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Early Warning and Crop Condition Assessment

October 1981

AN EMPIRICAL, GRAPHICAL, AND ANALYTICAL STUDY OF THE RELATIONSHIP BETWEEN VEGETATION INDICES

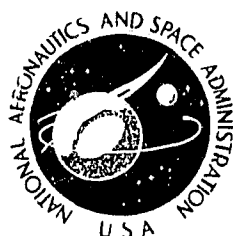
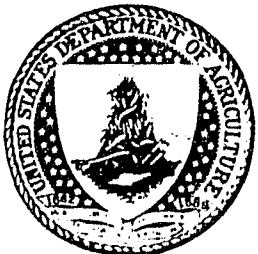
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U.S. Department of Agriculture
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AN EMPIRICAL, GRAPHICAL, AND ANALYTICAL STUDY OF THE
RELATIONSHIPS BETWEEN VEGETATION INDICES

Lyle F. Lautenschlager and Charles R. Perry, Jr.
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The aim of science is to seek the simplest explanation of complex facts. We are apt to fall into the error of thinking that the facts are simple because simplicity is the goal of our quest. The guiding motto in the life of every natural philosopher should be, "Seek simplicity and distrust it".

Alfred North Whitehead

ABSTRACT

Since the launching of Landsat I in 1972, investigators have derived numerous formulae for the reduction of multispectral scanner (MSS) measurements to a single value (vegetation index) for predicting and assessing vegetative characteristics such as plant leaf area, total biomass and general plant stress and vigor. This report summarizes the origin, motivation, and derivation of some four dozen vegetation indices. Empirical, graphical, and analytical techniques are used to investigate the relationships among the various indices. It is concluded that many vegetative indices are very similar, some being simple algebraic transforms of others.

1. INTRODUCTION

Current and accurate information on a global basis regarding the extent and condition of the world's major food and fiber crops is important in today's complex world. Traditional sampling techniques for estimating crop conditions, based on field collection of data, are time consuming, costly, and not generally applicable to foreign regions. An alternate approach is remote sensing - the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation [Lillesand and Kiefer (1979)].

A series of earth resources technology satellites (Landsats) have provided a way to monitor worldwide crop conditions since 1972. The sensor system onboard the Landsats, the multispectral scanner (MSS), measures the reflectance of the scene in four wavelength intervals (bands or channels) in the visible and near-infrared portions of the spectrum. The spectral measurements are influenced by the vegetation canopy, soil type, and atmospheric condition.

Investigators have developed techniques for qualitatively and quantitatively assessing the vegetative canopy from spectral measurements. The objective has been to reduce the four bands of Landsat spectral data to a single number for predicting or assessing such canopy characteristics as leaf area, biomass, percent ground cover, and plant population.

This report summarizes and references the origin, derivation, and motivation for some four dozen of these formulae which are referred to as vegetation indices (VIs). The VIs are categorized on the basis of statistical correlations and algebraic similarities. This analysis reveals the similarities of many vegetation indices.

2. LANDSAT DATA CHARACTERISTICS

Three Landsats have been launched since the summer of 1972, with Landsats 2 and 3 still operational. Each satellite is capable of providing 18-day repetitive coverage of the earth's surface. Each Landsat's onboard four-channel MSS system measures reflectance in four bands (fig. 1). The measurements are converted to digital counts and transmitted to receiving stations. Landsat MSS images cover an area of 185 by 185 kilometers and are composed of 7,581,600 picture elements (pixels). [Watkins and Freedman (1979)].

Typical reflectance patterns for herbaceous vegetation and soil are compared in figure 1. Dead or dormant vegetation has higher reflectance than living vegetation in the visible spectrum and lower reflectance in the near-infrared. Soil has higher reflectance than green vegetation and lower reflectance than dead vegetation in the visible, whereas in the near-infrared, soil has lower reflectance than green and dead vegetation [Tappan (1980)]. Jackson et al. (1980), Tucker and Miller (1977), and Deering et al. (1975) provide an extensive discussion of reflectance properties. Three papers of historical interest are Jordan (1969), Knipling (1970), and Pearson and Miller (1972).

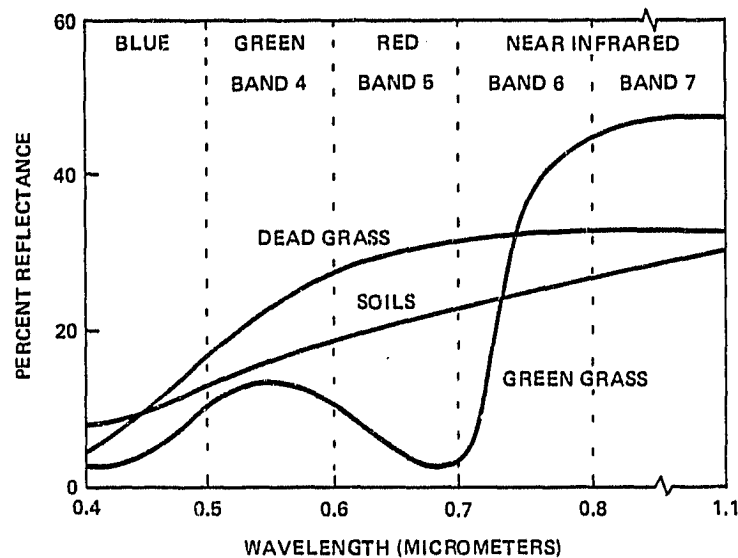


Figure 1. Typical Reflectance of herbaceous vegetation and soil from 0.4 to 1.1 micrometers.

3. DEVELOPMENT OF VEGETATION INDEX FORMULAE

Numerous vegetation indices have been used to make quantitative estimates of leaf area index, percent ground cover, plant height, biomass, plant population, and other parameters [Pearson and Miller (1972) and Wiegand et al. (1974)]. The formulae are based on ratios and linear combinations of the MSS bands.

The individual Landsat bands (CH4, CH5, CH6, CH7) have been used to estimate percent ground cover and vegetative biomass [Wiegand et al. (1974) and Seevers et al. (1973)]. The correlation coefficients reported ranged from 0.295 for CH7 with crop cover to 0.877 for CH6 with leaf area index. Similar correlations were reported by Tucker (1979).

Ratios of the Landsat bands have been used to estimate and monitor green biomass, etc. [Rouse et al. (1973, 1974), Carneggie et al. (1974), Johnson (1976), and Maxwell (1976)]. The obtained coefficients of determinations were slightly higher than those for the corresponding band differences. The twelve pairwise ratios (six of which are inverses of the other six) will be denoted by $R45 = CH4/CH5$, $R46 = CH4/CH6$, etc.

Rouse et al. (1973, 1974) proposed using the normalized difference of Landsat channels 7 and 5 for monitoring vegetation, which will be referred to as ND7. Deering et al. (1975) added 0.5 to ND7 to avoid negative values and took the square root of the result in hopes of stabilizing the variance. This index is referred to as the transformed vegetation index and will be denoted by TVI7. Similar formulae using channels 6 and 5 were proposed.

$$ND6 = (CH6 - CH5)/(CH6 + CH5)$$

$$ND7 = (CH7 - CH5)/(CH7 + CH5)$$

$$TVI6 = (ND6 + 0.5)^{1/2}$$

$$TVI7 = (ND7 + 0.5)^{1/2}$$

Our experience has been that the addition of 0.5 does not eliminate all negative values. We suggest the following computationally correct formulae:

$$\begin{aligned} \text{TVI6} &= (\text{ND6} + .5) / \text{ABS}(\text{ND6} + .5) [\text{ABS}(\text{ND6} + .5)]^{1/2} \\ \text{TVI7} &= (\text{ND7} + .5) / \text{ABS}(\text{ND7} + .5) [\text{ABS}(\text{ND7} + .5)]^{1/2} \end{aligned}$$

where ABS denotes absolute value, and 0/0 is set equal 1. In section 6, it is shown that these formulae are equivalent for decision making to the basic ratios R65 and R75. Therefore, their use can only be justified if either they improve the regression fit or they normalize the regression errors [Draper and Smith (1966)].

Kauth and Thomas (1976) proposed an orthogonal transformation of the original Landsat data space to a new four-dimensional space. They christened this transformation the tassal cap transformation and named the four new axes soil brightness (SBI), green vegetation (GVI), yellow stuff (YVI), and non-such (NSI). The names attached to the new axes indicate the characteristics the indices were intended to measure.

$$\begin{aligned} \text{SBI} &= .332 \text{ CH4} + .603 \text{ CH5} + .675 \text{ CH6} + .262 \text{ CH7} \\ \text{GVI} &= -.283 \text{ CH4} - .660 \text{ CH5} + .577 \text{ CH6} + .388 \text{ CH7} \\ \text{YVI} &= -.899 \text{ CH4} + .428 \text{ CH5} + .076 \text{ CH6} - .041 \text{ CH7} \\ \text{NSI} &= -.016 \text{ CH4} + .131 \text{ CH5} - .452 \text{ CH6} + .882 \text{ CH7} \end{aligned}$$

Wheeler et al. (1976) and Misra et al. (1977) applied principal component analysis to Landsat data. The structure of the resulting transformation and the interpretation of the principal components are similar to those for the Kauth-Thomas transformation.

$$\begin{aligned} \text{NSBI} &= .406 \text{ CH4} + .600 \text{ CH5} + .645 \text{ CH6} + .243 \text{ CH7} \\ \text{MGVI} &= -.386 \text{ CH4} - .530 \text{ CH5} + .535 \text{ CH6} + .532 \text{ CH7} \\ \text{MYVI} &= .723 \text{ CH4} - .597 \text{ CH5} + .206 \text{ CH6} - .278 \text{ CH7} \\ \text{MNSI} &= .404 \text{ CH4} - .039 \text{ CH5} - .505 \text{ CH6} + .762 \text{ CH7} \end{aligned}$$

Misra et al. (1977) proposed another linear transform, based on the idea of spectral brightness and contrast. Generalizations of spectral brightness and contrast were defined in spectral density space, then transformed back to count space. The first two components of the resulting transformation are similar to the first two components of the two preceding transformations.

$$\begin{aligned} \text{SSBI} &= .437 \text{ CH4} + .564 \text{ CH5} + .661 \text{ CH6} + .233 \text{ CH7} \\ \text{SGVI} &= -.437 \text{ CH4} - .564 \text{ CH5} + .661 \text{ CH6} + .233 \text{ CH7} \\ \text{SYVI} &= -.437 \text{ CH4} + .564 \text{ CH5} - .661 \text{ CH6} + .233 \text{ CH7} \\ \text{SNSI} &= -.437 \text{ CH4} + .564 \text{ CH5} + .661 \text{ CH6} - .233 \text{ CH7} \end{aligned}$$

Richardson and Wiegand (1977) used the perpendicular distance to the "soil line" as an indicator of plant development. The "soil line", a two-dimensional analogue of the Kauth-Thomas SBI, was estimated by linear regression. Two perpendicular vegetation indices were proposed.

$$\begin{aligned} \text{PVI7} &= [(.355 \text{ CH7} - .149 \text{ CH5})^2 + (.355 \text{ CH5} - .852 \text{ CH7})^2]^{1/2} \\ \text{PVI6} &= [(-.498 - .457 \text{ CH5} + .498 \text{ CH6})^2 + (2.734 + .498 \text{ CH5} - .543 \text{ CH6})^2]^{1/2} \end{aligned}$$

Evidently a minor error was made in the derivation of PVI6. The formula for PVI6 should be:

$$\text{PVI6} = [(-2.507 - .457 \text{ CH5} + .498 \text{ CH6})^2 + (2.734 + .498 \text{ CH5} - .543 \text{ CH6})^2]^{1/2}$$

These formulae are computationally inefficient and do not distinguish right from left of the "soil line" (water from green stuff). The standard formula from analytic geometry for the perpendicular distance from a point to a line solves this difficulty [Salas and Hille (1978)].

$$\begin{aligned} \text{PVI6} &= (1.091 \text{ CH6} - \text{CH5} - 5.49)/(1.091^2 + 1^2)^{1/2} \\ \text{PVI7} &= (2.4 \text{ CH7} - \text{CH5} - .01)/(2.4^2 + 1^2)^{1/2} \end{aligned}$$

The difference vegetation index (DVI), suggested by Richardson and Wiegand (1977) as computationally easier than PVI7, is essentially a rescaling of PVI7.

$$DVI = 2.4 CH7 - CH5$$

The Ashburn vegetation index [Ashburn (1979)] was suggested as a measure of green growing vegetation. The doubling of CH7 is to make the scale compatible; CH7 is 6-bit data and has one-half the range of the other three bands which are 8-bit data.

$$AVI = 2.0 CH7 - CH5$$

Colwell et al. (1979) proposed a vegetation indicator called greenness above bare soil (GRABS). This was another attempt to develop an indicator for which a threshold value could be specified for detecting green vegetation. The calculations were made using the Kauth-Thomas tassell cap transformation applied to sun-angle and haze-corrected data. The resulting index is quite similar to the GVI, since the contribution of SBI is less than 10 percent of GVI.

$$GRABS = GVI - .09178 SBI + 5.58959$$

Kanemasu et al. (1977) regressed winter wheat leaf area measurements on MSS band ratios and produced the following regression equation.

$$ELAI = 2.68 - 3.69 R45 - 2.31 R46 + 2.88 R47 + 0.43 R56 - 1.35 R57 \\ + 3.07[R45 - (.5 R47)(R45)]$$

Pollack and Kanemasu (1979) later used a larger data set plus stepwise regression and obtained another regression equation.

$$CLAI = .366 - 2.265 R46 - .431(R45 - R47)(R45) + 1.745 R45 + .057 PVI7$$

Separate regression equations were also obtained for CLAI values above and below 0.5.

$$\text{LAI} = 1.903 - 1.138 \text{ R56} - .071(\text{R45} - \text{R47})\text{R45} - .016 \text{ PVI6},$$

if CLAI is less than 0.5

$$\text{LAI} = -5.33 + .036 \text{ PVI7} + 6.54 \text{ TVI6},$$

if CLAI is greater than 0.5

The Foreign Crop Condition Assessment Division (FCCAD) of the Foreign Agricultural Service (FAS), Houston, Texas uses another leaf area model. We have been unable to find any reference to the development of this model.

$$\text{OLAI} = 41.325 \text{ R45} - 42.45 \text{ R46}$$

Badhwar (1981) proposed a ratio of GVI to SBI as an indicator of crop discrimination. It will be shown in section 6 that this index is a generalization of a normalized difference.

$$\text{GVSB} = \text{GVI/SBI}$$

Craig Wiegand (personal communication) suggested converting reflectance values to radiances. Linear transformations were used to change from reflectance to radiance values. Ratio and normalized difference formulae were also created using the radiance values.

$$\text{RAD5} = 0.0157 \text{ CH5} \quad \text{for Landsat 1}$$

$$= 0.0134 \text{ CH5} + 0.06 \quad \text{for Landsat 2}$$

$$= 0.0139 \text{ CH5} + 0.03 \quad \text{for Landsat 3}$$

$$\text{RAD7} = 0.0730 \text{ CH7} \quad \text{for Landsat 1}$$

$$= 0.0603 \text{ CH7} + 0.11 \quad \text{for Landsat 2}$$

$$= 0.0603 \text{ CH7} + 0.03 \quad \text{for Landsat 3}$$

$$\text{RADR75} = \text{RAD7/RAD5}$$

$$\text{NDRAD} = (\text{RAD7} - \text{RAD5}) / (\text{RAD7} + \text{RAD5})$$

Thompson and Wehmanen (1978) proposed a technique utilizing transformed Landsat digital data to indicate when agricultural vegetation is undergoing moisture stress. The screening number or green number (GIN) was proposed to estimate the percentage of land in an area with a "healthy" cover of vegetation. A "soil line" is determined by inspecting the channel data and discarding data not considered reasonable for agricultural data. The "soil line" is then evaluated as the minimum value remaining in CH5 and subtracted from GVI to obtain GIN.

$$\text{GIN} = \text{SVI} - \text{soil line}$$

The data sets included in this study did not permit the computation of GIN. However, GIN is a linear transformation of GVI.

