \text{if farm crop acreages} = 0, \text{ and farm hogs} > 0, \\ \dfrac{\text{tract cattle}}{\text{entire farm cattle}} & \text{if farm crop acreages} = 0, \text{ farm hogs} = 0, \text{ and farm cattle} > 0, \\ 1 & \text{if operator lives inside the segment} \\ 0 & \text{otherwise.} \end{cases}$$

This estimator is hereafter defined as the separate greatest acreage estimate.

Here, the largest planted acreage on the farm is used as the weighting variable when there are crops on the farm. If the tract operator has no crops on the farm, the weight becomes tract hogs divided by entire farm hogs. If there are no crops or hogs on the farm, the weight is tract cattle divided by entire farm cattle. Finally, if none of these items are present on the farm, the weight is one or zero depending on whether the tract operator is a resident farm operator (RFO) or non-RFO, respectively. This estimate is combined with the tract expansion of non-PIGA cattle from the Part A questionnaire and with the EO expansion from the list frame for the State-level tract cattle estimate.

If entire farm cattle are available for every tract operator, a greatest acreage weighted estimate could be generated which would not require the respondent to differentiate between the PIGA and non-PIGA classification. In this case, entire farm cattle is multiplied by the greatest acreage weight and this expanded value is then added to the list frame EO expansion for the State level weighted farm cattle estimate. This estimator is hereafter refered to as the combined greatest acreage estimate.

4. RESULTS

This section presents the results of statistical tests on the estimators and nonsampling issues studies by the author. Statistical tests performed were paired t-tests (univariate) and Hotelling paired T tests (multivariate) computed from the difference between the Part A and Part C estimates of PIGA cattle.* JES and DES data were analyzed for 1982-84.

Two points should be stressed for those reviewing these findings. First, the cost of the two procedures are not included in the statistical model. All tests are based on the variance of the difference. It is logical to assume the Part C procedure is more expensive, as more enumerator and office time involved in obtaining and interviewing from permittee lists translates into costs over and above those incurred for the Part A procedure. These costs should be considered in the final decision on which procedure to adopt. Second, nonsampling biases exist and are unknown for the data sets used in this analysis. Statistical differences uncovered here could be attributable to sources of error outside of sampling variability (eg., survey procedures).

Potential nonsampling errors have not been ignored. Our study reviewed (1) JES permittee list building and updating procedures in all 11 Western States; (2) the manual EO edit process for the Part C questionnaires in Colorado, Wyoming, and Oregon; and (3) Part A & C survey procedures from field office visits to Colorado, Oregon, Wyoming, and New Mexico by headquarters personnel for the 1985 JES. These results will be presented after a discussion of difference testing.

4.1. JES ANALYSIS

Table 2 gives the results of the univariate tests for each of the 11 Western States and the 11-State total for PIGA cattle. A significant difference was found for the 11-State total in 1982 and 1983, but not in 1984, and the Part C estimate was larger than the Part A each year. Arizona, Idaho and New Mexico showed consistent differences each year. There is a difference in Utah 2 out of 3 years analyzed. For all other States, there is at most 1 year with a statistically significant difference. The Part C is generally higher than the Part A estimate at the State level, however, this seems to disappear as you move from 1982 to 1984. In 1982, in 10 of 11 States, the Part C is higher, while only in 5 out of 11 is higher in 1984.

Arizona, Idaho, Montana and New Mexico account for 69 percent of the difference in total cattle in 1982. Arizona, Idaho and New Mexico account for 88 percent in 1983 and Arizona and New Mexico account for 91 percent in 1984. When these States are excluded from the 11-State tests (e.g., Arizona, Idaho, Montana and New Mexico for 1982, or Arizona and New Mexico for 1984), there are no significant differences in the two estimates for 1983 ($p=.18$) or 1984 ($p=.88$), while the 1982 achieved significance level is 0.04. A detailed look at why these particular States differ from the rest will follow later.

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* See appendix B for the test statistic formula, and a discussion of the application of two sample t-tests in place of paired t-tests in this situation.

Table 2. Part A and Part C PIGA Cattle Direct Expansion Difference 1/, Relative Difference 2/, and Significance Level for the June Enumerative Survey by State and Year of Survey.

JUNE ENUMERATIVE SURVEY									
	1982			1983			1984		
STATE	DIFF.	REL. DIFF.	SIGN. LEVEL	DIFF.	REL. DIFF.	SIGN. LEVEL	DIFF.	REL. DIFF.	SIGN. LEVEL
AZ	-96,123	-72.1	.02*	-312,047	-72.1	<.01*	-281,949	-70.3	<.01*
CA	-138,502	-43.9	.15	-168,284	-72.6	.09	38438	72.3	<.01*
CO	-80,667	-63.2	.32	766	.8	1.00	191587	72.3	.12
ID	-236,991	-50.8	.05*	-596,696	-80.1	<.01*	-229,650	-56.5	.03*
MT	-490,867	-69.2	.01*	-54,839	-20.4	.67	8,955	1.8	.96
NV	-46,885	-29.8	.40	29,973	12.3	.80	34,890	17.9	.64
NM	-286,849	-58.7	<.01*	-375,731	-68.2	<.01*	-411,363	-67.1	<.01*
OR	63,558	121.0	.19	79,729	41.5	.30	308,699	149.0	.28
UT	-180,352	-76.6	.04*	-5,043	-5.7	.90	-180,667	-72.1	.02*
WA	1,948	1000.0	.32	3,586	15.4	.82	6,470	18.1	.84
WY	-115,031	-36.8	.26	-66,374	-30.9	.44	-245,337	-44.2	.36
Total	-1,607,758	-53.6	<.01*	-1,464,960	-47.4	<.01*	-759,930	-23.4	.12

1/ Difference = Part A PIGA Cattle Direct Expansion - Part C PIGA Cattle Direct Expansion.
2/ Relative Difference = Difference / Part C Part C PIGA Cattle Direct Expansion * 100.
* Denotes significance levels less than or equal to 0.05.

Table 3. Multivariate Test Significance Levels for the Difference in the Part A and Part C PIGA Cattle Inventory Items by State and Year of Survey for the June Enumerative Survey.

JUNE ENUMERATIVE SURVEY SIGNIFICANCE LEVELS			
STATES	1982	1983	1984
Arizona	.49	<.01*	<.01*
California	.77	.37	.21
Colorado	.22	.35	.37
Idaho	.28	.05*	.05*
Montana	<.01*	.27	.40
Nevada	.69	.54	.32
New Mexico	<.01*	.01*	<.01*
Oregon	.14	.04*	.54
Utah	.09	.70	.72
Washington	1.00	.48	.08
Wyoming	.13	.76	.09
11-States	<.01*	<.01*	<.01*

* Denotes significance levels less than or equal to 0.05.

Next, multivariate paired-T tests were performed for the eight cattle inventory items. The results are given in table 3. Appendix C gives univariate significance levels for these eight inventory items comprising the multivariate analysis. In each year, there were multivariate differences in the cattle inventory items at the 11-State level. Consistent differences (1982-84) existed only for New Mexico, while Arizona differed 2 out of the 3 years. The only other multivariate differences were for Montana in 1982 and Oregon in 1983. Excluding Arizona and New Mexico from the overall tests eliminated any multivariate differences for 1983 and 1984 ($p>.10$ and $p>.05$, respectively). A difference still existed for 1982 ($p<.01$).

Detailed analyses on selected States followed from the above univariate and multivariate test results. Stratum level estimates and individual tract records were reviewed to see where the differences occurred and if individual records were a factor. Segment rotation was analyzed for States showing consistent differences to see what effect our overlapping sampling scheme has on these differences. One can easily imagine segments that remain in the sample over the 3 years of this study contributing significantly to this difference.

Montana was analyzed first (table 4), because of the extreme change in levels of the estimates from 1982-84. An inspection of this table reveals a difference of -490,867 total cattle in 1982 (218,828 - 709,695), while only -54,839 and 8,955 cattle for 1983 and 1984, respectively. There are several interesting things to note at the stratum level. First, some strata estimates vary considerably from one year to the next. The stratum 2 estimate for the Part C PIGA cattle in 1982 (364,305) is very large compared with 1983 (77,479 cattle) and 1984 (100,803 cattle). Stratum 74 for the Part C varies from 109,748 cattle in 1982 to zero cattle in 1983 to 223,894 cattle in 1984. This variability (stratum 74) is caused from just <u>one report</u>. Also, the 364,305 cattle in 1982 for the Part C estimate comes from only three reports. The effect on difference testing of eliminating just two reports (1982) from the Part C responses was measured (184,699 from stratum 200 and 109,748 from stratum 7400). The resulting univariate test becomes nonsignificant ($p=.14$), when it was highly significant before these two reports were deleted ($p=.01$). Multivariates considered, there still remained a difference ($p<.01$). In Montana, then, the levels of the estimates are easily influenced by a few reports.

Table 4. Montana JES PIGA Cattle Direct Expansions by Land Use Strata and Year.

JUNE ENUMERATIVE SURVEY						
	PIGA CATTLE					
	1982		1983		1984	
LAND USE STRATUM	PART A	PART C	PART A	PART C	PART A	PART C
2	0	364,305	0	77,479	0	100,803
10-30	106,215	7,650	37751	3,246	54,807	1,898
70	34,753	33,348	106,721	0	159,610	47,269
71	0	98,803	1,521	70,066	0	17,094
72	77,859	95,842	31,351	87,673	91,227	66,586
73	0	0	36,299	30,017	64,481	29,201
74	0	109,748	0	0	125,574	223,894
Total	218,828	709,695	213,642	268,481	495,699	486,744

Also of concern, is the consistent differences found for Arizona and New Mexico. Why do these States differ from all the rest? Apart from nonsampling errors that might cause these differences, one area of investigation is our area frame segment rotation procedures. That is, are nonrotating segments contributing most to the difference while newly rotated segments show little difference between the Part C and A PIGA cattle estimates? The contribution to the direct expansion for newly rotated segments and nonrotating segments were computed for New Mexico (table 5) and Arizona (table 6).

An inspection of the New Mexico data (table 5) reveals the relative difference between the Part A and Part C estimates is nearly unchanged whether the segment is new or is nonrotating. If one were to expect that nonrotating segments had an effect, then the relative difference should be small (near zero) for segments new for the current survey, while large (near 100 percent) for "old" segments. This was not supported by the data. In 1984, for example, the relative difference ranges from -58 percent to -78 percent with most near the state average, -67 percent. For segments new in 1984, the relative difference is only slightly smaller at 58%. The differences vary slightly more for 1982 and 1983 JES data. Newly rotated segments actually show large relative differences. A look at the individual segment data revealed no outlier effects. This is substantiated somewhat by the comparatively low coeffecient of variation in the Part C estimates in New Mexico to other States (1982-17 percent, 1983-21 percent, 1984-19 percent versus C.V.s (coefficient of variation) of 25-55 percent in other States).

In Arizona, the conclusions are similar. While the newly rotated segments have smaller relative differences than nonrotating segments, there is not as large a difference as would be expected.

Table 5. New Mexico JES Part A and Part C PIGA Cattle Direct Expansion and Relative Difference 1/ by Year of Segment Rotation and Year of Survey.

NEW MEXICO -- JUNE ENUMERATIVE SURVEY									
	1982			1983			1984		
YEAR OF ROTATION	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.
PRIOR TO 1981	304,220	170,246	-44	169,598	88,677	-48	100,779	33,301	-67
1981	89,269	4,115	-95	186,999	29,429	-85	128,944	39,007	-69
1982	94,985	27,262	-71	64,004	23,903	-63	69,985	21,742	-69
1983	---	---	---	130,215	33,077	-75	122,074	26,990	-78
1984	---	---	---	---	---	---	190,840	80,219	-58
Total	488,473	201,624	-59	550,816	175,086	-68	612,622	201,260	-67

/1/ Relative Difference = (Part A PIGA Cattle Direct Expansion - Part C PIGA Cattle Direct Expansion) / Part C PIGA Cattle Direct Expansion) * 100.

Table 6. Arizona JES Part A and Part C PIGA Cattle Direct Expansion and Relative Difference 1/ by Year of Segment Rotation and Year of Survey.

ARIZONA -- JUNE ENUMERATIVE SURVEY						
	1982			1983		
YEAR OF ROTATION	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.
PRIOR TO 1981	81,106	16,321	-80	172,207	55,872	-68
1981	1,065	2,939	176	116,414	7,738	-93
1982	51,224	18,013	-65	91,186	31,857	-65
1983	---	---	---	53,106	25,408	-52
1984	2/	---	---	---	---	---
Total	133,396	37,273	-72	432,913	120,865	-72

/1/ Relative Difference = (Part A PIGA Cattle Direct Expansion - Part C PIGA Cattle Direct Expansion) / Part C PIGA Cattle Direct Expansion) * 100.
/2/ Arizona received a new area frame in 1984.

Finally, Idaho JES data were analyzed, since large univariate statistical differences existed each year. Table 7 presents expanded total PIGA cattle by year of segment rotation. Contrary to the findings for Arizona and New Mexico, there seems to be some segment rotation effect in Idaho. Outliers in the data also exist. From an inspection of table 7 one can see the relative differences for "new" segments is smaller than those existing in previous years. For example, a relative difference of -14 percent exists for segments new in 1984 compared with -74 percent for segments sampled since 1982. This difference begins to show up in 1983 as a few "old" segments are rotated out. In addition to this effect are outlier effects. Specifically, two reports (1983 data) of 161,305 and 87,479 PIGA cattle account for 33 percent of the total PIGA cattle estimate of 745,201. These same segments are sampled in 1982 and 1984, but contribute nothing to the cattle estimate in those years.

In summary, difference testing and analyses of State data suggest the following. No consistent difference (univariate and multivariates considered) across all States exists in the levels of the Part A and C estimates. That is, certain States (Arizona and New Mexico) contribute most to the differences, while the remaining States add very little. Other States contribute to the difference sporadically, due in part to either outlier segments (Idaho and Montana) or segment rotation (Idaho). The differences for Arizona and New Mexico, however, cannot be explained by either factor.

Table 7. Idaho JES Part A and Part C PIGA Cattle Direct Expansion and Relative Difference 1/ by Year of Segment Rotation and Year of Survey.

JUNE ENUMERATIVE SURVEY									
	1982			1983			1984		
YEAR OF ROTATION	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.	PIGA CATTLE PART C	PIGA CATTLE PART A	REL. DIFF.
PRIOR TO 1981	2/	----	---	----	----	---	----	----	---
1981	2/	----	---	----	----	---	----	----	---
1982	466,451	229,459	-51	616,966	113,823	-82	235,141	61,403	-74
1983	---	---	---	128,235	34,683	-73	122,525	73,570	-40
1984	---	---	---	---	---	---	48,836	41,879	-14
Total	466,451	229459	-51	745,201	148,506	-80	406,502	176,851	-56

/1/ Relative Difference = (Part A PIGA Cattle Direct Expansion - Part C PIGA Cattle Direct Expansion) / Part C PIGA Cattle Direct Expansion) * 100.
/2/ Idaho received a new area frame in 1982.

Table 8. Part A and Part C PIGA Cattle Direct Expansion Difference 1/, Relative Difference 2/, and Significance Level for the December Enumerative Survey by State and Year of Survey.

DECEMBER ENUMERATIVE SURVEY									
	1982			1983			1984		
STATE	DIFF.	REL. DIFF.	SIGN. LEVEL	DIFF.	REL. DIFF.	SIGN. LEVEL	DIFF.	REL. DIFF.	SIGN LEVE
AZ	-62,115	-66.0	.38	-134,637	-67.4	.22	-132,996	-52.7	.25
CA	-2,308	-20.9	.86	81,558	675.1	.24	-170,568	-84.2	.40
CO	15,730	88.7	.66	-1,888	-16.0	.88	186,592	-84.2	.22
ID	2,309	12.1	.88	-17,762	-36.1	.60	-5,669	-15.2	.85
MT	-2,945	-19.9	.84	44,242	128.2	.34	-21	1.8	.76
NV	-59,169	-59.0	.20	-37,489	-33.1	.58	-128,617	-72.6	.12
NM	-89,007	-30.1	.50	-362,785	-84.8	.02*	-411,582	-84.6	.02*
OR	-10,793	-22.8	.76	31,519	1000.0	.02*	21,225	1000.0	.14
UT	-29,935	-36.7	.66	-6,422	-28.7	.72	-20,838	-80.1	.22
WA	-1,691	-100.0	.30	-27,564	-100.0	.18	13,756	1000.0	.28
WY	73,470	743.6	.04*	11,892	53.3	.54	-5,230	-16.8	.80
Total	-166,454	-24.0	.36	-419,337	-45.5	.07	-668,075	-52.2	.05*

1/ Difference = Part A PIGA Cattle Direct Expansion - Part C PIGA Cattle Direct Expansion.
2/ Relative Difference = Difference / Part C Part C PIGA Cattle Direct Expansion * 100.
* Denotes significance levels less than or equal to 0.05.