4. EVALUATION OF VEGETATION INDICES

4.1 BACKGROUND

Richardson and Wiegand (1977) correlated eight VIs (GVI, DVI, SBI, PVI6, PVI7, TVI6, TVI7, and R57) with four plant component variables (crop cover, shadow cover, plant height, and leaf area index). The correlation coefficients obtained by plant component with the VIs (excluding SBI) were very similar. Later, Wiegand et al. (1979) correlated leaf area indices for winter wheat fields to five VIs (TVI7, TVI6, PVI7, PVI6, and GVI). The correlation coefficients by field and even between fields were similar.

Aaronson et al. (1979) studied the similarities and differences among seven VIs (AVI, DVI, GVI, OLAI, PVI7, TVI7, and KVI). The obtained correlation coefficients ranged from 0.8 to 1.0 and were stable from spring greenup to harvest. Aaronson and Davis (1979) later used a large data set, which included vegetation measurements and several VIs, to study interrelationships. The VIs (AVI, DVI, GVI, OLAI, KVI, PVI6, PVI7, TVI6, and TVI7) were correlated against each other and against vegetation measures such as plant height from tillering through harvest. The correlation coefficients between the VIs ranged from 0.81 to 1.00, and those between VIs and vegetation measures were similar.

4.2 CLUSTER ANALYSIS OF VI

The similarity between the VIs was first studied using the BMDP program P1M, cluster analysis of variables (Dixon and Brown, 1979) and the data set described in appendix A. The absolute value of the bivariate correlations was used as the measure of distance between VIs, and the average distance between elements was used as the between cluster distance. Similar results were obtained using other standard distance measures.

This procedure separated the VIs into two large clusters plus a number of small clusters. One large cluster contained VIs based on MSS bands 5 and 7, which included AVI, PVI7, R75, TVI7, and ND7. The other large cluster contained VIs, based on MSS bands 5 and 6, and a few VIs involving three or all four bands, which included GRABS, CLAI, OLAI, R65, TVI6, ND6, GVI, MGVI, PVI6, and SGVI. The VIs within these two clusters had absolute

simple linear correlations greater than 0.90, with most greater than 0.95. The elements of these two large clusters are correlated at 0.8 or higher. Three smaller clusters readily apparent were: (NSI, R76), (R64, R74), and (SBI, MSBI, SSBI, SNSI). This clustering is applicable to the period from spring greenup to harvest. There are some clusters, however, which have high correlations for the whole season, especially those involving bands 5 and 7. The cluster trees on which this discussion is based are attached as appendix B.

Some VIs were not used in the cluster analysis because of their known relationships to others. The inverse ratios R54, R46, R47, R56, R67, and R57 were not used. DVI was discarded because of its relationship to PVI7, as were RAD5, RAD7, RADR75, and NDRAD because of the linear relationships to CH5, CH7, R75, and ND7.

5. VEGETATION INDICES EQUIVALENCE

In this section, a definition of VI equivalence will be developed. This permits a natural categorization of the VIs. VIs are functions which associate a real value to the four-dimensional Landsat reflectance measurement vector, (MSS4, MSS5, MSS6, MSS7). Thus, it will be convenient to employ standard function notation: $f:S_1 \rightarrow S_2$ denotes a function from the set S_1 into the set S_2 ; $f(X)$, the value of f at the point (X) of S_1 ; $\text{Dom}(f)$, the domain of f ; $\text{Ran}(f)$, the range of f ; and $f^{-1}:S_2 \rightarrow S_1$, the inverse of f when it exists. The inverse exists if, and only if, f is one-to-one and onto. The composition of two functions has an inverse if, and only if, both functions have inverses; in which case

$$(f \circ g)^{-1} = g^{-1} \circ f^{-1}.$$

It might seem that VI equivalence should correspond to function equality; i.e., $V_1 = V_2$ if, and only if, $V_1(X) = V_2(X)$ for each Landsat reflectance value X . However, this requirement is too restrictive because it involves only the VIs output and ignores the decisions made on the basis of this output. Since vegetation indices are formulae used in making decisions about crop characteristics and conditions, it seems appropriate to say that two VIs are equivalent if the same decision results regardless of the VI employed. This means that two VIs, V_1 and V_2 , are equivalent for making the set of decisions D if, and only if for every decision rule --- $d_1:\text{Ran}(V_1) \rightarrow D$, there corresponds a decision rule $d_2:\text{Ran}(V_2) \rightarrow D$ such that the decision, based on d_2 and V_2 , is the same as the decision based on d_1 and V_1 for all Landsat reflectance measurements X ; that is, $d_1(V_1(X)) = d_2(V_2(X))$ for each X . It is easy to see that the two vegetation indices, V_1 and V_2 , are equivalent if, and only if, there exists a one-to-one onto function

$T:\text{Ran}(V_1) \rightarrow \text{Ran}(V_2)$ such that $T \circ V_1 = V_2$. This implies that a decision d results from the same set of Landsat reflectance regardless of which VI is used; that is

$$V_1^{-1}[T^{-1}(d)] = (T \circ V_1)^{-1}(d) = V_2^{-1}(d) \quad (\text{Equation 1})$$

for each decision d in D , where the superscript -1 indicates the inverse image of d under the given function. The relationship defined is an equivalence relation on the set of vegetation indices; that is,

- i. Each VI is equivalent to itself: Reflexive property.
- ii. If V_1 is equivalent to V_2 , then V_2 is equivalent to V_1 : Symmetric property.
- iii. If V_1 is equivalent to V_2 , and V_2 is equivalent to V_3 , then V_1 is equivalent to V_3 : Transitive property.

These properties are important because they permit one to avoid many tedious computations.

A number of studies have investigated the transformed vegetation indices TVI6 and TVI7 and the corresponding ratios R65 and R75 as predictors of biomass, leaf area index, plant height, and percent ground cover. The predictive ability of TVI6 and R65 or TVI7 and R75 are similar as evidenced by the estimated correlation coefficient. We now show that the transformed vegetation index and its generalizations are equivalent to the corresponding ratios. This example makes clear not only the algebraic and geometric meaning of VI equivalence but also demonstrates the utility and appropriateness of this definition.

Let a and b be positive constants, and define the functions f , g , and T by

$$\begin{aligned}f(X_5, X_7) &= (aX_7 - bX_5)/(aX_7 + bX_5) \\g(X_5, X_7) &= X_7/X_5 \\T(y) &= (b/a)[(1 + y)/(1 - y)]\end{aligned}$$

for X_5 and X_7 positive and $ABS(y)$ less than one. Observe that T is invertible; in fact

$$T^{-1}(z) = (az - b)/(az + b) \text{ for } z \text{ positive}$$

Thus, f and g are equivalent and the values of f can be computed from the values of g and vice versa.

$$\begin{aligned} (T \circ f)(X_5, X_7) &= g(X_5, X_7) \\ (T^{-1} \circ g)(X_5, X_7) &= f(X_5, X_7) \end{aligned}$$

Let k and p be real, and define the functions $G:(-1,1) \rightarrow (k-1, k+1)$ and $H:(k-1, k+1) \rightarrow (L, U)$ by

$$\begin{aligned} G(v) &= v + k \\ H(w) &= w[ABS(w)]^{p-1}, \text{ for} \end{aligned}$$

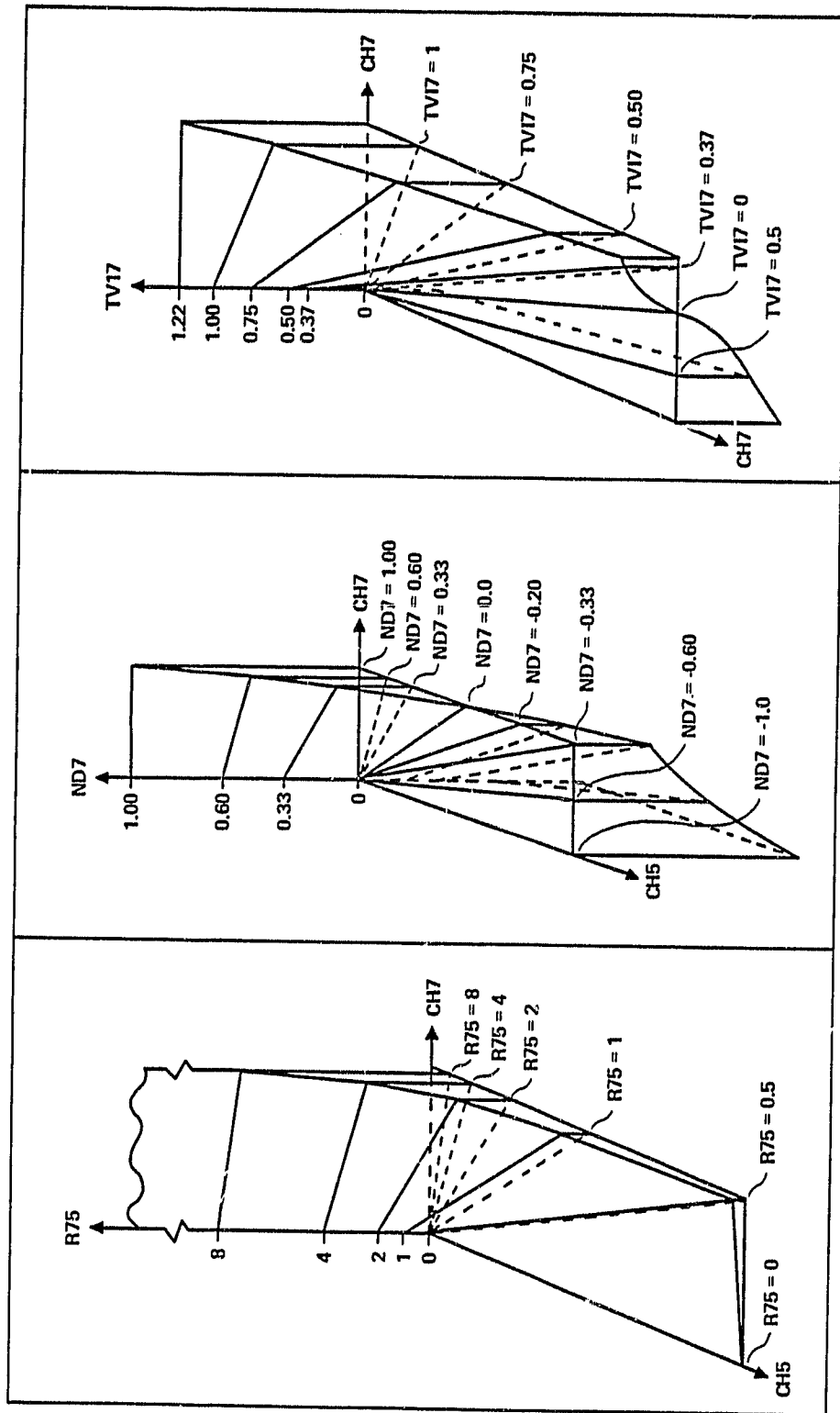
w between k-1 and k+1, $L = (k-1)[ABS(k-1)]^{p-1}$, $U = (k+1)[ABS(k+1)]^{p-1}$, for $ABS(v)$ less than one, and O/O defined as 1. It is easy to verify that G and H are one-to-one and onto and that

$$(H \circ G \circ T^{-1} \circ g)(X_5, X_7) = (f(X_5, X_7) + k)[ABS(f(X_5, X_7) + k)]^{p-1}.$$

Taking $k = p = 1/2$ and $a = b = 1$ shows that the transformed vegetation index, TVI7, is equivalent to the seven-five ratio, R75.

$$(H \circ G \circ T^{-1}) R75 = TVI7$$

Equivalence of VIs means their response surfaces determine precisely the same partition of the reflectance measurement space (equation 1). Elements of this partition are referred to as decision classes. Representative response surfaces and equivalence classes associated with R75, ND7, and TVI7 are illustrated in figures 2a, 2b, and 2c. Similar graphs for other popular indices are attached as appendix C. The nonlinear algebraic relationships exhibited among R75, ND7, and TVI7 are illustrated graphically in figure 3. Similar graphs for other indices are studied in appendix D.



(a) Associated with $R75$ (b) Associated with $ND7$ (c) Associated with $TVI7$

Figure 2. Response surface and equivalence classes.

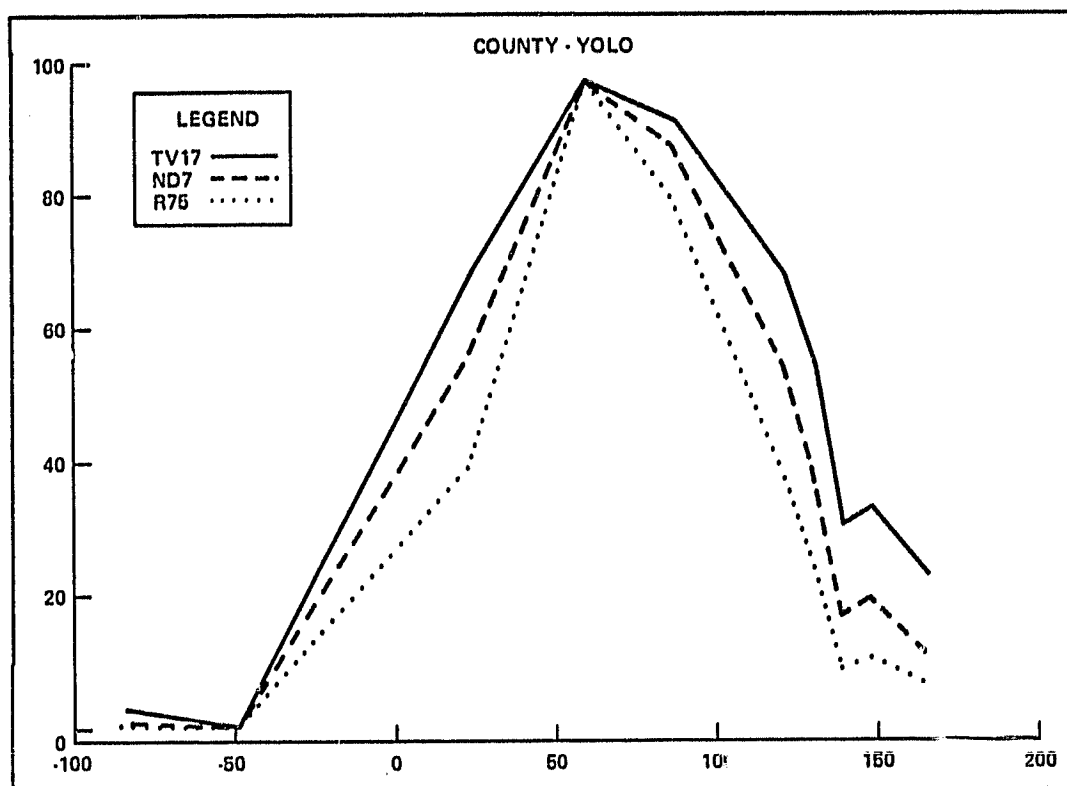


Figure 3. R75, ND7, and TV17 versus time using data listed in Appendix A. All VI values have been rescaled 0 to 100.

As a further illustration of the utility of VI equivalence, GVSB is shown to be approximated by ND6. Thus, the more complicated GVSB can be expected to provide approximately the same information about crop condition as the simple ratio R65.

Using Landsat data described in appendix A, the following estimates were obtained.

GRANT AREA DATA / N = 6084

Variable	N	Mean	Std. Dev.
CH4	6084	23.2	7.2
CH5	6084	26.7	10.0
CH6	6084	41.4	15.9
CH7	6084	17.5	6.3

CORRELATION COEFFICIENTS

Variable	CH4	CH5	CH6	CH7
CH4	1.00			
CH5	0.86	1.00		
CH6	0.73	0.64	1.00	
CH7	0.67	0.50	0.96	1.00

From these estimates, one easily obtains the regression equations

$$\text{CH7} = .4100 \text{ CH6} + .5100$$

$$\text{CH4} = .6236 \text{ CH5} + 6.564$$

Naively substituting into the formulae for GVI and SBI gives the following formulae.

$$\text{EGVI} = .74 (\text{CH6} - 1.14 \text{ CH5} + .03)$$

$$\text{ESBI} = .78 (\text{CH6} + 1.03 \text{ CH5} + 2.96)$$

These approximations are illustrated in figures 4 and 5. Using the information in the above tables pertaining to the expected range of the data, it is easy to see that a rough approximation for GVSB is:

$$\text{EGVSB} = (\text{CH6} - 1.14 \text{ CH5}) / (\text{CH6} + 1.03 \text{ CH5})$$

which is approximately ND6. In fact, let

$$h(v) = (b + vd) / (a - vc)$$

$$k(x,y) = (ax - by) / (cx + dy)$$

$$r(x,y) = x/y,$$

$$\text{then } h(k(x,y)) = x/y = r(x,y)$$

Thus, the estimate, EGVSB, is equivalent to R65 and ND6. These relationships are illustrated graphically in figure 6. Graphs similar to figures 4, 5 and 6 for other sites are contained in appendix E.

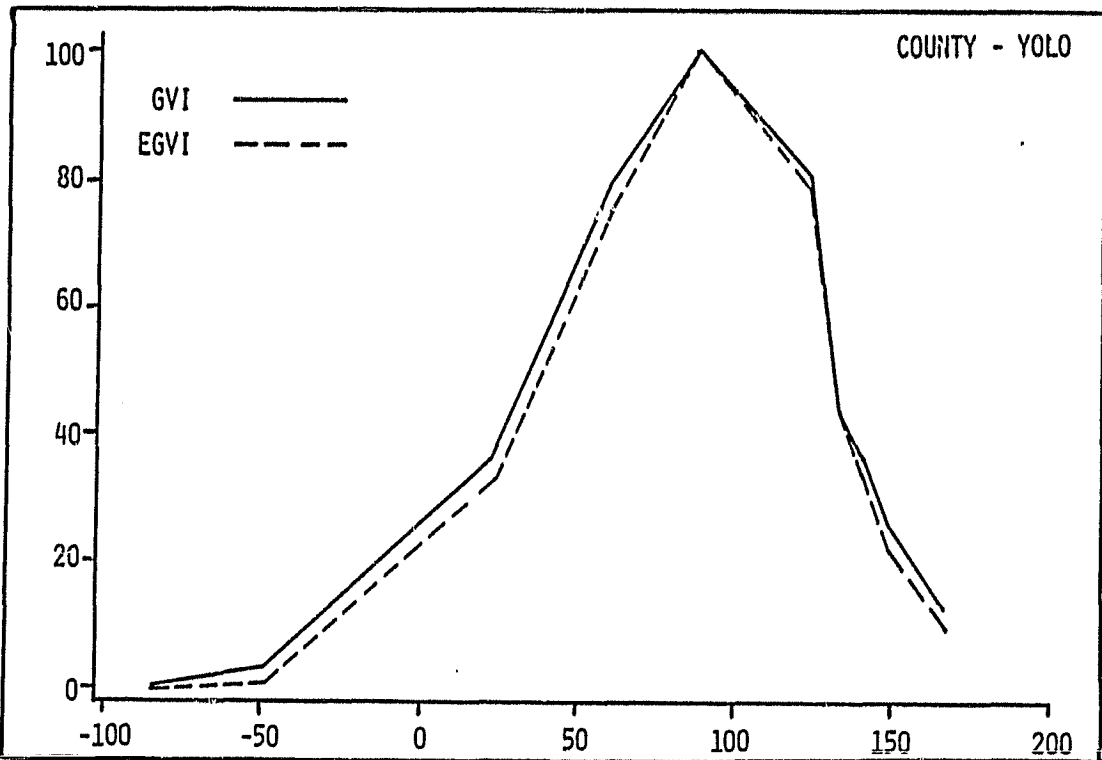


Figure 4. GVI and EGVI versus time using data listed in Appendix A. All VI values have been rescaled 0 to 100.

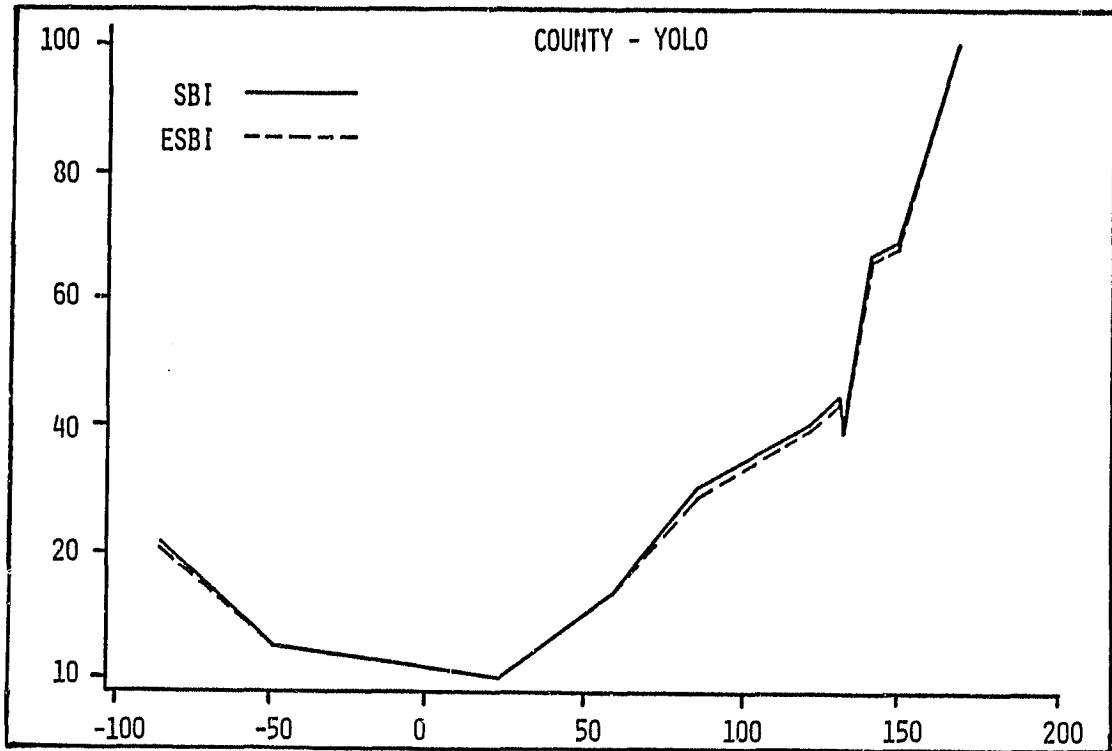


Figure 5. SBI and ESBI versus time using data listed in Appendix A. All VI values have been rescaled from 0 to 100.

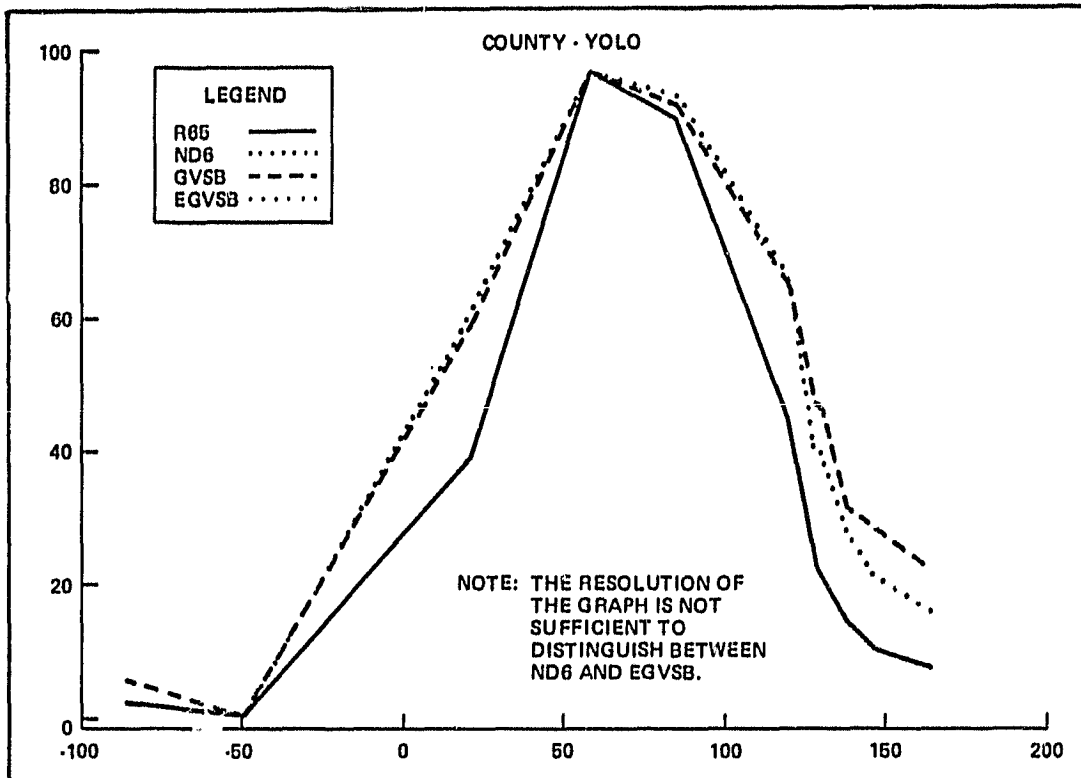


Figure 6. R65, GVSB, ND6, and EGVSB versus time using data listed in Appendix A. All VI values have been rescaled 0 to 100.

6. SUMMARY AND CONCLUSIONS

Other researchers have studied the relationships among a few of the VIs considered in this report. Past work has been based exclusively on correlation analysis. Aaronson and Davis (1979) showed conclusively that, during the spring greenup to harvest phase of the crop season, the VIs used operationally by The Foreign Agriculture Service (FAS)/Foreign Crop Condition Assessment Division (FCCAD) were highly correlated and had similar correlations with various plant components such as biomass, plant height, etc.

This study extends analysis to include all VIs found in the literature. Techniques used to investigate relationships between the VIs included variable clustering by correlation, graphical presentations, and functional equivalence for decision making. Variable clustering separated out two large clusters of VIs. One cluster contained those VIs which used channels 5 and 7 data. The other cluster contained VIs using channels 5 and 6 data plus some VIs using all four channels of data. The variable clustering technique also showed that these two clusters were highly correlated. The relationships were stable during the spring greenup to harvest period of the crop season. Graphical presentations reinforced the clustering results, illustrating the relationships over time and through response surfaces. Mathematical techniques were used to formalize the idea of VI equivalence. This equivalence was used to confirm relationships observed earlier and to investigate less apparent relationships.

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APPENDIX A

DATA SET DESCRIPTIONS

The data set consisted of Landsat acquisitions from six different sites for the 1977-78 crop year. The six sites were Finney County, Kansas; Grant County, Oklahoma; Greeley County, Kansas; Keith County, Nebraska; Washington County, Colorado; and Yolo County, California. The Finney County site consists of an area 40 pixels by 26 lines or 1040 pixels of data. The Yolo County site consists of an area 40 pixels by 40 lines or 1600 pixels of data. All other sites consist of an area 26 pixels by 26 lines or 676 pixels of data.

One field within each area was also selected, since it had already been defined for another project. The Finney, Grant, Greeley, Keith and Washington County fields were winter wheat and consisted of 85, 79, 67, 100 and 53 pixels of data respectively. The Yolo county field was a barley field and consisted of 500 pixels of data.

The data sets are identified by county, acquisition date and Landsat satellite as follows:

Finney	Keith	Yolo
9-22-77 (2)	10-12-77 (2)	10-07-77 (2)
9-23-77 (2)	11-17-77 (2)	11-12-77 (2)
10-11-77 (2)	12-04-77 (2)	1-23-78 (2)
11-16-77 (2)	3-22-78 (2)	2-28-78 (2)
1-08-78 (2)	3-31-78 (3)	3-27-78 (3)
3-04-78 (2)	4-28-78 (2)	5-02-78 (3)
3-31-78 (3)	5-15-78 (2)	5-11-78 (2)
5-15-78 (2)	5-16-78 (2)	5-12-78 (2)
5-23-78 (3)	5-25-78 (3)	5-20-78 (3)
6-01-78 (2)	6-11-78 (3)	5-29-78 (2)
6-11-78 (3)	6-21-78 (2)	6-16-78 (2)
6-11-78 (3)	6-29-78 (2)	
6-19-78 (2)	7-27-78 (2)	
6-29-78 (3)	8-13-78 (2)	
7-26-78 (2)	8-14-78 (2)	

Grant	Greeley	Washington
10-08-77 (2)	10-11-77 (2)	10-12-77 (2)
11-13-77 (2)	11-16-77 (2)	11-17-77 (2)
12-19-77 (2)	3-22-78 (2)	3-24-78 (2)
3-09-78 (3)	3-31-78 (3)	4-11-78 (2)
3-28-78 (3)	4-27-78 (2)	4-28-78 (2)
4-06-78 (2)	5-15-78 (2)	5-16-78 (2)
4-24-78 (2)	5-25-78 (3)	5-26-78 (3)
5-30-78 (2)	6-11-78 (3)	6-12-78 (3)
6-17-78 (2)	6-29-78 (3)	

The data were calibrated as follows to all look like Landsat II LACIE segment data. Data from Landsat 2 EROS full frame CCT's were calibrated using the calibration below (NASA (1976) and RICE (1977)).

$$CH4 = CH4 * 1.275 - 1.445$$

$$CH5 = CH5 * 1.141 - 2.712$$

$$CH6 = CH6 * 1.098 - 2.950$$

$$CH7 = CH7 * 0.948 + 0.446$$

Data from Landsat 3 were calibrated using the following calibrations which were developed by Wehmanen (1978).

$$CH4 = CH4 * 1.161$$

$$CH5 = CH5 * 1.230$$

$$CH6 = CH6 * 1.246$$

$$CH7 = CH7 * 1.062$$

The field data were adjusted using the X-STAR haze correction procedure developed by Lambeck (1979). Pixel data screened as shadow, water, haze, cloud or garbled through this procedure were deleted from further use. Sun angle correction was also applied which is part of the X-STAR haze correction algorithm.

A partial listing containing descriptive statistics of MSS data by band, date, field or area, and county are attached.

The dates are Julian dates where positive dates are for 1978 and negative dates are for 1977 and indicate the number of days from end of year. The Julian date for 1977 may be obtained by adding 365 to each negative date.