Table 9. Multivariate Test Significance Levels for the Difference in the Part A and Part C PIGA Cattle Inventory Items by State and Year of Survey for the December Enumerative Survey.

DECEMBER ENUMERATIVE SURVEY SIGNIFICANCE LEVELS			
STATES	1982	1983	1984
Arizona	.64	.53	.93
California	.82	.54	.15
Colorado	.27	.40	.73
Idaho	<.01*	.43	.62
Montana	1.00	.05*	.30
Nevada	.78	.44	.60
New Mexico	.23	.36	.58
Oregon	<.01*	.29	.72
Utah	<.01*	.38	.62
Washington	.85	.86	.71
Wyoming	<.01*	.76	.64
11 States	.49	.39	.74

* Denotes significance levels less than or equal to 0.05.

4.2. DES ANALYSIS

Tables 8 and 9 present univariate and multivariate test results similar to those for the JES analysis (see app. B for formulas). In general, there were few statistically significant differences in the data either at the univariate or multivariate level. The Part C estimates were consistently higher than the Part A estimates at the 11-State level. However, a few States contributed most of this difference. These States are, again, Arizona and New Mexico. In 1983, they account for -497,422 cattle of the total 11-State level difference of -419,337 cattle, and in 1984 account for -544,578 of the total -668,075 cattle. When these data are removed from the 11-State total difference (becoming a 9-State total), and univariate tests made, the significant difference found for 1984 ($p=.05$) disappears, as does the slight significance in 1983 ($p=.07$). Only two other States differed significantly in the PIGA estimates: Oregon for 1983 and Wyoming for 1982. No multivariate tests were significant at the 11-State level (table 10).

This clearly indicates no statistically significant difference exists in the levels of the Part C and Part A estimates for the DES survey in the years under study. Whatever differences do occur are coming primarily from Arizona and New Mexico.

4.3. GREATEST ACREAGE ESTIMATE ANALYSIS

The problems with the current weight for the Part A estimator (the ratio of acreage in the tract to entire farm acreage) have been documented in section 2. The greatest acreage weight, as proposed by Bethel (1), is one alternative which may have application for PIGA cattle inventory estimation.

Estimates of PIGA cattle and all cattle by type of estimator for the 1984 Arizona June Enumerative Survey data were generated to address this issue. These data are presented table 10. Included are the previously reported Part C and Part A estimates for Arizona, along with the separate and combined greatest acreage estimates (section 3.3). Other State data were not available for comparison.

The statistics are presented as a focus for discussion, and any conclusions drawn from an analysis of one State's data for 1 year must be cautiously interpreted.

Table 10. Direct Expansion (D.E.), Standard Error (S.E.), and Coefficient of Variation (C.V.) for PIGA and All Cattle by Estimator for the 1985 June Enumerative Survey in Arizona.

JUNE ENUMERATIVE SURVEY - ARIZONA				
	ESTIMATOR			
TRACT ESTIMATE	PART C	PART A	GREATEST ACREAGE	
			SEPARATE	COMBINED
PIGA CATTLE				
D.E.	401,315	119,367	39,024	---
S.E.	72,237	50,134	20,140	
C.V.	18%	42%	52%	---
ALL CATTLE				1/ 2/
D.E.	1,315,993	1,034,045	953,702	962,474
S.E.	92,120	78,587	68,736	69,193
C.V.	7%	8%	7%	7%

1/ All Cattle Estimate = (((Entire Farm Cattle * Weight) * EF) + EO Expansion)
2/ Bethel (8) estimated 1,144,000 cattle. The reason for the discrepancy is unknown at this time.

Several things can be noted from table 10. First, the separate greatest acreage estimate for PIGA cattle is lower than the Part A (39,024 compared with 119,367). However, because of their large C.V.s, 42 percent and 52 percent, respectively, one cannot say with any confidence there is a difference. The same difference exists for all cattle (953,702 compared with 1,034,045) since the non-PIGA and list frame EO expansion contributions are the equal for each estimator.

Second, the separate and combined greatest acreage estimators for all cattle perform about equally as well. This can be seen by the fact that their levels are nearly the same (953,702 and 962,474), and have the same C.V.s (7 percent). In addition, while both greatest acreage estimates are only slightly smaller than the Part A, they are much lower than the Part C estimates. The difference with the Part C estimate was not narrowed by use of these alternative estimators. Finally, the C.V.s' for all estimators are quite similar, with the greatest acreage estimates slightly lower compared with the Part A estimate.

Overall, the performance of the greatest acreage estimators (separate and combined) appears to be comparable with the Part A procedure in Arizona for the 1984 JES. However, large differences still exist with the Part C estimate.

Other points need mentioning. The discrepancy between the separate greatest acreage and Part A PIGA cattle estimates (39,024 versus 119,367) was due in part to tracts with PIGA cattle contributing zero to the greatest acreage estimate because of a weight equal zero (primarily from operators with crops on the farm but not on the tract). This compared with a positive contribution to the Part A estimate for all tracts with PIGA cattle (the operational weight can never be zero). This brings to focus the fact that zero weights are a definite disadvantage of the greatest acreage weight. In essence, all available information is not being utilized for the greatest acreage weight. In

contrast, the current weight is never undefined and there is some contribution to the Part A estimate from all tracts having PIGA cattle.

Apart from the statistics in the table itself, certain other observations are given which may seriously detract from the application of the greatest acreage weight in its current form. First, the use of crop acres and hog numbers as weights to weight cattle estimates in States where many operations do not raise hogs or grow crops means the weight will often default to tract cattle (entire farm cattle cancel out when cattle are used as the weight) or the farm estimator. Consequently, when reporting tract cattle, one again must address the issue of PIGA versus non-PIGA cattle, and reporting biases can again be introduced. Also, the estimator may default to the farm weight more frequently than desired. Research has shown (15) the farm estimator not to perform as well as the tract or weighted estimators. The greatest acreage weight could default to the current weight instead of this farm weight. This would eliminate some of the problems of zero weights.

Even if the crop weight is used, there is a possibility for reporting biases just as there are for the reporting of total land-in-farm. For example, waste acres exist in individual field crop acreages as they do in entire farm acres.

Finally, while the combined estimate is appealing in that it removes a section of the Part A questionnaire, the PIGA cattle section, the drawbacks are that many more interviews about entire farm cattle for nonresident operators would be required, and the same problems with the greatest acreage weight discussed above would be present.

5. NONSAMPLING ISSUES

A discussion of two nonsampling issues dealing with the Part C procedure is presented. An attempt was made to uncover possible biases in this procedure that have been mentioned by statisticians experienced with this estimating program. Next, there is discussion of handling refusal and inaccessible records, which is based on observations made by visiting headquarters personnel during the 1985 June Enumerative Survey.

5.1. PERMITTEE LIST UPDATING PROCEDURES

A questionnaire was developed to see if SSO's were consistently applying the permittee list procedures outlined in the JES Supervising and Editing (S & E) Manual. These procedures call for accurate and current updates of permittee lists gathered from controlling agencies of grazing units in sampled segments. Up-to-date lists are essential for unbiased survey estimates. The degree to which each State adhers to this policy was measured through a series of open-ended questions mailed during the 1985 JES. Additional questions were asked to see how name changes, adds, and drops to the list are handled once the sample of permittees has been drawn. While the JES PIGA instructions stress the need for up-to-date lists, the discussion of list procedures is limited. A highly defined set of rules is applied for sampled list records from the list frame (LSF) when name changes, adds, or drops occur (Section 9.7, June S&E Manual). Just how the States handle this in the absence of such rules is addressed. The questionnaire sent to the States appears in appendix D. Two sections of this questionnaire are not discussed (sections IA & III). Section

III was not useable as States rarely keep list tracking information for permittees. Section IA was asked so the States would distinguish between new and nonrotating segments.

The updating procedures for nonrotating segments (question I.B.3) varied by State, but in general permittee lists are (1) updated either prior to the JES when new point samples are received from the sampling frames section, (2) updated during the survey period, or (3) some combination of the two. Controlling agencies are contacted either by the SSO or by enumerator visit. When the SSO's contact the controlling agencies directly, they then check the finalized permittee list against the LSF EO list, sample the names, and mail the sample to the enumerators. If enumerators contact these controlling agencies, they will mail the updated list to the SSO and the same procedures are then followed. While variability exists across the 11 Western States studied, all States annually update and do not treat their lists as fixed or unchanging. This is an important finding. There seems to be a recognizable need to maintain current permittee lists.