Keith County Field Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=81 -----						
CH4	85	35.33	3.88	26.00	43.00	0.42
CH5	85	42.87	4.80	28.00	55.00	0.52
CH6	85	48.19	5.34	29.00	57.00	0.58
CH7	85	20.19	2.13	11.00	24.00	0.23
----- DATE=98 -----						
CH4	95	30.47	2.30	23.22	37.15	0.24
CH5	95	34.57	3.73	24.60	44.28	0.38
CH6	95	51.13	5.45	32.40	63.55	0.56
CH7	95	20.37	2.54	10.62	23.36	0.26
----- DATE=118 -----						
CH4	99	18.61	1.62	16.00	23.00	0.16
CH5	99	15.49	2.49	11.00	23.00	0.25
CH6	99	46.53	3.70	36.00	53.00	0.37
CH7	99	23.67	2.29	18.00	28.00	0.23
----- DATE=135 -----						
CH4	95	30.71	2.92	25.20	42.00	0.30
CH5	95	28.76	4.39	21.00	48.00	0.50
CH6	95	61.62	2.61	55.00	68.00	0.27
CH7	95	29.51	2.16	24.00	34.00	0.22
----- DATE=136 -----						
CH4	100	25.16	3.22	20.00	35.00	0.32
CH5	100	22.53	4.41	15.00	38.00	0.44
CH6	100	56.42	3.19	47.00	65.00	0.32
CH7	100	27.42	2.21	22.00	33.00	0.22
----- DATE=145 -----						
CH4	100	29.33	3.66	22.06	44.12	0.37
CH5	100	27.06	5.67	18.45	49.20	0.57
CH6	100	62.66	3.86	53.58	69.78	0.39
CH7	100	27.99	2.40	23.36	32.98	0.24
----- DATE=162 -----						
CH4	100	24.99	2.78	19.74	34.83	0.28
CH5	100	25.79	4.82	15.99	43.05	0.48
CH6	100	60.33	4.79	52.33	74.76	0.48
CH7	100	30.81	3.12	25.49	38.23	0.31

Keith County Field Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD EROR OF MEAN
----- DATE=178 -----						
CH4	100	28.59	2.64	24.05	35.53	0.26
CH5	100	30.63	2.55	23.53	41.79	0.35
CH6	100	51.87	5.00	45.36	66.22	0.50
CH7	100	23.25	2.47	17.51	28.99	0.25
----- DATE=180 -----						
CH4	100	33.83	1.69	29.02	35.99	0.17
CH5	100	49.73	3.44	39.36	57.81	0.34
CH6	100	63.23	3.12	57.32	72.27	0.31
CH7	100	26.67	1.83	23.36	32.98	0.18
----- DATE=248 -----						
CH4	100	31.54	3.15	20.00	38.00	0.32
CH5	100	40.23	5.10	20.00	48.00	0.51
CH6	100	46.82	3.98	37.00	58.00	0.40
CH7	100	19.02	1.88	15.00	27.00	0.19
----- DATE=-80 -----						
CH4	100	22.26	2.17	16.40	26.60	0.22
CH5	100	26.82	3.40	18.97	32.66	0.34
CH6	100	37.27	4.88	24.50	48.66	0.41
CH7	100	17.47	1.76	10.87	20.35	0.18
----- DATE=-44 -----						
CH4	100	11.92	1.17	10.03	15.13	0.12
CH5	100	11.45	2.21	7.56	20.11	0.22
CH6	100	27.52	2.27	16.31	33.28	0.23
CH7	100	14.32	1.32	8.03	16.56	0.13
----- DATE=-27 -----						
CH4	95	9.60	1.22	7.00	14.00	0.12
CH5	95	9.68	1.69	7.00	14.00	0.17
CH6	95	13.11	2.29	9.00	19.00	0.24
CH7	95	7.04	1.02	5.00	9.00	0.10

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Keith County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERR. OF MEAN
----- DATE=81 -----						
CH4	676	36.80	4.36	22.00	52.00	0.19
CH5	676	44.92	6.32	28.00	63.00	0.24
CH6	676	49.46	5.49	29.00	64.00	0.21
CH7	676	20.49	2.05	11.00	25.00	0.08
----- DATE=90 -----						
CH4	676	34.06	4.01	22.22	47.60	0.15
CH5	676	40.93	7.00	24.60	63.96	0.28
CH6	676	51.00	7.66	32.40	72.27	0.29
CH7	676	19.29	2.97	10.62	25.49	0.11
----- DATE=118 -----						
CH4	676	22.74	4.09	16.00	34.00	0.16
CH5	676	24.83	7.44	11.00	48.00	0.29
CH6	676	37.69	8.31	12.00	54.00	0.32
CH7	676	17.47	4.59	9.00	28.00	0.19
----- DATE=135 -----						
CH4	676	38.51	6.05	25.00	52.00	0.23
CH5	676	42.42	10.54	21.00	65.00	0.41
CH6	676	57.94	4.72	44.00	73.00	0.18
CH7	676	25.04	3.31	19.00	34.00	0.13
----- DATE=136 -----						
CH4	676	32.91	5.67	20.00	46.00	0.23
CH5	676	35.89	10.28	15.00	56.00	0.40
CH6	676	50.51	5.10	36.00	65.00	0.20
CH7	676	21.36	3.64	16.00	33.00	0.15
----- DATE=145 -----						
CH4	676	38.66	7.46	22.06	52.64	0.29
CH5	676	44.74	14.03	18.45	71.34	0.54
CH6	676	64.60	5.53	49.64	70.50	0.21
CH7	676	25.23	2.12	20.18	33.98	0.08
----- DATE=162 -----						
CH4	676	34.54	8.39	19.74	51.00	0.32
CH5	676	46.15	16.52	15.99	76.26	0.64
CH6	676	66.45	11.53	42.36	90.96	0.44
CH7	676	30.25	4.38	22.30	38.23	0.16

Keith County Area Data by Julian Date

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VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=172 -----						
CH4	676	30.78	3.90	21.50	41.90	0.15
CH5	676	32.77	6.55	15.54	47.49	0.25
CH6	676	50.12	5.73	34.27	70.62	0.22
CH7	676	20.75	2.81	15.67	30.64	0.11
----- DATE=180 -----						
CH4	676	31.49	4.14	26.90	42.95	0.16
CH5	676	41.62	12.31	19.68	61.50	0.47
CH6	676	65.67	6.30	47.35	80.99	0.24
CH7	676	29.31	5.03	19.12	40.36	0.19
----- DATE=208 -----						
CH4	676	29.26	7.69	17.00	52.00	0.30
CH5	676	32.77	14.61	12.00	67.00	0.56
CH6	676	55.45	8.72	32.00	74.00	0.34
CH7	676	25.66	6.66	13.00	39.00	0.26
----- DATE=225 -----						
CH4	676	29.96	5.96	17.00	42.00	0.23
CH5	676	32.18	11.39	14.00	54.00	0.44
CH6	676	51.92	8.25	33.00	71.00	0.32
CH7	676	23.96	6.40	13.00	37.00	0.25
----- DATE=226 -----						
CH4	676	27.46	5.60	16.00	38.00	0.22
CH5	676	29.81	10.73	13.00	49.00	0.41
CH6	676	48.61	9.14	31.00	68.00	0.31
CH7	676	22.13	6.33	13.00	34.00	0.24
----- DATE=-80 -----						
CH4	676	22.59	4.62	13.65	32.99	0.18
CH5	676	25.37	7.90	16.68	48.63	0.30
CH6	676	37.91	7.40	17.91	56.34	0.28
CH7	676	16.64	2.99	9.03	23.25	0.12
----- DATE=-44 -----						
CH4	676	14.88	3.21	8.75	22.78	0.12
CH5	676	18.56	6.64	7.55	32.66	0.26
CH6	676	26.94	4.79	12.42	39.87	0.18
CH7	676	11.86	2.53	4.29	17.57	0.09

Keith County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=27 -----						
CH4	676	10.75	1.57	6.00	15.00	0.06
CH5	676	11.97	2.56	5.00	20.00	0.10
CH6	676	12.59	3.32	6.00	22.00	0.13
CH7	676	6.21	1.63	3.00	11.00	0.06

Yolo County Field Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=23 -----						
CH4	465	12.81	1.13	8.75	15.13	0.05
CH5	465	11.34	1.91	7.56	15.54	0.09
CH6	465	22.37	3.87	12.42	33.28	0.18
CH7	465	10.81	1.96	6.13	16.56	0.09
----- DATE=59 -----						
CH4	465	16.51	1.48	12.00	22.00	0.07
CH5	465	11.95	2.11	8.00	23.00	0.10
CH6	465	45.78	5.86	28.00	62.00	0.27
CH7	465	21.71	3.28	12.00	32.00	0.15
----- DATE=86 -----						
CH4	485	24.04	1.71	18.58	33.67	0.08
CH5	485	17.91	3.15	12.30	34.44	0.14
CH6	485	64.80	7.88	39.87	88.47	0.36
CH7	485	27.87	4.14	15.93	40.36	0.19
----- DATE=122 -----						
CH4	495	32.90	2.39	26.70	41.00	0.11
CH5	495	31.04	3.39	22.14	55.35	0.15
CH6	495	70.32	5.21	54.82	95.97	0.23
CH7	495	28.72	2.02	19.12	35.05	0.09

Yolo County Field Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD. ERR. OF MEAN
----- DATE=131 -----						
CH4	500	34.34	5.27	26.00	43.00	0.15
CH5	500	41.36	6.67	26.00	61.00	0.30
CH6	500	65.66	5.25	54.00	81.00	0.23
CH7	500	29.36	1.91	25.00	36.00	0.09
----- DATE=132 -----						
CH4	500	31.31	3.50	24.00	41.00	0.16
CH5	500	38.98	6.78	23.00	55.00	0.30
CH6	500	68.50	4.86	51.00	77.00	0.22
CH7	500	27.24	1.90	23.00	33.00	0.08
----- DATE=140 -----						
CH4	500	47.19	3.06	40.63	56.69	0.14
CH5	500	61.81	6.78	43.05	78.72	0.30
CH6	500	83.31	3.93	74.76	97.19	0.18
CH7	500	31.02	1.29	27.61	36.11	0.06
----- DATE=149 -----						
CH4	500	47.48	6.34	32.98	71.23	0.28
CH5	500	66.66	11.46	39.58	104.54	0.51
CH6	500	81.69	8.94	67.32	114.54	0.40
CH7	500	34.62	2.58	29.63	45.00	0.13
----- DATE=167 -----						
CH4	500	62.38	7.06	29.35	75.05	0.32
CH5	500	94.10	12.13	52.06	115.95	0.54
CH6	500	106.90	10.01	73.91	128.01	0.45
CH7	500	42.69	2.93	31.73	48.79	0.13
----- DATE=-85 -----						
CH4	265	28.22	4.62	20.23	40.63	0.27
CH5	285	34.54	6.54	20.11	55.48	0.39
CH6	285	34.37	7.64	16.81	57.44	0.45
CH7	265	12.93	2.85	7.08	21.30	0.17
----- DATE=-49 -----						
CH4	320	19.10	2.71	12.58	27.69	0.15
CH5	320	22.56	4.63	12.12	34.94	0.26
CH6	320	21.04	5.81	9.13	35.48	0.32
CH7	320	8.27	1.74	4.24	12.77	0.10

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Yolo County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD. DEVIATION OF MEAN
----- DATE=23 -----						
CH4	1640	12.78	1.51	7.48	17.68	0.24
CH5	1640	11.15	2.45	4.13	21.25	0.06
CH6	1640	23.22	5.74	4.74	46.46	0.14
CH7	1640	3.65	2.87	2.49	21.36	0.07
----- DATE=59 -----						
CH4	1640	16.66	1.78	6.00	27.00	0.04
CH5	1640	12.54	2.28	6.00	28.00	0.06
CH6	1640	42.31	7.95	16.00	68.00	0.20
CH7	1640	19.86	4.33	7.00	34.00	0.11
----- DATE=86 -----						
CH4	1640	25.90	3.90	18.58	41.80	0.10
CH5	1640	21.57	7.24	12.30	54.12	0.18
CH6	1640	68.24	18.62	33.64	88.47	0.26
CH7	1640	25.01	5.68	18.62	40.36	0.15
----- DATE=122 -----						
CH4	1640	34.41	3.59	25.54	49.92	0.10
CH5	1640	34.14	7.14	28.91	63.96	0.18
CH6	1640	68.45	6.68	41.12	85.97	0.16
CH7	1640	27.17	3.79	12.81	36.11	0.09
----- DATE=131 -----						
CH4	1640	35.03	4.24	24.00	58.00	0.10
CH5	1640	41.35	7.53	28.00	63.00	0.19
CH6	1640	61.97	8.23	36.00	82.00	0.20
CH7	1640	27.53	4.88	13.00	39.00	0.12
----- DATE=132 -----						
CH4	1640	31.86	4.32	19.00	47.00	0.11
CH5	1640	38.69	7.64	15.00	58.00	0.19
CH6	1640	57.21	8.42	31.00	77.00	0.21
CH7	1640	25.10	4.91	12.00	38.00	0.12
----- DATE=140 -----						
CH4	1640	47.23	3.56	37.15	56.89	0.09
CH5	1640	61.80	8.10	36.99	78.72	0.20
CH6	1640	90.63	7.99	51.09	98.43	0.20
CH7	1640	29.42	4.89	18.05	37.17	0.10

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Yolo County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=149 -----						
CH4	1640	46.60	5.60	31.70	71.23	0.14
CH5	1640	62.32	12.05	32.65	104.54	0.30
CH6	1640	75.21	12.55	38.77	114.54	0.31
CH7	1640	30.56	6.19	13.77	45.06	0.15
----- DATE=167 -----						
CH4	1640	53.96	8.98	34.25	75.05	0.22
CH5	1640	77.99	17.79	37.22	115.95	0.44
CH6	1640	88.49	20.02	42.07	128.81	0.49
CH7	1640	34.52	8.40	14.72	47.90	0.21
----- DATE=-85 -----						
CH4	1640	30.94	6.13	18.95	61.03	0.15
CH5	1640	37.66	8.94	18.97	65.75	0.22
CH6	1640	36.61	10.65	5.83	67.32	0.26
CH7	1640	12.32	4.27	5.24	28.94	0.11
----- DATE=-49 -----						
CH4	1640	21.01	4.39	12.58	36.80	0.11
CH5	1640	24.88	6.80	10.98	52.06	0.17
CH6	1640	23.75	7.79	8.03	50.85	0.19
CH7	1640	8.09	2.82	1.45	18.51	0.07

Finney County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=8 -----						
CH4	1040	13.00	1.27	9.00	18.00	0.04
CH5	1040	15.73	2.26	11.00	22.00	0.07
CH6	1040	17.33	2.45	12.00	23.00	0.08
CH7	1040	8.36	1.11	6.00	12.00	0.03
----- DATE=63 -----						
CH4	1040	35.20	12.73	17.68	98.00	0.39
CH5	1040	41.43	14.50	23.53	119.37	0.45
CH6	1040	43.22	12.36	28.89	115.63	0.38
CH7	1040	16.35	3.37	9.98	34.63	0.10

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Finney County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD. ERROR OF MEAN
----- DATE=98 -----						
CH4	1040	35.96	3.16	26.70	45.28	0.10
CH5	1040	42.64	5.82	38.29	57.81	0.18
CH6	1040	54.31	4.89	41.12	72.27	0.15
CH7	1040	19.94	2.27	14.67	25.49	0.07
----- DATE=155 -----						
CH4	1007	36.24	7.94	18.95	55.93	0.25
CH5	1007	41.90	12.89	15.54	72.59	0.41
CH6	1007	56.08	5.90	39.87	76.11	0.19
CH7	1007	23.22	3.40	15.67	65.91	0.11
----- DATE=143 -----						
CH4	1040	40.73	6.84	24.38	61.53	0.21
CH5	1040	46.35	12.27	18.45	78.72	0.38
CH6	1040	64.06	6.03	48.59	85.97	0.19
CH7	1040	22.83	1.86	16.99	28.67	0.06
----- DATE=152 -----						
CH4	1040	36.63	6.47	24.00	55.00	0.20
CH5	1040	40.45	10.97	19.00	70.00	0.34
CH6	1040	52.75	6.19	38.00	77.00	0.19
CH7	1040	21.96	1.95	17.00	28.00	0.06
----- DATE=162 -----						
CH4	1040	35.90	6.15	24.38	55.73	0.19
CH5	1040	49.12	12.17	23.37	83.64	0.38
CH6	1040	64.91	8.57	47.35	93.45	0.27
CH7	1040	27.38	2.90	19.12	36.11	0.09
----- DATE=170 -----						
CH4	1040	48.54	18.96	22.00	127.00	0.59
CH5	1040	57.02	21.84	19.00	127.00	0.68
CH6	1040	60.24	20.84	18.00	127.00	0.65
CH7	1040	22.54	7.40	5.00	48.00	0.23
----- DATE=180 -----						
CH4	1040	40.14	4.08	33.67	58.05	0.13
CH5	1040	60.69	6.48	45.51	37.33	0.20
CH6	1040	66.75	6.61	51.09	93.45	0.20
CH7	1040	25.93	2.38	21.24	35.05	0.07

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Finney County Area Data by Julian Date

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
----- DATE=207 -----						
CH4	1040	40.18	4.50	30.00	61.00	0.15
CH5	1040	50.23	7.44	36.00	81.00	0.23
CH6	1040	53.74	6.97	38.00	82.00	0.20
CH7	1040	21.35	2.10	15.00	30.00	0.07
----- DATE=204 -----						
CH4	1040	40.27	5.45	30.00	60.00	0.17
CH5	1040	49.35	8.72	29.00	80.00	0.27
CH6	1040	52.54	6.66	36.00	78.00	0.21
CH7	1040	20.69	2.33	14.00	29.00	0.07
----- DATE=225 -----						
CH4	1040	37.55	5.70	28.00	62.00	0.18
CH5	1040	46.76	8.67	26.00	82.00	0.27
CH6	1040	50.39	7.19	32.00	78.00	0.22
CH7	1040	19.99	2.56	13.00	29.00	0.08
----- DATE=-106 -----						
CH4	1040	27.64	2.99	19.00	37.00	0.09
CH5	1040	33.78	4.61	20.00	46.00	0.14
CH6	1040	38.57	4.62	23.00	50.00	0.15
CH7	1040	15.79	2.17	9.00	22.00	0.07
----- DATE=-99 -----						
CH4	1040	25.58	3.02	18.00	34.00	0.09
CH5	1040	31.95	4.54	18.00	43.00	0.14
CH6	1040	36.00	5.23	19.00	49.00	0.16
CH7	1040	15.13	2.33	9.00	21.00	0.07
----- DATE=-81 -----						
CH4	1040	24.43	3.92	14.00	38.00	0.12
CH5	1040	30.41	5.36	16.00	49.00	0.17
CH6	1040	35.20	5.91	19.00	53.00	0.18
CH7	1040	15.51	2.36	9.00	22.00	0.07
----- DATE=-45 -----						
CH4	1040	15.54	1.96	10.03	21.50	0.06
CH5	1040	17.97	3.22	9.34	28.09	0.10
CH6	1040	23.97	4.59	12.42	34.38	0.15
CH7	1040	9.97	2.56	5.24	16.62	0.08

APPENDIX B

CLUSTER TREES

The cluster trees included in this appendix are for the Yolo County and Keith County locations as described in appendix A. Separate trees were produced by date for the area pixels and the field pixels. Data were also combined by area or by field for the period spring greenup to harvest which indicate the correlation coefficients remain high over this time period. Although cluster trees are not attached for other data sets described in appendix A, the results were very similar.