Less encouraging are the approaches to handling alterations to the list of sampled names (question I.B.3.3). However, at least a few States rarely have to sample from their grazing units (because they never have more than five permittees). Or, to avoid the problem, they interview all permittees in any given segment. Sampling should occur from a frozen frame allowing each permittee an equal chance of selection. Any change occurring after the sample is drawn can be handled in several ways. The whole list can be resampled, or data can be collected from "good" respondents, letting those represent other nonresponding permittees in the segment.

When asked what enumerators do when a name change, add, or drop occurs for a sampled permittee, the eleven responses were:

(1) Enumerators make name changes where necessary and obtain data for new permittees on the list.
(2) Data are collected for all current permittees during the survey period.
(3) The new permittee is substituted if he or she does not already have another permit in the segment when a name change occurs.
(4) Enumerators are instructed to make notes whether it is a new addition or should be dropped when a change to the permittee lists is encountered. All permittees are sampled, even if there are more than five.
(5) Enumerators call the office for a substitute when there is a name change. A new permittee not on the list is caught only during update. They call the office if a operation is out of business.
(6) They get the correct name and data when a name change occurs. They get the new name and data when a new permittee is discovered.
(7) If a name change occurs, enumerators get the new name and data. Since they are not given a complete listing of permittees for a segment, only those that are sampled, they would not know whether the new permittee was on the list or not. Out of business is treated as zero data (rarely occurs).
(8) Enumerators are instructed to update the entire permittee list if any changes occur. After updates, the list is checked against the EO list.

(9) Enumerators are instructed to pick up information for permittees when there is a name change.
(10) Contact the controlling agency for updated permittee information for name change or out-of-business operations. Call the SSO to find out if an EO. Pick up data if necesssary.
(11) One State's response was not useable.

To summarize, some States are unaffected by changes in their permittee lists because they completely enumerate or rarely have more than five permittees in any sampled segment. However, for those that do sample, there is more list consciousness in some States than others. That is, some States strictly update their entire list when a name change occurs and check it against the EO list, while other States seem to freely substitute one operation for another. This lack of consistent responses across all 11 States indicates the potential for problems in the handling of these permittee lists.

When asked whether these same procedures have been followed consistently (question II), the responses were generally positive. A few States could not comment because of turnover in their staff. One State had used enumerator information as the primary source for updating compared with the current procedure of visits to the controlling agency offices when mapping out new range segments.

5.2. PART C EDITING PROCEDURES FOR EXTREME OPERATOR RECORDS

Wyoming, Colorado, and Oregon participated in a review of the Part C questionnaires for the 1985 JES. These States were chosen because headquarters personnel were there assisting with the JES. The Part C procedures call for each sampled permittee to be checked against the cattle EO list and the data to be zeroed out in the questionnaire if the sampled unit was overlap. The remaining cattle data are then added for a grazing unit total and coded in the appropriate boxes on the front page of the Part C questionnaire. This contrasts with the Part A questionnaire, where the area frame data for overlap records are automatically edited out in this estimation process.

A reviewer in each State was asked to review this zeroing out process for errors after the questionnaires were keyed and completed for the survey proper. Verification of the EO/non-EO classification was also made at the same time. Failure to correctly take out EO overlap records would, consequently, introduce an upward bias in the Part C PIGA estimate.

Results indicate a bias exists. However, the magnitude of the bias cannot be measured since only a few States were examined. Specifically, while no misclassification of EO's were found, one of the three States errored in the zeroing out of overlap records. The review process in Oregon uncovered one permittee with 506 cattle that was overlap but included in the segment total. The estimated expansion based on 1984 segment acreage is 7,237 cattle (1985 JES not available), or approximately 2 percent of the Oregon's total PIGA cattle.

5.3. REFUSALS AND INACCESSIBLES

Two observations are made regarding refusal and inaccessible records for the JES. First, refusal and inaccessible records are more frequent for the Part A

than the Part C procedure because controlling agencies regulate a permittee's right to graze cattle. Operator cattle numbers in this grazing unit are public knowledge. The livestock in the grazing unit, if not given by the permittee, can be knowledgeably estimated from information maintained by the controlling agencies or from other permittees operating in the same grazing unit. Conversely, no PIGA cattle information for Part A refusals are readily available for the statistician, other than last year's JES or DES response. PIGA cattle item presence or cattle numbers are not maintained on the list frame master. Second, statistician hand imputation of PIGA cattle for Part A refusals is minor compared with entire farm cattle imputation. That is, evidence suggests little editing of PIGA cattle is done in practice (for operations not known to operate on PIGA land), while the statistician imputes entire farm cattle data as needed. Lack of PIGA cattle control data compared with entire farm cattle control information restricts the imputation process.

The author believes, then,an additional downward bias exists in the Part A estimate. SSO statisticians often edit in zero PIGA cattle when positive entire farm cattle data are imputed for refusals or inaccessibles. The true presence and extent of this bias are not known.

6. SUMMARY

Paired comparisons were made for the Part A and Part C estimators, both univariately for total PIGA cattle and multivariately for the eight PIGA cattle inventory items. Univariate differences were found at the 11-State level for the 1982 and 1983 June Enumerative Surveys, and 1984 DES. Multivariate differences existed each year for the JES. None were found in the DES data.

Certain States contributed most to this difference. That is, each year they accounted for most of the 11-State total cattle difference. This held true for the JES and DES. Other States sporadically contributed to the difference for the JES.

The States differing consistently for the JES and DES were Arizona and New Mexico (univariate and multivariates considered). Idaho, Montana, and Utah showed sporadic differences for the JES. For Montana, the difference can be explained by a few segments with outliers. Consistent differences found for Arizona and New Mexico cannot be attributed to a nonrotating segment influence. The contribution to the difference in the two estimators was nearly the same no matter whether the segments were newly rotated or were nonrotating. Conversely, Idaho JES data indicate a segment rotation effect, as well as some effect due to outliers.

Separate and combined greatest acreage estimates were computed for the 1984 JES in Arizona as an alternative to the Part A estimate. Both greatest acreage estimates were slightly lower than the Part A estimate and had slightly smaller C.V.s. The difference between the Part C and the greatest acreage estimates was much larger than for the corresponding Part A and Part C difference. How the greatest acreage estimate performs for other States and in general is not known. Problems were noted in applying the greatest acreage weight in its current form to PIGA cattle inventory estimation. Most notable are concerns over (1) zero weights, (2) default to the tract cattle and farm weight, and (3) biases in reporting crop acreages.

Two areas of possible bias were studied: updating procedures for permittee lists and hand editing of permittee data for EO overlap records. Each State made a concerted effort to maintain accurate and up-to-date lists of permittees for sampled segments. Inconsistencies occurred, however, in procedures for handling name changes, adds, or drops for sampled names. This is due to lack of emphasis placed in the Interviewer and S&E manuals. Bias was also found in the handling of EO overlap permittees. The extent of this bias is not known. Biases in the Part A were not objectively studied, but this is not to say they do not exist.

Finally, observations from field office visits during the JES seemed to indicate biases in statistician hand imputation of PIGA cattle for Part A refusals and inaccessibles. Refusals for the Part C procedure do not seem to be a problem.

7. CONCLUSIONS

This study uncovered significant differences between the Part A and C estimators of PIGA cattle. However, we can attribute most of this difference to a few States. This is very encouraging for recommending one procedure over the other since, in most States, using one or the other produces the same estimate within sampling error. When one considers the higher cost of the Part C procedure compared with the Part A, minor differences become unimportant.

Biases also exist and partially explain why the levels of the Part C estimates are higher than the Part A estimates. An upward bias exists in the Part C estimator from the hand editing of EO overlap records, and a downward bias exists in the Part A estimator for refusals and inaccessibles. The direction of the bias on the level of the Part A estimator caused by the current operational weight is unknown.

8. RECOMMENDATIONS

We recommend adopting the Part A estimator in each of the 11 Western States and eliminating the Part C estimator, except in Arizona and New Mexico. Survey procedures should be reviewed in an attempt to explain reasons for these discrepant estimates before the Part C estimator is dropped completely.