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Keith County - March 27 thru August 14, 1978 - Area

TRACER PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	NO	CORRELATION MATRIX																											
AVI	(1)	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98	97/98
NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED																									
CH4	(2) 91/84 83 82 71/31 46 14	14	10	33 71																									
CH5	(3) 84 83 82 78/17 11 2	10	10	39 64																									
MDB1	(13) 95/99/97 18 5 20	10	10	39 76																									
QDB1	(32) 97/97/19 5 20	10	10	38 22																									
SB1	(29) 97/21 2 22	10	10	37 19																									
GNB1	(31) 55 15 37	10	10	37 78																									
ELAI	(8) 66/64	10	10	37 42																									
VVI	(36) 49	10	10	37 86																									
MNB1	(14)	10	10	37 78																									

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OF POOR QUALITY

Keith County - October 12, 1977 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1	1	1	22 72
ND7	18	18	2	99 31
R75	10	10	3	99 79
TV17	17	17	4	98 39
PV17	17	17	5	94 13
CLAI	17	17	6	94 03
ND6	17	17	7	98 02
TV16	17	17	8	99 76
R65	17	17	9	99 47
CLAI	17	17	10	98 62
QVSB	11	11	11	99 76
QVI	10	10	12	99 47
QSVI	30	30	13	98 28
HQVI	13	13	14	98 28
LAI	12	12	15	98 28
GRAB8	9	9	16	98 28
PV16	21	21	17	98 28
SVVI	33	33	18	98 28
ELAI	8	8	19	98 28
R64	24	24	20	98 28
R74	26	26	21	98 28
HYV1	16	16	22	98 28
R45	23	23	23	98 28
YV1	36	36	24	98 28
CH4	2	2	25	98 28
CH5	3	3	26	98 28
CH6	4	4	27	98 28
MSB1	15	15	28	98 28
SSB1	32	32	29	98 28
SB1	29	29	30	98 28
SNS1	31	31	31	98 28
CH7	5	5	32	98 28
MNS1	14	14	33	98 28
NS1	19	19	34	98 28
R76	28	28	35	98 28

Keith County - November 17, 1977 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE	NO	NAME	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	AVI	36	33	17.33
PV17	22	PV17	1	33	99.67
ND7	18	ND7	1	33	99.39
TV17	35	TV17	1	33	99.18
CLAI	6	CLAI	21	10	97.82
ND6	17	ND6	34	6	99.90
TV16	34	TV16	6	6	99.62
OLA1	20	OLA1	10	10	99.11
QV1	11	QV1	11	10	99.48
DQV1	30	DQV1	10	10	99.84
HQV1	13	HQV1	10	6	99.76
QVSB	11	QVSB	11	6	98.36
ORAB8	9	ORAB8	21	1	99.45
PV16	21	PV16	27	1	96.89
R65	23	R65	1	10	98.59
R75	27	R75	1	10	96.06
LA1	12	LA1	1	10	94.07
R64	24	R64	26	3	95.57
R74	26	R74	1	3	92.46
BYV1	33	BYV1	23	2	83.58
MYV1	13	MYV1	23	2	90.76
R45	23	R45	31	2	80.76
CH4	2	CH4	31	2	85.78
CH5	3	CH5	31	2	93.97
MNS1	15	MNS1	31	2	93.97
SSD1	32	SSD1	31	2	94.97
S01	29	S01	31	2	99.96
BNS1	31	BNS1	31	2	47.95
CH6	4	CH6	31	2	58.00
CH7	5	CH7	31	2	81.67
ELA1	8	ELA1	31	2	45.30
MNSI	14	MNSI	31	2	64.76
R76	28	R76	31	2	79.32
YV1	36	YV1	31	2	32.20

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Keith County - December 4, 1977 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	NAME	VARIABLE NO.	BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	(1) 99/90	AV1	1	28	1	23 30
PV17	(22) 97 96/92/91/74	PV17	2	27	1	97 04
ND7	(10) 99/94/89/74	ND7	3	1	1	97 10
R73	(27) 90/80/74	R73	4	1	1	92 30
TV17	(35) 83/61	TV17	5	1	1	99 09
R74	(26) 61 76 74 71 77 73 76 85 83 89 86 94/66/67	R74	6	1	1	88 33
CLAI	(6) 96 97 97/93/90 93 88 88 86 91 88/66/52 78/ 7 33 64 27 28 29 32 58/61 48 6/48 33 21	CLAI	7	1	1	83 36
ND6	(17) 99 98/98/94 97 95 95 94 98/86/72/56 85/13 38 64 24 25 27 31 67/54 46 2/41 19 3	ND6	8	1	1	98 88
TV16	(34) 99/96/94 96 94 94 93 97/86/71/57 84/14 36 65 23 26 28 31 66/54 45 2/42 20 3	TV16	9	1	1	97 69
DLAI	(20) 96/91 93 92 91 90 96/84/71/55 81/13 36 63 24 25 26 30 64/53 47 1/40 20 5	DLAI	10	1	1	99 47
R63	(23) 94 96 96 95 94 96/84/76/51 84/18 40 62 22 23 24 28 66/53 47 3/39 16 0	R63	11	1	1	97 39
GRAB5	(9) 98/94 93 94 94/93/70/52 81/ 3 25 75 40 41 42 40 79/58 44 9/28 10 2	GRAB5	12	1	1	96 06
PV16	(21) 97 97 96 95/92/71/59 87/ 7 29 73 35 36 37 41 73/53 38 3/44 21 3	PV16	13	1	1	99 47
GV1	(10) 99/99/97/80/72/57 87/28 44 60 12 19 21 26 70/43 38 13/36 3 12	GV1	14	1	1	97 63
SOVI	(30) 99/97/80/72/63 90/28 40 63 21 22 24 31 70/38 32 21/44 10 7	SOVI	15	1	1	99 47
MGVI	(13) 97/80/73/63 90/25 36 65 25 26 27 34 76/56 30 20/36 1 13	MGVI	16	1	1	97 63
GVSB	(11) 83/74/63 89/20 35 65 26 27 29 34 74/40 35 15/36 4 9	GVSB	17	1	1	99 47
SYVI	(33) 62/52 76/29 1 86 59 60 61 58 74/64 35 20/42 34 26	SYVI	18	1	1	97 39
LAI	(12) 44 68/13 24 31 21 22 23 27 37/29 28 11/26 2 6	LAI	19	1	1	96 06
ELAI	(8) 85 6 20 72 54 54 57 73 65/23 45 62/60 10 20	ELAI	20	1	1	99 47
R64	(24) 14 5 79 46 46 49 62 77/10 4 44/59 14 10	R64	21	1	1	97 39
CH4	(2) 77/47 76 76 74 55 27/23 9 36/17 12 35	CH4	22	1	1	96 06
CH5	(3) 42 78 77 76 72 22/40 67 5 2 1 33	CH5	23	1	1	99 47
CH6	(4) 88 89 89 90/83/22 11 6/43 21 30	CH6	24	1	1	97 39
MSDI	(15) 99/99/94/70/ 1 34 2/22 11 34	MSDI	25	1	1	96 06
SSDI	(32) 99/94/71/ 3 32 3/22 11 35	SSDI	26	1	1	99 47
S01	(29) 95/72/ 1 34 0/27 11 34	S01	27	1	1	97 39
BN91	(31) 68/12 48 24/46 21 42	BN91	28	1	1	96 06
CH7	(5) 12 0 12/ 3 28 21	CH7	29	1	1	99 47
MYVI	(16) 85/77/ 2 40 18	MYVI	30	1	1	97 39
R43	(23) 67/22 9 17	R43	31	1	1	96 06
YVI	(36) 43 14 8	YVI	32	1	1	99 47
MNSI	(14) 78 72	MNSI	33	1	1	97 39
NSI	(19) 89	NSI	34	1	1	96 06
R76	(28) 1	R76	35	1	1	99 47

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Keith County - March 31, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	NO																																		
AV1	(1)	98	98	99	98	93	91	91	92	92	94	92	91	90	84	82	88	59	71	73	43	52	57	62	7	60	69	8	31	30	29	26	3	22	72
ND7	(16)	99	99	99	95	93	93	93	93	95	94	92	88	86	71	64	76	76	53	59	53	57	10	51	60	18	20	20	18	15	9	19	72		
R75	(27)	99	98	94	92	92	93	92	94	94	93	91	87	83	91	63	73	77	54	58	53	57	10	51	59	18	21	20	18	15	8	20	72		
PV17	(22)	99	94	92	92	93	92	95	94	94	92	88	86	92	63	76	74	56	59	53	56	10	50	59	19	19	18	17	14	9	20	72			
TV17	(33)	94	92	92	92	94	94	93	92	88	86	90	64	75	72	55	59	54	57	10	51	59	19	20	19	18	13	9	19	71					
CLAI	(6)	98	98	98	99	97	96	94	95	92	92	81	63	73	68	47	68	71	67	1	48	62	21	20	19	18	14	23	5	49					
ND6	(17)	99	99	99	98	98	97	98	94	96	84	73	84	70	53	75	64	56	9	44	53	32	10	9	8	3	37	13	42						
TV16	(34)	99	99	98	98	97	98	95	96	84	73	84	69	53	75	64	56	9	43	53	32	10	9	8	2	38	14	41							
R63	(23)	99	98	98	97	97	94	95	83	71	84	73	52	73	63	57	10	45	54	30	12	11	9	4	36	13	44								
DLAI	(20)	97	97	95	95	93	94	81	66	79	69	49	72	69	63	2	44	37	27	14	13	12	8	32	13	43									
QV1	(10)	99	99	99	94	96	90	78	88	73	58	73	55	48	19	46	52	33	9	8	7	0	37	8	49										
QV5B	(11)	99	99	95	96	91	79	89	74	60	74	53	47	20	43	49	36	5	4	3	2	38	9	49											
MGV1	(13)	99	95	97	93	83	91	73	65	76	48	40	23	39	43	41	0	0	2	8	41	9	49												
SGV1	(30)	95	97	90	83	91	72	61	76	50	41	23	42	46	39	2	1	0	6	43	14	44													
GRAB	(9)	98	83	76	85	66	74	89	60	44	5	16	29	55	16	17	18	21	42	20	39														
PV16	(21)	84	82	90	66	70	88	56	39	15	21	30	55	15	16	17	22	52	28	32															
R74	(26)	83	89	76	71	60	21	44	40	35	38	2	2	4	11	27	18	68																	
ELAI	(8)	96	57	73	72	4	14	63	17	3	64	31	32	34	43	70	26	22																	
R64	(24)	67	73	77	19	4	54	24	15	61	24	24	26	37	67	25	28																		
LAI	(12)	47	44	26	30	27	41	39	20	10	10	8	3	17	14	34																			
CH7	(5)	81	4	13	28	33	32	86	68	68	69	70	41	7	35																				
SVVI	(33)	49	19	2	24	10	82	53	54	55	57	63	50	4																					
MYVI	(16)	90	66	21	56	3	28	27	28	33	3	22	12																						
R43	(23)	64	45	77	35	58	57	57	63	33	11	36																							
YVI	(36)	23	15	26	17	17	19	34	31	0	7																								
CH4	(2)	91	61	86	86	85	76	16	34	43																									
CH5	(3)	61	89	88	88	83	29	30	47																										
CH6	(4)	90	90	91	92	69	50	14																											
MSBI	(15)	99	99	97	51	43	32																												
SSBI	(32)	99	97	51	43	31																													
SBI	(29)	98	52	43	30																														
SNSI	(31)	64	49	33																															
MNSI	(14)	82	49																																
NSI	(19)	80																																	
R76	(28)																																		

VARIABLE NAME	NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1	28	35	30 07
ND7	16	35	4	98 07
R75	27	18	18	99 29
PV17	22	18	18	99 29
TV17	33	1	1	98 77
CLAI	6	21	21	95 14
ND6	17	20	11	99 36
TV16	34	17	17	99 56
R63	23	17	17	99 55
DLAI	20	20	6	98 72
QV1	10	30	6	99 44
QV5B	11	10	10	99 60
MGV1	13	30	30	99 70
SGV1	30	6	6	97 39
GRAB	9	21	21	98 87
PV16	21	1	1	92 18
R74	26	1	1	87 82
ELAI	8	24	17	81 42
R64	24	1	1	77 80
LAI	12	1	1	71 37
CH7	5	33	33	81 42
SVVI	33	1	1	64 26
MYVI	16	36	36	65 60
R43	23	16	16	90 18
YVI	36	1	1	36 53
CH4	2	28	28	41 26
CH5	3	2	2	91 07
CH6	4	31	31	91 26
MSBI	15	31	31	98 09
SSBI	32	13	13	99 59
SBI	29	13	13	99 57
SNSI	31	13	13	80 37
MNSI	14	28	28	65 03
NSI	19	14	14	82 49
R76	28	1	1	30 07

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Keith County - April 28, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	CORRELATION MATRIX																								
AV1	(1)	1	97/99	97/98	98	90	99	98	99	99	97	90	97/96	97/95	97/94	96/76	91	92/83	89/66	83/67	51/26	70/30	4	7	11	20/
PV17	(2)	97/99	1	90	90	99	98	99	99	90	98	97/96	97/96	98/96	99	92	93/83	80/62	81/68	51/26	77/29	9	12	15	24/	
ND7	(10)	97/99	90	90	99	98	99	97	97	90	97	98/95	97/96	76	90	91/84	90/66	84/65	51/23	77/30	4	6	10	19/		
TV17	(35)	97/98	90	90	90	90	98	97	97	97/95	95/94	96/95	75	89	91/84	80/66	84/67	51/23	70/29	3	6	9	10/			
CLA1	(6)	99	99/99	99	99	99/99	99	99/97	96/95	96/95	00	91	95/88	90/61	81/67	57/14	69/24	10	13	16	23/					
ND6	(17)	99	99	99	99/90	99/99	97	96/96	96/95	00	90	95/87	89/62	81/69	60/12	68/20	9	12	15	23/						
TV16	(34)	99	99	99	99/98	99/99	96	95/96	95/94	00	90	95/87	80/62	81/71	61/11	68/28	10	12	16	26/						
QV1	(10)	99	99/99	99	99/98	99	96/97	97/96	00	91	94/84	87/65	82/71	61/15	71/33	8	10	14	23/							
SOVI	(30)	99	99	99	99/90	99	96/90	97/96	00	90	94/83	86/65	81/72	63/13	69/33	9	11	15	26/							
MQVI	(13)	99	99	99	99/90	99	96/98	97/96	81	92	94/83	86/63	80/73	61/16	71/34	11	13	17	20/							
QV8D	(11)	99	99	99	99/98	99	96/97	97/96	00	91	94/84	87/63	81/72	60/16	70/32	10	12	16	26/							
GRAB8	(9)	99	99	96	95/96	95/94	86	94	90/80	87/53	74/70	58/13	67/22	21	23	27	35/									
PV16	(21)	98	96	95	96/95	83	93	97/87	86/57	77/72	63/9	65/27	17	20	23	33/										
DLA1	(20)	98	97/94	94/95	78	89	94/88	93/61	81/63	57/13	68/23	8	11	14	23/											
R65	(25)	99	96	96/95	77	88	92/84	91/62	80/60	57/15	67/29	7	10	13	23/											
R75	(27)	95	97/95	74	88	89/81	92/64	81/57	49/26	75/29	4	6	10	19/												
R64	(24)	98	94/83	91	92/75	79/62	74/70	68/12	64/44	16	18	22	36/													
R74	(26)	95	78	91	89/74	82/65	78/72	54/29	76/42	9	11	15	26/													
LA1	(12)	75	88	89	78	86/65	80/63	54/22	73/35	5	7	11	21/													
CH6	(4)	94	93/71	60/10	32/76	57/0	37/12	66	68	70	77/															
CH7	(5)	75/75	74	32	33/74	46/26	65/20	44	4/	30	36/															
SVV1	(33)	88	82/37	62/71	61/1	53/12	37	39	42	50/																
MYV1	(16)	91/38	71/40	43/5	50/18	12	14	16	17/																	
R43	(23)	98	83/31	36/16	68/0	8	5	2	0/																	
CH4	(2)	91/37	45/19	64/64	65	63	60	44/																		
CH5	(3)	38	44/18	73/35	48	46	43	33/																		
ELAI	(8)	71/0	35/37	35	37	40	57/																			
MNSI	(14)	56	2/35	12	14	16	38/																			
NSI	(19)	75/13	11	11	10	17/																				
R76	(28)	28/21	19	16	14/																					
YV1	(36)	23	23	20	2/																					
MSDI	(15)	99/99	95/																							
SSDI	(32)	99/95/																								
SDI	(29)	96/																								
SNSI	(31)																									

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1	1	1	22
PV17	2	1	2	42
ND7	10	1	10	89
TV17	35	1	35	89
CLA1	6	1	6	65
ND6	17	1	17	65
TV16	34	1	34	70
QV1	10	1	10	70
SOVI	30	1	30	71
MQVI	13	1	13	71
QV8D	11	1	11	71
GRAB8	9	1	9	96
PV16	21	1	21	96
DLA1	20	1	20	96
R65	25	1	25	96
R75	27	1	27	96
R64	24	1	24	96
R74	26	1	26	96
LA1	12	1	12	96
CH6	4	1	4	96
CH7	5	1	5	96
SVV1	33	1	33	96
MYV1	16	1	16	96
R43	23	1	23	96
CH4	2	1	2	96
CH5	3	1	3	96
ELAI	8	1	8	96
MNSI	14	1	14	96
NSI	19	1	19	96
R76	28	1	28	96
YV1	36	1	36	96
MSDI	15	1	15	96
SSDI	32	1	32	96
SDI	29	1	29	96
SNSI	31	1	31	96

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Keith County - May 15, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	NO
AVI	1
PV17	22
TV17	35
ND7	10
CLAI	6
ND6	17
TV16	34
OLA1	20
QV1	10
SOV1	30
MOV1	13
QV8B	11
GRAB8	9
PV16	21
R63	25
R73	27
R64	24
R74	26
LA1	12
CH4	2
CHD	3
SYV1	33
CH7	5
R76	28
MYV1	16
R45	23
MSB1	15
SB81	32
SB1	29
SNB1	31
ELA1	8
YV1	36
MNS1	14
CH6	4
NS1	19

VARIABLE NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	1	1	26
PV17	22	1	2	99
TV17	35	1	3	99
ND7	10	1	4	99
CLAI	6	1	5	99
ND6	17	1	6	99
TV16	34	1	7	99
OLA1	20	1	8	99
QV1	10	1	9	99
SOV1	30	1	10	99
MOV1	13	1	11	99
QV8B	11	1	12	99
GRAB8	9	1	13	99
PV16	21	1	14	99
R63	25	1	15	99
R73	27	1	16	99
R64	24	1	17	99
R74	26	1	18	99
LA1	12	1	19	99
CH4	2	1	20	99
CHD	3	1	21	99
SYV1	33	1	22	99
CH7	5	1	23	99
R76	28	1	24	99
MYV1	16	1	25	99
R45	23	1	26	99
MSB1	15	1	27	99
SB81	32	1	28	99
SB1	29	1	29	99
SNB1	31	1	30	99
ELA1	8	1	31	99
YV1	36	1	32	99
MNS1	14	1	33	99
CH6	4	1	34	99
NS1	19	1	35	99

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OF POOR QUALITY

Keith County - May 16, 1978 - Area

FILE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	19	35	99 95
PV17	22	1	35	99 70
ND7	18	1	35	99 56
TV17	35	1	35	99 34
CLAI	8	21	10	99 92
ND6	17	34	6	99 88
TV16	34	6	6	99 65
CLAI	20	11	10	99 65
QV1	10	10	10	99 55
EQV1	30	11	6	99 43
MGV1	13	21	6	99 73
QVSB	11	10	6	99 36
GRAB8	9	21	1	99 55
PV16	21	27	24	99 60
R64	24	27	27	99 59
R74	26	24	24	99 60
R65	23	27	27	99 36
R75	27	27	27	96 55
LA1	12	12	12	99 06
SYVI	33	33	33	99 42
CH7	31	31	31	99 16
CH4	2	31	31	99 43
CH3	3	31	31	99 34
R76	28	28	28	80 34
MYVI	16	28	28	99 28
R45	23	23	23	82 49
CH6	4	23	23	69 00
ELAI	8	14	7	70 00
YVI	36	8	8	80 00
MNSI	14	14	14	62 79
MBSI	15	21	6	92 03
SSDI	32	32	32	99 85
SBI	29	32	32	96 08
SNSI	31	32	32	99 08
NSI	19	32	32	99 59

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OF POOR QUALITY

Keith County - May 25, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE	NAME	NO
AVI	(1)	99/99/99/99 70 90 90 97 90 90 90/90/96 96/96 96 93/91/93/94 97 90 90 90 88 92/81 71/66/52 17 60/38 19
PV17	(22)	99/99/99/99 90 90 90 97 98 90 90/90/97 96/96 97 96/91/93/93 96 09 88 88 86 92/80 72/69/50 16 60/39 20
TV17	(35)	99/99/99 90 90 90 97 90 90 97/90/96 93/93 96 93/90/94/94 97 91 91 90 88 92/81 71/64/54 17 60/37 19
ND7	(10)	99/99 99 99 90 90 90 90 97/90/96 93/90 90 97/92/94/93 96 09 88 88 86 92/79 72/67/50 14 59/36 22
CLAI	(6)	99 99 99/99/99 90 90/98/98 97/97 97 94/91/93/92 96 88 88 07 05 88/83 77/63/47 10 52/35 13
QV00	(11)	99 99/99/99 99 99/98/97 90/98 97 96/93/93/93 95 07 87 86 03 07/80 76/67/45 4 51/42 25
ND6	(17)	99/99/99 99 99/90/98 90/98 97 93/93/94/92 95 07 87 86 03 86/03 70/63/43 3 48/39 20
TV16	(34)	99/99 99 99/90/90 90/97 96 94/93/94/92 96 00 07 07 04 06/04 70/64/46 4 48/40 1
OLA1	(20)	90 90 97/90/97 97/98 97 93/91/97/91 95 07 86 86 04 06/03 77/64/46 7 49/30 13
QV1	(10)	99 99/90/90 90/97 96 93/94/92/93 95 06 06 06 02 86/01 70/67/43 2 48/43 24
MOV1	(13)	99/90/90 90/97 96 96/93/91/92 94 05 85 84 00 06/79 70/70/41 0 49/47 26
GOV1	(30)	97/90 99/97 95 93/93/90/92 94 05 85 84 00 04/00 79/68/40 2 46/48 27
LA1	(12)	96 96/96 96 93/92/93/92 95 07 07 07 04 88/80 73/66/48 9 54/37 22
GRAB8	(9)	99/96 94 92/91/92/85 91 79 79 70 76 82/87 87/73/32 1 42/39 11
PV16	(21)	96 94 92/94/90/87 91 79 79 78 75 79/84 86/71/31 6 37/43 19
R65	(25)	99/96 93/93/89 91 82 82 82 70 84/79 77/69/39 2 48/33 23
R73	(27)	97/93/93/90 92 04 03 03 80 90/73 71/71/44 12 58/32 24
R74	(26)	96/85/92 90 02 82 82 77 90/66 67/73/42 7 61/49 39
R64	(24)	79/88 85 73 73 74 67 78/63 74/72/28 16 41/60 47
R45	(23)	84 93 86 85 85 87 84/90 73/56/52 24 51/ 8 6
CH4	(2)	97/96 96 96 91/88/67 51/43/68 11 60/46 38
CH5	(3)	97 97 97 93/89/81 61/47/67 19 58/33 16
M801	(13)	99/99/98/87/72 42/30/82 29 64/27 19
S801	(32)	99/98/87/71 41/29/82 29 63/27 19
801	(29)	98/87/71 41/28/83 30 64/26 18
8N81	(31)	87/73 39/27/85 42 68/14 4
R76	(28)	64 46/63/64 45 85/26 20
MYV1	(16)	81/43/37 15 25/ 3 33
8YV1	(33)	74/13 28 0/33 6
CH7	(5)	17 0 41/39 21
CH6	(4)	58 68/ 3 4
M881	(14)	76/50 42
881	(19)	4 17
ELAI	(8)	73
VVI	(36)	

VARIABLE	NAME	NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI		1	1	1	27 90
PV17		22	1	22	99 72
TV17		35	1	35	99 34
ND7		10	1	10	99 08
CLAI		6	1	6	99 73
QV00		11	1	11	99 93
ND6		17	1	17	99 37
TV16		34	1	34	99 33
OLA1		20	1	20	99 91
QV1		10	1	10	99 92
MOV1		13	1	13	98 61
GOV1		30	1	30	98 25
LA1		12	1	12	98 30
GRAB8		9	1	9	97 50
PV16		21	1	21	97 13
R65		25	1	25	99 15
R73		27	1	27	96 36
R74		26	1	26	93 36
R64		24	1	24	92 41
R45		23	1	23	88 1
CH4		2	1	2	97 21
CH5		3	1	3	98 67
M801		13	1	13	100 00
S801		32	1	32	99 91
801		29	1	29	87 31
8N81		31	1	31	81 39
R76		28	1	28	73 45
MYV1		16	1	16	60 33
8YV1		33	1	33	63 22
CH7		5	1	5	58 76
CH6		4	1	4	73 91
M881		14	1	14	27 90
881		19	1	19	
ELAI		8	1	8	
VVI		36	1	36	

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Keith County - June 11, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	(1) 97/98 96 96/99 90 90 97 97 96 98 98 95 93/89 93/89 90/85 90/86/01 86 73 72 72 73 49/69/ 5 3 42/30	AVI	1	28 23
PV17	(22) 90 97 97/98 97 96 95 95 94 96 96 94 94/90 93 92 93/82 87/84/74 80 64 64 63 64 39/70/ 5 43/30 43/27	PV17	2	99 31
QVI	(10) 97/99 90 90 98 97 97 95 95 96 95 93/93 93/93 96/85 86/76/77 82 66 65 65 65 39/73/ 0 49/ 14 26/23/	QVI	10	99 20
QOVI	(30) 99/97 97 97 96 96 94 94 94 94 92/94 93/94 97/83 84/72/74 79 62 62 61 61 34/78/ 3 52/ 8 23/21/	QOVI	10	99 20
MGVI	(13) 97 96 96 95 95 93 93 93 93 91/94 93/96 97/80 82/73/70 75 57 57 56 56 29/77/10 56/10 28/20/	MGVI	13	99 20
CLA1	(6) 99/99 99 99/98/90 98/97 96/90 94/91 93/88 92/81/79 85 70 70 70 70 43/67/ 5 43/26 34/33/	CLA1	6	99 20
LAI	(12) 99 99 99/98/90 98/97 96/90 94/89 91/88 92/81/82 87 74 73 73 73 49/68/10 38/24 32/31/	LAI	12	99 20
QV80	(11) 90 99/98/99 90/97 97/92 95/87 90/86 92/82/83 88 75 74 74 74 51/69/12 34/23 32/27/	QV80	11	99 20
N86	(17) 99/99 98 98/97 96/90 93/87 90/89 93/79/83 89 75 75 75 75 52/66/14 37/21 27/31/	N86	17	99 20
TV16	(34) 99/98 98/96 95/89 92/87 90/89 93/79/84 89 76 76 75 75 52/67/15 36/21 26/32/	TV16	34	99 20
OLA1	(20) 90 97/90 97/87 91/85 88/90 96/80/82 88 76 75 75 76 53/58/16 35/26 29/36/	OLA1	20	99 20
ND7	(18) 99/97 98/88 93/84 86/85 94/88/84 89 77 77 76 77 53/62/14 29/34 41/30/	ND7	18	99 20
TV17	(35) 94 95/86 93/83 86/87 93/88/86 91 79 79 79 79 58/63/17 28/35 41/32/	TV17	35	99 20
R65	(25) 98/92 95/87 87/83 92/77/78 83 69 68 68 60 43/59/ 6 39/21 30/27/	R65	25	99 20
R75	(27) 90 96/84 85/80 92/83/79 83 70 70 70 70 48/56/ 7 33/32 43/26/	R75	27	99 20
R64	(24) 95/87 91/86 73/66/69 70 54 53 53 50 26/80/ 9 49/ 2 24/ 3/	R64	24	99 20
R74	(26) 84 86/70 82/83/77 79 66 65 65 64 42/71/ 1 34/26 48/ 7/	R74	26	99 20
GRAB8	(9) 98/78 76/61/ 50 59 38 37 37 30 7/70/30 75/ 5 20/30/	GRAB8	9	99 20
PV16	(21) 80 77/60/58 65 45 44 44 44 15/75/20 70/ 1 13/23/	PV16	21	99 20
MYVI	(16) 92/64/74 85 74 74 74 76 53/47/20 34/24 7/66/	MYVI	16	99 20
R45	(23) 80/80 88 79 78 70 80 61/58/26 24/40 30/53/	R45	23	99 20
R76	(28) 78 80 75 74 74 77 63/43/17 0/69 76/23/	R76	28	99 20
CH4	(2) 97/97 97 97 93/87/56/59 16/31 29/17/	CH4	2	99 20
CH5	(3) 96 96 96/84/53/54 4/36 28/34/	CH5	3	99 20
M88I	(15) 99/99/99/94/40/72 28/41 28/30/	M88I	15	99 20
S88I	(32) 99/99/95/40/72 29/41 28/30/	S88I	32	99 20
B8I	(29) 99/93/39/72 29/41 27/30/	B8I	29	99 20
GNSI	(31) 95/35/71 28/48 31/37/	GNSI	31	99 20
CH6	(4) 16/86 56/49 27/27/	CH6	4	99 20
ELA1	(8) 9 41/20 8/20/	ELA1	8	99 20
CH7	(5) 73/18 13/19/	CH7	5	99 20
BYVI	(33) 35 17/18/	BYVI	33	99 20
MNSI	(14) 84/45/	MNSI	14	99 20
N8I	(19) 0/	N8I	19	99 20
YVI	(36) 0/	YVI	36	99 20