Commensurate with this should be the following. First, imputation by statisticians in the field should be replaced by computer imputation of PIGA cattle for refusal and inaccessible records. Much research has been done in this area (8, 9, 13, 7). In addition, Carney (13) has demonstrated inexpensive SAS imputation procedures for the grain stock estimating program. Second, the greatest acreage estimate should be further studied as related to PIGA cattle estimation and cattle estimation in general. The greatest acreage weight in its current form is less suitable for estimation in States with extensive grazing areas and little crop acreage. However, modifications to the weight may make it more appealing than the current operational weight. Further study is needed.

Third, procedures for minimizing the effect of outliers should be evaluated. Outliers, we have seen, cause sporadic differences in the levels of the estimates in some States. Two areas of research we recommend are (1) the effect of increasing sample sizes, and (2) robust estimation. Increasing sample

sizes directly lowers expansion factors, which may reduce the impact of large PIGA cattle segment totals. Robust estimation is a technique that attempts to model the affect of outliers in the data, instead of the usual approach of excluding them from the estimate.

Fourth, each PIGA State should make a concerted effort to obtain permittee lists for the entire State to update cattle EO lists. Since PIGA cattle are a rare item, and not efficiently stratifiable on the area frame, we must work towards this "list approach." This will tend to make the nonoverlap domain small and reduce sampling variance for our PIGA cattle estimates.

Fifth, while it is recommended the Part C procedure be dropped, its continued use in those States which occassionally sample a segment containing PIGA land may need to be considered. Other alternatives are to (1) carry the PIGA cattle section in the Part A questionnaire for all States previously known to have cattle on PIGA land, or (2) ignore the small contribution thes PIGA cattle make to the total cattle estimate.

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10. APPENDIX A

10.1. June Enumerative Survey Estimators

10.1.1. Part A Estimator

The sample estimate of the total is:

$$\hat{Y}_a = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} \hat{Y}'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} e_{ijk} \hat{Y}_{ijk},$$

where,

s = the number of land use strata in the State,

p_i = the number of paper strata within land use stratum i,

r_{ij} = the number of segments within paper stratum j within land use stratum i,

e_{ijk} = the expansion factor for segment k in paper stratum j within land use stratum i,

$$\hat{Y}_{ijk} = \begin{cases} \sum_{l=1}^{f_{ijk}} a_{ijkl} Z_{ijkl} & \text{if } f_{ijk} > 0, \\ 0 & \text{otherwise,} \end{cases}$$

f_{ijk} = the number of agricultural tracts in segment k, within paper stratum j, within land use stratum i,

a_{ijkl} = the weight for tract l, within segment k, within paper stratum j, within land use stratum i. The weight for each tract is the ratio of tract acreage to entire farm acreage. Entire farm acreage excludes that used on an animal unit month (AUM) basis,

Z_{ijkl} = the entire farm value for the number of cattle on PIGA land for tract l, within segment k, within paper stratum j, within land use stratum i.

Also, the variance for the estimated total is:

$$\text{var}(\hat{Y}_a) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} \frac{(1 - \frac{1}{\bar{e}_{ij.}})}{(1 - \frac{1}{r_{ij}})} (\hat{Y}'_{ijk} - \hat{\bar{Y}}'_{ij.})^2$$

where

$$\hat{\bar{Y}}'_{ij.} = \sum_{k=1}^{r_{ij}} \frac{\hat{Y}_{ijk}}{r_{ij}}, \quad \text{and} \quad \bar{e}_{ij.} = \sum_{k=1}^{r_{ij}} \frac{e_{ijk}}{r_{ij}}$$

10.1.2. Greatest Acreage Estimator

The "separate" estimator (section 3.3) is the same as the Part A, except the weight for tract 1 is now defined instead as:

$$a_{ijkl} = \begin{cases} \dfrac{fm_{(ijkl)}}{fm_{(p)}} \text{ if } f_{(p)} > 0 \\ \dfrac{hg_{(ijkl)}}{hg_{(p)}} \text{ if } f_{(p)} = 0 \text{ , } hg_{(p)} > 0 \\ \dfrac{ct_{(ijkl)}}{ct_{(p)}} \text{ if } f_{(p)} = 0 \text{ , } hg_{(p)} = 0 \text{ , } ct_{(p)} > 0 \\ 1 \text{ if operator lives in the ijk-th segment} \\ 0 \quad \text{otherwise} \end{cases}$$

where, $fm_{(p)}$ = the crop of greatest acreage on farm p

$fm_{(ijkl)}$ = the tract acreage corresponding to $fm_{(p)}$

$hg_{(p)}$ = the number of hogs on farm p

$hg_{(ijkl)}$ = the number of hogs on the tract corresponding to $hg_{(p)}$

$ct_{(p)}$ = the number of cattle on farm p

$ct_{(ijkl)}$ = the number of cattle on the tract corresponding to $ct_{(p)}$

The "combined" estimator (section 3.3) immediately follows. The weight, a_{ijkl}, is the greatest acreage weight, and the cattle reported item, Z_{ijklm}, is entire farm cattle instead of entire farm PIGA cattle.

10.1.3. Part C Estimator

The sample estimate of the total is:

$$\hat{Y}_c = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} \hat{Y}'_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} e_{ijk} \hat{Y}_{ijk},$$

where s, p_i, r_{ij}, and e_{ijk} are defined as before, and

$$\hat{Y}_{ijk} = \begin{cases} \sum_{l=1}^{f_{ijk}} a_{ijkl} Z_{ijkl} & \text{if } f_{ijk} > 0 \\ 0 & \text{otherwise,} \end{cases}$$

where

f_{ijk} = the number of PIGA tracts in segment k, within paper stratum j, within land use stratum i,

a_{ijkl} = the weight for tract l, within segment k, within paper stratum j, within land use stratum i. The weight is defined as the ratio of tract acreage of PIGA land to total grazing unit land,

$$Z_{ijkl} = \begin{cases} \sum_{m=1}^{g_{ijkl}} b_{ijklm} W_{ijklm} & \text{if } g_{ijkl} > 0, \\ 0 & \text{otherwise,} \end{cases}$$

where,

g_{ijkl} = the number of sampled permittees in tract l, segment k, within paper stratum j, within land use stratum i,

b_{ijklm} = the ratio of total to sampled permittees in the grazing unit for permittee m, within tract l, within segment k, within paper stratum j, within land use stratum i, and

W_{ijklm} = the permittee reported cattle item of interest for permitte m,

within tract 1, within segment k, within paper stratum j, within land use stratum i.

The variance for the Part C estimator is the same as the Part A.

10.2. December Enumerative Survey Estimators

10.2.1. Part A Estimator

The sample estimate for the total is:

$$\hat{Y}_a = \sum_{h=1}^{L} \hat{Y}_h = \sum_{h=1}^{L} \sum_{w=1}^{t_h} e_{wh} \hat{Y}'_{wh}$$

where,

L = 8 = the number of summary strata in the State,

t_h = the number of tracts in summary strata h,

e_{wh} = the DES expansion factor for tract w in stratum h,

= (DES sampling interval)(JES expansion factor),

$\hat{Y}'_{wh} = q_{wh} a_{wh} Z_{wh}$

$$q_{wh} = \begin{cases} 1 & \text{if cattle on PIGA land,} \\ 0 & \text{otherwise,} \end{cases}$$

a_{wh} = the weight for tract w, within stratum h. It is defined as the ratio of tract to entire farm acreage. Entire farm acreage excludes that used on an AUM basis,

Z_{wh} = the entire farm value for the number of cattle on PIGA land for tract w, within summary strata h,

The variance for the estimated total follows from Coulter (6), and is:

$$\text{var}(\hat{Y}_a) = \text{var}_1(\hat{Y}) + \text{var}_2(\hat{Y})$$

where, the $\text{var}_1(Y)$ is the between tract within summary stratum component of the variance, and $\text{var}_2(Y)$ is the between segment within paper stratum component of the variance due to the subsampling design in the DES.