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Keith County - June 29, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	1	1	19
PV17	2	1	2	14
TV17	3	1	3	97
CLAI	4	1	4	99
ND7	5	1	5	99
QV8	6	1	6	99
ND6	7	1	7	99
TV16	8	1	8	99
GRAB	9	1	9	99
PV16	10	1	10	99
QV1	11	1	11	99
HQV1	12	1	12	99
BQV1	13	1	13	99
LAI	14	1	14	99
DLAI	15	1	15	99
R65	16	1	16	99
R75	17	1	17	99
BYV1	18	1	18	99
CH5	19	1	19	99
R64	20	1	20	99
R74	21	1	21	99
CH7	22	1	22	99
MYV1	23	1	23	99
R45	24	1	24	99
R76	25	1	25	99
CH4	26	1	26	99
CH6	27	1	27	99
ELAI	28	1	28	99
MSB1	29	1	29	99
MSB1	30	1	30	99
MSB1	31	1	31	99
MSB1	32	1	32	99
MSB1	33	1	33	99
MSB1	34	1	34	99
MSB1	35	1	35	99
MSB1	36	1	36	99
MSB1	37	1	37	99
MSB1	38	1	38	99
MSB1	39	1	39	99
MSB1	40	1	40	99
MSB1	41	1	41	99
MSB1	42	1	42	99
MSB1	43	1	43	99
MSB1	44	1	44	99
MSB1	45	1	45	99
MSB1	46	1	46	99
MSB1	47	1	47	99
MSB1	48	1	48	99
MSB1	49	1	49	99
MSB1	50	1	50	99
MSB1	51	1	51	99
MSB1	52	1	52	99
MSB1	53	1	53	99
MSB1	54	1	54	99
MSB1	55	1	55	99
MSB1	56	1	56	99
MSB1	57	1	57	99
MSB1	58	1	58	99
MSB1	59	1	59	99
MSB1	60	1	60	99
MSB1	61	1	61	99
MSB1	62	1	62	99
MSB1	63	1	63	99
MSB1	64	1	64	99
MSB1	65	1	65	99
MSB1	66	1	66	99
MSB1	67	1	67	99
MSB1	68	1	68	99
MSB1	69	1	69	99
MSB1	70	1	70	99
MSB1	71	1	71	99
MSB1	72	1	72	99
MSB1	73	1	73	99
MSB1	74	1	74	99
MSB1	75	1	75	99
MSB1	76	1	76	99
MSB1	77	1	77	99
MSB1	78	1	78	99
MSB1	79	1	79	99
MSB1	80	1	80	99
MSB1	81	1	81	99
MSB1	82	1	82	99
MSB1	83	1	83	99
MSB1	84	1	84	99
MSB1	85	1	85	99
MSB1	86	1	86	99
MSB1	87	1	87	99
MSB1	88	1	88	99
MSB1	89	1	89	99
MSB1	90	1	90	99
MSB1	91	1	91	99
MSB1	92	1	92	99
MSB1	93	1	93	99
MSB1	94	1	94	99
MSB1	95	1	95	99
MSB1	96	1	96	99
MSB1	97	1	97	99
MSB1	98	1	98	99
MSB1	99	1	99	99

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Keith County - July 27, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD
VARIABLE NAME

AVI (11 99/99/99/99 99 99 99 99 99 99/90 90/90/90/97 98 97 97/90/93 94/94/90/00 94/72/69/65 94 30/53 51 47 41)
PV17 (22/99/99/99 99 99 99 99 99/99 99/90/97 98 97 97/93/95 95/94/90/07 93/74/69/65 93 30/51 40 45 30)
ND7 (10/99/99 99 99 99 99 99/90 90/99/90/97 98 98 98/96/94 94/94/90/07 94/73/69/63 94 39/52 50 46 39)
TV17 (35/99 99 99 99 99 99/90 90/90/97/96 97 96 96/95/93 94/94/90/00 94/72/60/66 93 39/54 51 40 41)
CLAI (6/ 99 99 99/99 99 99/99 99/99/90/97 97 98 97/96/94 95/93/92/06 93/75/63/63 51 41/51 40 43 30)
QVSD (11/ 99 99/99 99 99/99 99/99/90/90 90 90 97/93/94 93/92/90/07 93/73/63/67 55 44/51 40 43 37)
ND6 (17/ 99/99 99 99/99 99/99/90/97 97 98 97/96/93 93/92/91/07 93/73/63/65 53 47/51 40 43 30)
TVI6 (34/99 99 99/99 99/99/90/97 97 97 96/95/93 93/91/92/07 94/73/62/66 52 43/51 49 43 30)
QVI (10/ 99/99 99 99/90/90 90 90 97 97/94/93 93/92/90/00 94/73/64/60 55 45/52 49 46 38)
SOVI (30/99/99 99/90/90 90 90 97 97/94/93 93/91/90/00 93/73/63/69 56 47/51 49 45 37)
MOVI (13/99 99/90/90/90 90 97 97/94/94 93/92/90/87 93/76/64/68 55 43/50 47 44 36)
CRAGS (9/ 99/90/97/97 97 97 96/95/96 90/90/92/02 90/81/62/66 40 42/43 40 36 30)
PV16 (21/90/97/97 97 97 96/94/93 97/90/92/01 91/79/60/60 51 47/43 43 39 31)
DLAI (20/97/96 97 90 90/90/93 93/91/92/03 93/74/64/67 49 40/51 40 43 30)
LAI (12/97 97 97 97/94/94 94/92/60/65 91/75/60/62 94 39/47 42 41 34)
R64 (24/ 99/98 97/91/73 93/69/04/86 90/76/63/70 63 50/47 44 41 30)
R74 (26/90 98/92/94 92/93/03/07 91/74/71/67 61 40/49 47 43 35)
R63 (25/ 99/97/93 93/90/00/05 91/74/63/36 54 42/49 46 43 35)
R73 (27/96/93 92/90/06/05 91/72/71/55 54 35/49 47 44 37)
R43 (23/88 91/69/93/02 91/60/64/42 37 30/32 49 46 43)
CH7 (5/ 96/89/04/60 70/09/60/65 44 33/22 19 15 9)
BYVI (33/83/93/71 82/89/52/64 30 48/27 24 21 14)
R76 (28/78/04 89/60/87/56 52 11/55 53 50 47)
MYVI (16/91 85/72/45/47 10 37/42 39 37 35)
CH4 (2/ 97/37/61/62 73 43/83 82 79 70)
CH5 (3/49/62/50 57 39/77 75 72 64)
CH6 (4/37/60 23 44/16 19 23 31)
NSI (19/32 42 29/41 40 30 40)
ELAI (8/ 69/62/26 24 21 3)
YVI (36/54/52 51 40 30)
MNSI (14/17 16 14 5)
MSBI (15/ 99/99/96)
OSBI (32/99/96)
OSI (29/97)
SNSI (31/)

VARIABLE NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	1	11	42 70
PV17	22	1	11	39 73
ND7	10	1	10	99 73
TV17	35	1	10	99 62
CLAI	6	15	6	99 72
QVSD	11	34	6	99 89
ND6	17	34	6	99 94
TVI6	34	34	6	99 84
QVI	10	34	6	99 96
SOVI	30	10	6	99 90
MOVI	13	10	6	99 34
CRAGS	9	2	6	99 83
PV16	21	32	6	99 27
DLAI	20	32	6	99 90
LAI	12	134	6	98 20
R64	24	134	6	98 15
R74	26	134	6	99 25
R63	25	134	6	99 77
R73	27	134	6	99 35
R43	23	33	6	99 65
CH7	5	33	6	96 35
BYVI	33	33	6	94 35
R76	28	20	6	91 82
MYVI	16	20	6	89 47
CH4	2	1	6	97 17
CH5	3	1	6	87 91
CH6	4	1	6	73 82
NSI	19	14	6	64 28
ELAI	8	10	6	98 67
YVI	36	10	6	57 10
MNSI	14	10	6	50 93
MSBI	15	10	6	68 69
OSBI	32	15	6	99 96
OSI	29	15	6	99 83
SNSI	31	1	6	42 70

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Keith County - August 13, 1978 - Area

TRIN PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	0	1	0
PV17	22	0	2	99
ND7	10	0	3	99
TV17	35	0	4	99
CLAI	8	0	5	99
GVDB	11	0	6	99
ND6	17	0	7	99
TV16	34	0	8	99
QVI	10	0	9	99
MGI	13	0	10	99
SOVI	30	0	11	99
GRADB	9	0	12	99
PV16	21	0	13	99
OLA1	20	0	14	99
R64	24	0	15	99
R74	26	0	16	99
R65	25	0	17	99
R75	27	0	18	99
LA1	12	0	19	99
CH7	3	0	20	99
BYVI	33	0	21	99
R45	33	0	22	99
CH4	2	0	23	99
CH5	3	0	24	99
R76	28	0	25	99
RYVI	16	0	26	99
CH6	4	0	27	99
ELA1	8	0	28	99
YVI	36	0	29	99
NSI	19	0	30	99
MNSI	14	0	31	99
MGB1	15	0	32	99
GBB1	32	0	33	99
GBI	29	0	34	99
BNSI	31	0	35	99

CONFIDENTIAL
 WYOMING COUNTY

Keith County - August 14, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
 CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO.	VARIABLE NO.	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	(1)	1	31	3	26.58
PV17	(22)	22	1	3	99.97
ND7	(18)	18	1	3	99.77
TV17	(35)	35	1	3	99.46
CLAI	(6)	6	2	3	99.59
GVSB	(11)	11	34	3	99.87
ND6	(17)	17	34	3	99.93
TV16	(34)	34	34	3	99.80
CVI	(10)	10	30	3	99.97
MGVI	(13)	13	10	3	99.98
SGVI	(30)	30	21	3	99.85
GRABB	(9)	9	21	3	99.30
PV16	(21)	21	1	3	99.02
DLAI	(20)	20	24	3	99.71
R64	(24)	24	27	3	99.96
R74	(26)	26	27	3	99.32
R63	(23)	23	27	3	99.85
R73	(27)	27	1	3	99.00
LAI	(12)	12	1	3	99.32
CH7	(5)	5	1	3	99.77
SYVI	(33)	33	1	3	99.62
R43	(23)	23	1	3	99.51
CH4	(2)	2	1	3	99.42
CH3	(3)	3	1	3	99.39
R76	(28)	28	1	3	99.14
CH6	(4)	4	1	3	86.05
HYVI	(16)	16	36	3	80.32
ELAI	(8)	8	36	3	80.32
YVI	(36)	36	1	3	58.03
NSI	(19)	19	1	3	47.15
MNSI	(14)	14	31	3	89.35
MSBI	(15)	15	31	3	99.83
SSBI	(32)	32	1	3	99.42
SBI	(29)	29	1	3	99.58
SNSI	(31)	31	1	3	26.58

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Keith County - March 22 thru July 27, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE	NAME	NO	ABSOLUTE CORRELATION MATRIX (Upper Triangular)																								
AVI	(1)	99/96	95 98 97 98	70 97 96 96 97	90 97 93 91	92/88 91/84 81/83/40	70 41	70 30 36 34 34	1 59 83/68	2																	
PV17	(22)	96 96 98 97 98	97 96 95 95 96 97 96 92 90 91	80 91/81 79/84/45	82 43/67 32 30 28 28	2 40 82/66	0																				
GRAB5	(9)	99/97 97 97	96 92 92 93 90 92 93 90 86 84	82 81/74 78/93/58 83 41/53	19 17 16 17/14	20 67/76 12																					
PV16	(21)	98 98 98/96 94 94 94 91 93 94 91	88 83/86 83/76 77/94/57	81 46/58 22 20 10 17/23	15 65/73 5																						
QVI	(10)	99/99/98 97 97 97 95 96 97 93 92	90/90 90/82 79/88/48 79 47/69 32 31 20 26/17 25 73/68	1																							
SOVI	(30)	99/97 97 96 96 94 95 96 92 91 89/92	90/80 76/88/31 79 51/69 30 20 26 22/22 24 72/65	5																							
MOVI	(13)	97 96 95 95 94 95 94 92 90 89/91 91/78 75/88/52	82 51/67 20 26 23 20/19 20 74/64	6																							
CLAI	(6)	98 99 99/98 98/98/97/94	93/87 88/88 88/84/37 72 34/71 43 41 39 38	8 27 76/75	8																						
QVBD	(11)	99 99/99 98/98/97/96 95/92 93/88 84/78/33	69 42/79 47 43 43 39/14 29 78/63	3																							
ND6	(17)	99/98 98/98/98/96 95/89 89/90 88/80/31	65 35/77 49 48 46 42/14 22 74/71	2																							
TV16	(34)	98 98/98/98/93 93/88 88/90 87/81/32	65 37/76 48 47 45 42/15 21 73/72	3																							
ND7	(18)	99/98/97/97 97/90 93/90 87/74/26	67 34/79 51 50 48 45/2 38 84/65	1																							
TV17	(35)	97/96 94 94/88 91/89 83/77/30	67 38/77 49 47 45 43/3 35 82/68	1																							
LAI	(12)	96/95 94/88 90/88 86/80/33	69 36/75 46 44 42 40/8 29 77/70	2																							
DLAI	(20)	97 95/84 83/91 93/77/25	60 22/75 32 31 49 47 9 20 72/74	9																							
R63	(23)	98/90 91/87 88/72/24	60 27/79 51 50 48 44/12 24 73/63	3																							
R73	(27)	90 94/87 86/66/21	62 27/80 33 31 49 46/1 40 82/57	6																							
R64	(24)	96/71 62/69/42	72 62/78 32 30 27 16/33 30 71/38 37																								
R74	(26)	76 67/63/32 73 54/81 40 38 36 28/9 35 83/38 31																									
CH3	(3)	90/56/8 33 10/86 79 78 77 75/4 22 70/72 15																									
R43	(23)	67/5 40 11/63 61 59 59 64/11 15 63/84 38																									
SYVI	(33)	73 82 37/28 3 6 7 3/25 1 44/77 23																									
CH6	(4)	82/51/18 66 67 69 69/41 3 11/20 11																									
CH7	(5)	55/24 24 26 28 27/8 43 64/36 13																									
ELAI	(8)	38 13 13 16 32/31 15 11 63																									
CH4	(2)	79 79 77 63/13 32 68/29 34																									
MSBI	(15)	99/99/93/20 17 45/36	9	OTHER BOUND			NUMBER OF ITEMS	DISTANCE OR SIMILARITY																			
SSBI	(32)	99/93/21 18 44/34	8	BY			IN CLUSTER	WHEN CLUSTER FORMED																			
SB1	(29)	96/22 16 42/33 10		NAME	VARIABLE	NO	CLUSTER																				
SNS1	(31)	41 19 43/47 34		AVI	22	1		34 64																			
MNSI	(14)	64 38/8 46		PV17	22	1		34 79																			
NS1	(19)	80/13 25		GRAB5	21	13		98 20																			
R76	(28)	35 11		PV16	9	10		99 41																			
MYVI	(16)	69		QVI	10	13		99 80																			
YVI	(36)			SOVI	30	10		99 85																			
				MOVI	13	1		97 43																			
				CLAI	6	27		95 59																			
				QVBD	11	34		99 42																			
				ND6	17	34		99 89																			
				TV16	34	6		98 88																			
				ND7	18	35		99 16																			
				TV17	35	6		99 54																			
				LAI	12	8		98 33																			
				DLAI	20	6		97 66																			
				R63	23	27		98 72																			
				R73	27	1		94 63																			
				R64	24	26		96 86																			
				R74	26	1		89 42																			
				CH3	3	23		90 10																			
				R43	23	1		87 55																			
				SYVI	33	1		78 73																			
				CH6	4	6		81 64																			
				CH7	5	7		44 59																			
				ELAI	8	1		48 30																			
				CH4	2	1		73 33																			
				MSBI	15	1		75 37																			
				SSBI	32	15		99 97																			
				SB1	29	13		99 92																			
				SNS1	31	10		44 59																			
				MNSI	14	10		31 29																			
				NS1	19	6		80 72																			
				R76	28	1		36 17																			
				MYVI	16	1		25 52																			
				YVI	36	1		34 64																			