$$\text{Now,} \quad \text{var}_1(\hat{Y}) = \sum_{h=1}^{L} \text{var}_1(\hat{Y}_h),$$

$$\text{var}_1(\hat{Y}_h) = \left(\frac{T_h - v_h}{T_h}\right) \left(\frac{v_h}{v_h - 1}\right) \sum_{w=1}^{t_h} (\hat{Y}'_{wh} - \hat{\bar{Y}}'_{h.})^2$$

where,

$T_h = \sum_{k=1}^{r_h} e_{kh}\, t_{kh}$ = the expanded number of JES tracts, in stratum h,

e_{kh} = the JES expansion factor for segment k within stratum h,

t_{kh} = the number of JES tracts in segment k within stratum h,

v_h = the number of DES tracts in stratum h,

and, $$\hat{\bar{Y}}'_{h.} = \frac{\sum_{w=1}^{t_h} \hat{Y}'_{wh}}{v_h},$$

$$\text{The} \quad \text{var}_2(\hat{Y}) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \text{var}_2(\hat{Y}_{ij})$$

where,

$$\text{var}_2(\hat{Y}_{ij}) = \left(\frac{R_{ij} - r_{ij}}{R_{ij}}\right) \left(\frac{r_{ij}}{r_{ij} - 1}\right) \sum_{k=1}^{r_{ij}} (\hat{X}'_{ijk} - \hat{\bar{X}}'_{ij.})^2,$$

s = the number of land use stratum in the state,

p_i = the number of paper strata within land use stratum i,

r_{ij} = the number of JES segments in paper stratum j, within land use stratum i,

$R_{ij} = \sum_{k=1}^{r_{ij}} e_{ijk}$ = the expanded number of segments in paper, stratum j, within land use stratum i,

$$\hat{X}'_{ijk} = e_{ijk}\ T_{ijk} = e_{ijk} \sum_{h=1}^{L} t_{hijk}\ \hat{\bar{Y}}_h,$$

t_{hijk} = the number of JES tracts in segment k, paper stratum j, within land use stratum i and summary stratum h,

$\hat{\bar{Y}}_h = \dfrac{\hat{Y}_h}{t_h}$ = the weighted stratum mean for stratum h,

$t_h = \sum_{w=1} e_{wh}$

$\hat{\bar{X}}_{ij.} = \sum_{k=1}^{r_{ij}} \dfrac{\hat{X}'_{ijk}}{n_{ij}}$.

10.2.2. Part C Estimator

The formula used are the same as for the Part A estimator except for the following modifications:

$$\hat{Y}'_{wh} = q_{wh}\ a_{wh}\ Z'_{wh}$$

where,

$q_{wh} = \begin{cases} 1 & \text{if a Part C quesitonnaire completed,} \\ 0 & \text{otherwise,} \end{cases}$

a_{wh} = the weight for tract w, within summary stratum h. The weight is ratio of tract acreage of PIGA land to total grazing unit land,

$$Z'_{wh} = \begin{cases} \sum_{m=1}^{g_{wh}} b_{whm} \, W_{whm} & \text{if } g_{wh} > 0, \\ 0 & \text{otherwise,} \end{cases}$$

g_{wh} = the number of sampled permittees in tract w, within summary stratum h,

b_{whm} = the ratio of total to sampled permittees in the grazing unit for permittee m, within tract w, within summary stratum h,

W_{whm} = the permittee reported cattle item of interest for permittee m, within tract w, within summary stratum h.

11. APPENDIX B

This appendix presents formulas for the univariate and multivariate test statistics. Paired t-tests are employed under the assumption that one can make two measurements (Part A and Part C) of PIGA cattle from each sampled segment.

One can argue, however, that paired t-tests are inappropriate in this situation, and instead, two sample t-tests should be used. That is, paired observations cannot be made for any segment in the population. The argument for this rests on the fact that SRS stratifies PIGA land out of agricultural strata, and excludes private land from segments drawn out in rangeland or point sampled strata. Remember, to obtain an estimate of Part A PIGA cattle there must exist a privately operated tract in the sampled segment. Conversely, to obtain an estimate of Part C PIGA cattle, a tract must be in PIGA hands. If this stratification is successful, and for example, one goes to a segment in an agricultural strata, a measurement exists then only for the Part A PIGA cattle. PIGA land cannot exist, and the Part C PIGA cattle estimate is missing. It cannot be assumed zero as would be done under the pairing approach.

The reason this becomes important is in calculating the correct variance for the test statistic. If we let X = Part A estimator and Y = Part C estimator, and D = X - Y. Then, the Var(D) = Var(X) + Var(Y) - 2Cov(X,Y) is the correct denominator (actually, the square root of Var(D)) for the test statistic involving pairing. For uncorrelated and independent estimators under the scenario just described, the correct variance is Var(X) + Var(Y). The overall result is that the calculated t-value will be much smaller (larger variance when one assumes independence) and we will reject the null hypothesis of no difference between the two estimators of PIGA cattle less often. That is, we will see less significant differences than are presented in the paper's tables.

In reality, stratification is not anywhere near perfect, so that Part A questionnaires are completed in rangeland strata, and Part C questionnaires in agricultural strata. In some segments, then, pairing is possible and in some segments it is not. Ideally, one would need to know in which segments in the population these two situations can exist and calculate the variance accordingly. This, however, is practically infeasable, and techniques for estimating this outside the scope of this paper.

One can assume the significance levels reported in the tables of this paper are the worst case scenario. In some cases, then, there may be no significant differences between the two estimators in a particular State when in fact one was reported.

11.1. June Enumerative Survey Tests

Using the statistics outlined in Appendix A for the JES PIGA estimators, we can define:

$$\hat{D} = \hat{Y}_a - \hat{Y}_c = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} e_{ijk} \left(\hat{Y}_{ijk}^{(a)} - \hat{Y}_{ijk}^{(c)}\right)$$

$$= \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} e_{ijk}\, \hat{d}_{ijk} = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ijk}} \hat{d}'_{ijk} \text{ , where,}$$

$$\hat{d}_{ijk} = \hat{Y}^{(a)}_{ijk} - \hat{Y}^{(c)}_{ijk} \text{ , and } \quad \hat{d}'_{ijk} = e_{ijk}\, \hat{d}_{ijk} .$$

$$\text{Then, } \quad \text{var}(\hat{D}) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} \frac{(1 - \frac{1}{\bar{e}_{ij.}})}{(1 - \frac{1}{r_{ij}})} (\hat{d}'_{ijk} - \hat{\bar{d}}'_{ij.})^2 ,$$

$$\text{where, } \quad \hat{\bar{d}}_{ij.} = \sum_{k=1}^{r_{ij}} \frac{\hat{d}_{ijk}}{r_{ij.}} .$$

Then, to test the hypothesis: H_o: D=0 versus H_a: D≠0 ,

we use $t = \frac{\hat{D}}{\text{S.E. } (\hat{D})}$, and reject H_o if $t > t_\alpha$.

Note: $T \longrightarrow Z$ random variable in large samples. Z tables were used.

For multivariate tests we let: $\hat{D}' = (\hat{D}_1, \hat{D}_2, \ldots, \hat{D}_o, \ldots, \hat{D}_q)'$, where, $\hat{D}_o = \hat{Y}^{(o)}_a - \hat{Y}^{(o)}_c$ for the o^{th} cattle inventory item. Here, $\hat{D}'$ is a (1 x q) vector of PIGA cattle inventory differences.

We, also, define $\hat{W}$ to be the variance-covariance matrix for $\hat{D}$, with the diagonal elements the variance and the off-diagonal elements the covariances. The elements of W, then, include:

$$\text{var}(\hat{D}_o) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} \frac{(1 - \frac{1}{\bar{e}_{ij.}})}{(1 - \frac{1}{r_{ij}})} (\hat{d}'_{o(ijk)} - \hat{\bar{d}}'_{o(ij.)})^2 , \text{ and}$$

$$\text{cov}(\hat{D}_o , \hat{D}_p) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \sum_{k=1}^{r_{ij}} \frac{(1 - \frac{1}{\bar{e}_{ij.}})}{(1 - \frac{1}{r_{ij}})} (\hat{d}'_{o(ijk)} - \hat{\bar{d}}'_{o(ij.)}) (\hat{d}'_{p\,(ijk)} - \hat{\bar{d}}'_{p\,(ij.)})$$

Hotelling (7) has shown that: $T^2 = \hat{D}'\, \hat{W}^{-1}\, \hat{D}$ is distributed as chi square in large samples, with df=q. For the hypothesis $H_o := \underline{0}$~ versus H_a : at least one difference not equal zero, we reject the null hypothsis if T^2 is greater than the tabulated chi-square with df=q

11.2. December Enumerative Survey Tests

Similarly, using the DES statistics formulated in Appendix A, we can define:

$$\hat{D} = \hat{Y}_a - \hat{Y}_c = \sum_{h=1}^{L} \sum_{w=1}^{t_w} e_{wh} \, (\hat{Y}^{(a)}_{wh} - \hat{Y}^{(c)}_{wh})$$

$$= \sum_{h=1}^{L} \sum_{w=1}^{t_h} e_{wh} \, \hat{d}_{wh} = \sum_{h=1}^{L} \sum_{w=1}^{t_h} \hat{d}'_{wh},$$

where, $\hat{d}_{wh} = \hat{Y}^{(a)}_{wh} - \hat{Y}^{(c)}_{wh}$, and $\hat{d}'_{wh} = e_{wh} \, \hat{d}_{wh}$.

Then, the new random variable, $\hat{D}$, has variance

$$\text{var}(\hat{D}) = \text{var}_1(\hat{D}) + \text{var}_2(\hat{D}).$$

$$\text{var}_1(\hat{D}_o) = \sum_{h=1}^{L} \sum_{w=1}^{t_h} \left(\frac{T_h - v_h}{T_h}\right) \left(\frac{v_h}{v_h - 1}\right) (\hat{d}'_{o(wh)} - \bar{\hat{d}}'_{o(h.)})^2 \text{ , and}$$

$$\text{var}_2(\hat{D}_o) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \left(\frac{R_{ij} - r_{ij}}{R_{ij}}\right) \left(\frac{r_{ij}}{r_{ij} - 1}\right) \sum_{k=1}^{r_{ij}} (\hat{c}'_{o(ijk)} - \bar{\hat{c}}'_{o(ij.)})^2 ,$$

where, $\hat{c}'_{ijk} = \hat{X}'^{(a)}_{ijk} - \hat{X}'^{(c)}_{ijk}$ (see Appendix A, Section10.2.1).

For multivariate tests on the DES data, let

$\hat{D}' = (\hat{D}_1, \hat{D}_2, \ldots, \hat{D}_o, \ldots, \hat{D}_q)'$, as before.

Also, let $\hat{W}$ be the variance-covariance matrix for vector $\hat{D}$, with variance elements defined above, and the covariance elements defined by

$\text{cov}(\hat{D}_o, \hat{D}_p) = \text{cov}_1 (\hat{D}_o, \hat{D}_p) + \text{cov}_2(\hat{D}_o, \hat{D}_p)$ for the o^{th} and p^{th} variables.

The

$$\text{cov}_1(\hat{D}_o, \hat{D}_p) = \sum_{h=1}^{L} \sum_{w=1}^{t_h} \left(\frac{T_h - v_h}{T_h}\right) \left(\frac{v_h}{v_h - 1}\right) (\hat{d}'_{o(wh)} - \bar{\hat{d}}'_{o(h.)})(\hat{d}'_{p(wh)} - \bar{\hat{d}}'_{p(h.)})$$

and,

$$\mathrm{cov}_2(\hat{D}_o, \hat{D}_p) = \sum_{i=1}^{s} \sum_{j=1}^{p_i} \left(\frac{R_{ij} - r_{ij}}{R_{ij}}\right) \left(\frac{r_{ij}}{r_{ij} - 1}\right) \sum_{k=1}^{r_{ij}} \left(\hat{c}'_{o(ijk)} - \bar{\hat{c}}'_{o(ij.)}\right) \left(\hat{c}'_{p(ijk)} - \bar{\hat{c}}'_{p(ij.)}\right)$$

The hypothesis and multivariate test statistic follows directly from that outlined in this appendix, Section 11.1.

12. APPENDIX C

This appendix gives the significance levels for the difference between the JES Part A and C estimates based on the univariate paired-t tests. Corresponding DES tests are not presented, but are available upon request.

Table 1. Significance Levels by State and Inventory Item for the 1982 June Enumerative Survey---Paired-t Tests Computed from the Difference Between the Part A and C Estimates.

JUNE ENUMERATIVE SURVEY								
Significance Levels								
Year	Beef Cows	Milk Cows	Bulls	Heifers Beef Repl.	Heifers Milk Repl.	Other Heifers	Steers	Calves
AZ	.02*	.82	.04*	.17	1.00	.30	.30	.04*
CA	.14	1.00	.18	.58	1.00	.62	.66	.16
CO	.28	1.00	.20	.16	1.00	1.00	.23	.20
ID	.06	1.00	.16	.21	.10	.32	.28	.08
MT	<.01*	1.00	.72	.05*	1.00	.86	.14	<.01*
NV	.58	.99	.72	.30	1.00	.94	.34	.40
NM	<.01*	.10	<.01*	<.01*	.32	.90	.91	<.01*
OR	.22	.32	.18	.72	1.00	.10	.32	.16
UT	.04*	.30	.04*	.10	.60	.72	.32	.02*
WA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.32
WY	.12	.32	.14	.56	1.00	.12	.40	.10

* Denotes significance levels less than or equal to .05.

Table 2. Significance Levels by State and Inventory Item for the 1983 June Enumerative Survey---Paired-t Tests Computed from the Difference Between the Part A and C Estimates.

JUNE ENUMERATIVE SURVEY								
Significance Levels								
Year	Beef Cows	Milk Cows	Bulls	Heifers Beef Repl.	Heifers Milk Repl.	Other Heifers	Steers	Calves
AZ	<.01*	.28	<.01*	.03*	1.00	.08	<.01*	<.01*
CA	.06	1.00	.36	.16	1.00	.94	.36	.10
CO	.44	1.00	.14	.10	1.00	1.00	.18	.25
ID	<.01*	1.00	.01*	.04*	.74	.12	.60	<.01*
MT	.76	1.00	.42	.58	1.00	.64	.98	.60
NV	.76	.30	.74	.88	1.00	.32	.38	.74
NM	<.01*	.84	<.01*	.04*	1.00	.10	.08	<.01*
OR	.26	1.00	.50	.96	.32	.34	.22	.24
UT	.86	.28	.82	.38	.26	.44	.26	.82
WA	.54	.32	.76	.52	1.00	.46	.56	.34
WY	.92	.88	.41	.26	.36	.65	.22	.85

* Denotes significance levels less than or equal to .05.

Table 3. Significance Levels by State and Inventory Item for the 1984 June Enumerative Survey---Paired-t Tests Computed from the Difference Between the Part A and C Estimates.

JUNE ENUMERATIVE SURVEY								
Significance Levels								
Year	Beef Cows	Milk Cows	Bulls	Heifers Beef Repl.	Heifers Milk Repl.	Other Heifers	Steers	Calves
AZ	<.01*	.50	<.01*	.04*	.26	.22	.04*	<.01*
CA	.24	1.00	.06	.24	.30	.14	.36	.62
CO	.20	1.00	.22	.21	1.00	.88	.48	.12
ID	<.01*	.32	<.01*	.82	.18	.40	.58	<.01*
MT	.99	.16	.70	.64	1.00	.26	.80	.99
NV	.66	.22	.60	.04*	1.00	.36	.54	.92
NM	<.01*	.30	.02*	.03*	.30	.32	.16	<.01*
OR	.36	1.00	.22	.42	1.00	.28	.29	.30
UT	.02*	.30	.01*	.38	.32	.44	.30	.04*
WA	.96	1.00	.82	.22	1.00	.06	.78	.54
WY	.36	.24	.40	.08	1.00	.32	.39	.36

* Denotes significance levels less than or equal to .05.

13. APPENDIX D

DOCUMENTATION OF UPDATING PROCEDURES FOR CATTLE PERMITTEE LISTS IN THE 11 WESTERN STATES

Arizona, California, Colorado, Idaho, Montana,
Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

Statistical Research Division
Survey Research Section
Brad Pafford, Mathematical Statistician

Purpose: The Survey Research Section is evaluating the procedures on the Part C and Part A questionnaires for estimating cattle located on Public, Industrial and Grazing Association (PIGA) land. This evaluation form concerns the Part C permittee list building and updating procedures followed for the June Enumerative Survey.

Directions: Please complete the attached inquiry as directed in the following pages. The questions ask for the procedures followed in this office for building and maintaining the PIGA permittee list, and not for finding tract boundaries from point samples. Information concerning procedures used during the preparation for the 1985 June Enumerative Survey is requested in Question I. Question II asks for any differences that may have existed in earlier JES surveys, and Question III for record counts of permittees by category. If additional space is needed for a question please use blank paper and attach to this document.

Due Date: Return with your JES survey evaluation forms to the Data Collection Branch by June 28, 1985.

Thank you for your cooperation.

I. Please comment on the procedures for gathering and updating your PIGA PERMITTEE LIST for the 1985 June Enumerative Survey.

A. Newly rotated in segments:

1. Dates list built:

---

2. Sources of names for the permittee list (ie.. U.S. Forest Service, B.L.M, B.I.A.):

---

3. Permittee list building procedures (once the segment boundaries are determined):

B. Procedures for Non-Rotating Segments:

1. Dates Permittee List Updated:

---

2. Sources of Names for Updating Permittee List:

---

3. Updating Procedures:

Include in your comments: (1) whether updated lists are obtained prior to the JES or enumerators update during the survey; (2) how on-off dates and number of head are determined, and (3) what enumerators do when there is a name change for a sampled permittee, a new permittee not on the list, or an out of business operation.

II. Comment on whether the procedures described above were consistently followed for the previous two June Enumerative Surveys(1983 and 1984). Describe any differences.

III. Supply the following counts, if possible, of the number of permittees on the June Enumerative Survey permittee list:

A. Number of Permittees:

	1984	1985
1. New Segments:	_____	_____
2. Non-Rotating Segments:	_____	_____
Total	_____	_____

B. Breakdown of Number of Permittees in Non-Rotating Segments:

	1984	1985
1. Drops (non-rotating segments only):	_____	_____
2. New Adds:	_____	_____
3. Existed in Prior JES:	_____	_____

(Note: B2 + B3 = A2)

C. Breakdown of Permittees that Existed in Previous JES:

	1984	1985
1. Changes Made to Name, Address, Number of Cattle Permitted to Graze, or On-Off Dates:	_____	_____
2. Required No Changes:	_____	_____

(Note: C1 + C2 = B3)

Crop Reporting Board
Statistical Reporting Service
U.S. Department of Agriculture
Washington, D.C. 20250

JUNE 1984 Acreage & Livestock ENUMERATIVE SURVEY

Form Approved
O.M.B. Number 0535-0089

C.E. 12-0030Q
PART C—1

Segment Number: _____ **Tract Letter:** _____

COUNTY: _____

NAME OF GRAZING UNIT: _____

Name and address of land owner or controlling agency.

State	District	Segment	Tract
__ __	_ _ _ _	00000 _ _ _ _	__ __

Part C Usage

1 - All land operated as a Grazing Association for use by the members.

2 - Public Grazing land administered on an *AUM or Fee Per Head* basis.

3 - Industrial owned/controlled grazing land administered on an *AUM or Fee Per Head* basis.

Response to this survey is voluntary and not required by law. However, cooperation is very important in order to estimate cattle numbers. Facts about this grazing unit will be kept CONFIDENTIAL and used only in combination with similar reports from other ranchers.

Controlling Agency: _____
(First) (Middle) (Last)

Contact Name _____
(First) (Middle) (Last)

Address: _____
(Route or Street)

_____
(City) (State) (Zip)

Phone Number: ( ) —
(Area Code)

Office Use
817 1
900 .
840 .
444
445
493
098
100
248

1. What is the total acreage in this grazing unit? ..... **Acres** _____

2. How many acres are **inside** this **blue** tract boundary drawn on the photo *(or map)*? ..... **Acres** _____

3. Total number of permittees? ..... **Number** _____

4. Number of permittees in sample? ..... **Number** _____

5. Intentions to have tract cattle during the 1984 DES period .....

Enumerator: _____ **Date:** _____

OPERATION(S) IN THIS GRAZING ARRANGEMENT

Name and Address of Permittee or Grazing Association Member *(from Controlling Agency)*	OFFI . E USE	Number Of Cattle Permitted to Graze	On and Off Dates	
			Beginning *(Month, Day)*	Ending *(Month, Day)*
1	2	3	4	5
Name of Farm, Ranch or Operation: ____ Name of Operator: ____ *(First)* *(Middle)* *(Last)* Address: ____ *(Route or Street)* ____ *(City)* *(State)* *(Zip)* Phone No. ( ) – ____ *(Area Code)*	☐ EO OL ☐ EO NOL ☐ EO OL ☐ EO NOL			
Name of Farm, Ranch or Operation: ____ Name of Operator: ____ *(First)* *(Middle)* *(Last)* Address: ____ *(Route or Street)* ____ *(City)* *(State)* *(Zip)* Phone No. ( ) – ____ *(Area Code)*	☐ EO OL ☐ EO NOL ☐ EO OL ☐ EO NOL			
Name of Farm, Ranch or Operation: ____ Name of Operator: ____ *(First)* *(Middle)* *(Last)* Address: ____ *(Route or Street)* ____ *(City)* *(State)* *(Zip)* Phone No. ( ) – ____ *(Area Code)*	☐ EO OL ☐ EO NOL ☐ EO OL ☐ EO NOL			

CATTLE AND CALVES ON PUBLIC, INDUSTRIAL OR GRAZING ASSOCIATION LAND

( ) **Permittee Name:** _____

Of the cattle and calves which you own or manage and now located on this grazing unit, how many are:

3. **Beef cows?** *(Include heifers that have calved.)* 251
4. **Milk cows,** whether dry or in milk? *(Include milk heifers that have calved.)* 252
5. **Bulls** weighing 500 pounds or more? 253
6. **Heifers** weighing 500 pounds or more:
   a. For **beef cow** replacement? *(Exclude heifers that have calved.)* 254
   b. For **milk cow** replacement? *(Exclude heifers that have calved.)* 255
   c. **Other heifers** weighing 500 pounds or more? *(Exclude heifers that have calved.)* 256
7. **Steers** weighing 500 pounds or more? 257
8. **Heifer, steer** and **bull calves** weighing less than 500 pounds? 258
   (Include new born calves.)
9. *Add items 3 through 8:* Then the **total cattle** and **calves** is 250
   Is that correct? ☐ **YES** - *Continue.*
   ☐ **NO** - *Make corrections.*

10. Will there be any cattle or calves on **this grazing unit during November or December 1984?** ..... ☐ **YES** ..... = 1 ☐ **DON'T KNOW** . = 2 ☐ **NO** ..... = 3 **Enter Code** .....

Do you operate any land in a partnership or joint arrangement? ☐ **YES** - *Continue.* ☐ **NO** - *Conclude interview.*

Now I would like to *(verify/identify)* the other person(s) in this partnership or joint land operating arrangement. *(Exclude Landlord—Tenant, cash rent or share crop arrangements.)*

OFFICE USE ☐ **EO** ☐ **OL** ☐ **EO NOL**

Name _____
(First) (Middle) (Last)

Address _____
(Route or Street)

_____
(City) (State) (Zip Code)

Phone Number ( ) – _____
(Area Code)

OFFICE USE ☐ **EO** ☐ **OL** ☐ **EO NOL**

Name _____
(First) (Middle) (Last)

Address _____
(Route or Street)

_____
(City) (State) (Zip Code)

Phone Number ( ) – _____
(Area Code)

Enumerator Code Box

909
☐ 1 Complete ☐ 3 Non-Respondent

SECTION H — CATTLE AND CALVES ON PUBLIC, INDUSTRIAL, OR GRAZING ASSOCIATION LAND

1. Does this operation own or manage cattle now located on Public, Industrial, or Grazing Association Land on an AUM basis?

☐ **YES** - *Continue.* ☐ **NO** - *Go to Section I.* →

HOW MANY ARE:

3.	**Beef cows?** *(Include heifers that have calved)*	151
4.	**Milk cows,** whether dry or in milk? *(Include milk heifers that have calved)*	152
5.	**Bulls** weighing 500 pounds or more?	153
6.	**Heifers** weighing 500 pounds or more: a. For **beef cow** replacement? *(Exclude heifers that have calved)*	154
	b. For **milk cow** replacement? (Exclude heifers that have calved)	155
	c. **Other heifers** weighing 500 pounds or more? *(Exclude heifers that have calved)*	156
7.	**Steers** weighing 500 pounds or more?	157
8.	**Heifer, steer and bull calves** weighing less than 500 pounds? *(Include newborn calves)*	158
9.	Then the **total cattle and calves** on Public, Industrial, or Grazing Association Land is	150

Is that correct? ☐ **YES** - *Continue.* ☐ **NO** - *Make corrections and continue.*

ENUMERATOR NOTES:

10. *Does operator live* **INSIDE** *tract?*

☐ **YES** - *Continue.*
☐ **NO** - *Go to item* (12).

11. *Were the cattle now located on Public, Industrial, or Grazing Association Land included in Section F?*

☐ **YES** - *Continue.*
☐ **NO** - *Include them in Section F, then continue.*

(12). *Was Section D, Acres Operated, completed?*

☐ **YES** - *Go to Section I.*
☐ **NO** - *Complete Section D, then go to Section I.*