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Keith County - October 12, 1977 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	NO.	CORRELATION MATRIX (Lower Triangle)																											
AVI	(1)	97/97	97/97	94/93	90/90	90/90	94/83	86/84	94/92	94/79	88/87	8/35	52/27	31/45	60/9	10/11	9/78	12/42	67/67										
PV17	(22)	93/95	94/93	94/88	88/88	92/82	88/86	84/94	92/93	78/87	39/6	35/49	19/43	32/65	17/18	20/17	84/11	41/63											
ND7	(18)	99/99	93/95	92/92	92/96	88/77	77/91	88/90	78/89	33/12	32/37	43/67	28/49	10/9	7/8	64/13	42/69												
TV17	(35)	99/93	95/92	92/92	95/88	77/77	90/88	89/77	88/33	12/31	37/42	67/20	48/10	9/7	8/65	14/43	69/69												
R75	(27)	93/95	92/92	93/96	89/77	77/90	88/85	88/33	12/32	38/43	67/28	49/10	9/7	9/64	12/42	68/68													
CLA1	(6)	98/97	97/97	95/96	92/92	96/94	94/74	74/23	91/99	70/17	54/50	74/12	13/14	11/71	3/13	43/43													
LAI	(12)	98/98	98/95	89/91	97/96	96/82	81/35	3/48	61/26	98/46	60/6	7/8	9/69	9/17	47/47														
ND6	(17)	99/98	98/97	86/89	95/94	93/81	76/32	1/52	65/31	63/42	67/0	1/3	4/59	18/6	37/37														
TV16	(34)	98/98	97/86	89/95	94/93	81/76	32/1	52/65	32/63	63/42	67/0	1/3	4/59	19/6	37/37														
R65	(25)	97/97	86/89	95/94	92/80	76/30	0/52	66/31	63/41	66/0	1/2	3/59	17/7	37/37															
QV58	(11)	91/84	87/96	96/95	88/45	17/36	52/40	62/40	60/0	0/1	5/65	13/20	49/49																
OLA1	(20)	84/85	89/87	85/65	62/9	19/67	81/22	65/37	68/1	0/0	3/33	9/1	32/32																
GRAB5	(9)	93/93	93/69	62/27	20/64	36/13	19/79	92/48	49/50	46/86	17/0	26/26																	
PV16	(21)	95/96	95/77	64/36	10/60	5/6	23/77	91/43	44/46	46/81	30/7	19/19																	
QV1	(10)	99/87	82/46	7/45	30/18	43/61	76/22	23/25	27/78	19/13	41/41																		
SOVI	(30)	99/89	82/51	11/42	45/19	40/63	76/24	25/27	31/78	25/9	37/37																		
MOVI	(13)	88/84	81/11	40/44	16/37	64/76	27/25	29/32	82/18	16/43																			
R64	(24)	87/80	52/2	9/44	40/43	49/8	9/11	26/63	38/15	37/37																			
R74	(26)	68/52	8/14	54/31	26/31	7/6	4/3	65/5	55/74																				
ELA1	(8)	83/47	50/40	2/32	14/14	13/16	38/42	44/16	22/22																				
YV1	(36)	81/65	69/16	20/39	30/31	28/6	2/22	33/29																					
MYV1	(16)	85/43	15/46	74/31	32/31	16/29	11/43	22/22																					
R45	(23)	2/56	12/49	11/9	10/26	20/18	7/16																						
CH4	(2)	80/58	45/82	82/81	67/26	2/37	45/45																						
CH5	(3)	42/9	76/75	74/73	11/14	25/46																							
CH6	(4)	91/90	90/91	90/83	38/24	11/11																							
SVVI	(33)	70/71	71/67	77/35	30/8																								
MSB1	(15)	99/99	95/65	26/26	27/27																								
SSB1	(32)	99/95	66/26	27/26																									
SB1	(29)	96/67	27/25	25/25																									
SNS1	(31)	63/46	32/31																										
CH7	(5)	4/30	45/45																										
MNS1	(14)	79/69																											
NS1	(19)	94/94																											
R76	(28)																												

VARIABLE NAME	NO.	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	28	1	27/77
PV17	22	1	1	99/37
ND7	18	27	1	99/39
TV17	35	18	1	99/89
R75	27	1	1	96/44
CLA1	6	20	1	95/85
LAI	12	6	1	98/98
ND6	17	6	1	99/38
TV16	34	17	1	98/24
R65	25	13	1	99/98
QV58	11	1	1	98/69
OLA1	20	6	1	97/69
GRAB5	9	1	1	92/28
PV16	21	1	1	94/77
QV1	10	10	1	98/65
SOVI	30	10	1	99/71
MOVI	13	10	1	90/00
R64	24	26	1	89/97
R74	26	8	1	79/89
ELA1	8	8	1	61/06
YV1	36	6	1	85/40
MYV1	16	6	1	85/84
R45	23	6	1	37/34
CH4	2	6	1	77/45
CH5	3	6	1	44/65
CH6	4	6	1	44/54
SVVI	33	6	1	70/59
MSB1	15	6	1	91/100
SSB1	32	6	1	99/99
SB1	29	6	1	99/93
SNS1	31	6	1	80/55
CH7	5	6	1	60/35
MNS1	14	6	1	74/65
NS1	19	6	1	44/54
R76	28	6	1	27/77

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Keith County -- November 17, 1977 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE
NAME NO

AV1	(1)	99/97 97 94/92 35 88 94 89 94 92 94 94 93 91 91/81/80/37 77 87/69 86/ 3 1 36 66/14 9 38/ 1 1 4 5/
PV17	(22)	93 96 92/90 83 86 93 88 93 91 94 92 92 89 89/80/76/55 76 87/71 89/ 7 3 53 63/12 12 40/ 3 6 9 9/
ND7	(18)	99/98/96 92 94 93 91 94 92 93 97 97 96 96/82/90/64 77 84/62 73/ 4 4 65 76/21 3 29/18 15 12 6/
TV17	(35)	96/96 91 92 94 91 95 92 94 97 97 96 96/83/90/63 77 83/63 74/ 1 4 65 74/22 3 29/17 13 10 3/
R75	(27)	94 93 96 90 87 91 89 90 94 93 93 92/79/80/63 75 82/58 70/11 4 62 78/20 2 29/20 17 14 8/
CLAI	(6)	98/96/96 94 94 92 92 96 98 98 98/91/91/34 73 71/67 65/14 17 79 84/33 22 9/14 10 8 3/
DLAI	(20)	95/91 88 87 85 84 90 93 94 94/87/91/46 63 61/58 35/30 29 85 92/28 26 6/21 17 16 14/
R65	(25)	92 93 94 93 92 95 95 96 93/88/89/63 80 75/67 60/ 9 3 71 79/43 22 2/16 13 10 2/
GRABS	(9)	98/98 96 97/95 96 95 96/96/80/50 79 75/82 77/ 1 6 72 72/38 21 7 8 12 14 19/
PV16	(21)	98 98 97/96 96 96 96/80/37 85 76/85 70/10 3 69 66/52 33 5/ 7 10 13 25/
CVI	(10)	99/99/98 97 97 97/92/82/63 88 85/81 76/15 10 61 64/43 21 7/ 2 3 8 21/
SOVI	(30)	99/97 96 96 96/92/80/67 91 83/83 74/20 15 59 60/31 26 2/ 4 7 10 26/
MCVI	(13)	97 96 95 95/90/79/63 90 87/83 79/20 15 56 59/44 17 10/ 6 9 13 23/
QVSB	(11)	99 98 98/87/89/71 88 86/71 70/11 9 62 67/42 19 1/12 9 3 9/
LAI	(12)	99 99/90/90/64 82 80/71 68/ 2 2 71 74/39 22 9/13 9 6 4/
ND6	(17)	99/91/92/65 82 77/69 63/ 0 3 73 76/44 28 3/16 13 10 2/
TV16	(34)	91/92/65 82 77/69 63/ 0 3 73 75/44 28 3/16 12 9 3/
SYVI	(33)	73/38 72 59/86 63/ 2 13 79 71/53 44 17/17 21 22 28/
CH5	(3)	68 66 65/37 39/18 17 74 81/30 24 9/31 48 46 33/
CH4	(2)	84 82/30 31/46 38 7 18/49 14 6/44 43 38 1/
R64	(24)	91/75 63/30 31 27 29/64 26 4/ 1 3 8 39/
R74	(26)	62 79/43 47 16 31/27 14 36/ 5 3 1 21/
CH6	(4)	75/34 21 41 31/36 30 16/57 39 62 70/
CH7	(5)	24 17 23 34/ 2 35 51/40 42 45 36/
ELAI	(8)	90/55 64/43 0 8/32 31 36 67/
YVI	(36)	66 61/40 3 2/17 15 21 57/
NYVI	(16)	91/24 46 19/18 14 15 24/
R45	(23)	4 20 9/31 28 29 40/
MNSI	(14)	86 78/ 9 11 13 33/
NS1	(19)	93/ 3 1 1 25/
R76	(28)	12 12 12 36/
MSBI	(13)	99/99/84/
SSDI	(32)	99/84/
SD1	(29)	86/
SNSI	(31)	

VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	31	30	18 81
PV17	28	30	99 83
ND7	27	30	97 06
TV17	35	18	99 63
R75	27	34	93 59
CLAI	6	30	93 33
DLAI	20	1	98 06
R65	25	6	96 06
GRABS	9	36	96 70
PV16	21	9	98 60
CVI	10	13	99 64
SOVI	30	10	99 73
MCVI	13	34	97 99
QVSB	11	34	98 52
LAI	12	34	99 70
ND6	17	34	99 90
TV16	34	1	92 82
SYVI	33	1	88 44
CH5	3	1	85 38
CH4	2	26	83 40
R64	24	3	91 19
R74	26	1	72 87
CH6	4	3	75 64
CH7	5	3	68 40
ELAI	8	3	90 56
YVI	36	8	50 32
NYVI	16	23	91 33
R45	23	2	16 51
MNSI	14	28	82 15
NS1	19	28	93 69
R76	28	3	24 02
MSBI	13	3	64 38
SSDI	32	3	99 92
SD1	29	1	99 77
SNSI	31	1	18 81

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Keith County - March 22, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	VARIABLE NO.	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OF SIMILARITY WHEN CLUSTER FORMED
AVI	1	1	1	0
ND7	18	1 18	2	26
R75	27	1 27	2	48
TV17	33	1 33	2	26
PV17	22	1 22	2	14
R74	26	1 26	2	26
CLAI	6	1 6	2	26
ND6	17	1 17	2	26
TV16	34	1 34	2	26
R63	23	1 23	2	26
QLAI	20	1 20	2	26
QVI	10	1 10	2	26
SCVI	30	1 30	2	26
QVSB	11	1 11	2	26
MVVI	13	1 13	2	26
PV16	21	1 21	2	26
ELAI	8	1 8	2	26
R64	24	1 24	2	26
MNSI	14	1 14	2	26
NSI	19	1 19	2	26
R76	28	1 28	2	26
CH4	2	1 2	2	26
CH5	3	1 3	2	26
CH6	4	1 4	2	26
SNSI	31	1 31	2	26
MSBI	19	1 19	2	26
SSBI	32	1 32	2	26
CH7	5	1 5	2	26
CRABS	9	1 9	2	26
SYVI	33	1 33	2	26
MYVI	16	1 16	2	26
YVI	36	1 36	2	26
R43	23	1 23	2	26
LAI	12	1 12	2	26

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Keith County - May 15, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	(1)	99/99		1	0
PV17	(22)	99/99 98/97		2	0.40
ND7	(18)	99/99 98/98 97/97		3	0.37
TV17	(33)	99/99 98/98 97/97 96/96		4	0.30
R73	(27)	99/99 98/98 97/97 96/96 95/95		5	0.36
CLAI	(6)	98/99 99/99 98/98 97/97		4	0.30
QVSB	(11)	99/99 99/99 99/99 98/98 97/97		5	0.44
LAI	(12)	99/99 99/99 98/98 97/97 96/96		5	0.38
ND6	(17)	99/98 98/98 97/98 96/96 95/95		5	0.36
TV16	(34)	98/98 98/98 97/97 96/96 95/95 94/94		6	0.36
QVI	(10)	99/99 99/99 98/98 97/97 96/96 95/95		6	0.44
MCVI	(13)	99/99 99/99 98/98 97/97 96/96 95/95 94/94		7	0.47
BOVI	(30)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93		8	0.47
R63	(25)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92		9	0.33
GRAB8	(9)	98/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93		8	0.30
PV16	(21)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92		9	0.37
CH5	(3)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92 91/91		10	0.34
DLAI	(20)	98/98 98/98 97/98 96/96 95/95 94/94 93/93 92/92 91/91 90/90		11	0.17
CH4	(2)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92 91/91 90/90 89/89		12	0.70
R64	(24)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92 91/91 90/90 89/89 88/88		13	0.69
R74	(26)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92 91/91 90/90 89/89 88/88 87/87		14	0.63
CH7	(5)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92 91/91 90/90 89/89 88/88 87/87 86/86		15	0.42
MYVI	(16)	80/44 79/23 22 24 29/18 23 2/56 47		16	0.47
R45	(23)	99/99 99/99 98/98 97/97 96/96 95/95 94/94 93/93 92/92 91/91 90/90 89/89 88/88 87/87 86/86 85/85		17	0.14
CH6	(4)	82/20 22 26 43/60 32 10/26 24		18	0.24
SYVI	(33)	28 26 24 9/42 14 18/ 3 10		19	0.10
MSB1	(15)	99/99/87/21 50 71/ 0 33		20	0.33
SSB1	(32)	99/87/22 51 71/ 0 33		21	0.33
SB1	(29)	89/24 50 69/ 3 29		22	0.29
SNS1	(31)	58 64 74/59 7		23	0.7
MNS1	(14)	82 63/47 30		24	0.30
NS1	(19)	93/ 3 24		25	0.24
R76	(20)	1 32		26	0.32
ELAI	(8)	89/		27	0.89
YVI	(36)			36	0.36

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Keith County - May 25, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE	NAME	NO
AVI	(1)	99/98
PV17	(22)	98/97
ND7	(18)	99/98
TV17	(35)	97/98
R75	(27)	97/97
CLAI	(6)	97/99
QVSB	(11)	99/99
LAI	(12)	99/99
ND6	(17)	99/98
TV16	(34)	98/97
R65	(23)	96/93
DLAI	(20)	91/89
GRAB8	(9)	98/96
PV16	(21)	97/97
QVI	(10)	99/99
HQVI	(13)	99/93
GOVI	(30)	94/91
R64	(24)	94/84
R74	(26)	86/82
CH4	(2)	89/80
CH5	(3)	82/82
R45	(23)	87/83
CH7	(5)	10/8
MSBI	(15)	99/99
SSBI	(32)	99/91
SB1	(29)	93/83
SNBI	(31)	71/17
CH6	(4)	80/51
BYVI	(33)	37/16
MYSI	(14)	76/57
NSI	(19)	92/10
R76	(28)	13/31
ELAI	(8)	82/72
VVI	(36)	59/
MYVI	(16)	/

VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	16	1	28
PV17	35	1	99
ND7	35	2	99
TV17	35	3	98
R75	35	4	97
CLAI	6	1	98
QVSB	11	1	99
LAI	12	1	99
ND6	17	1	99
TV16	34	1	98
R65	23	1	97
DLAI	20	1	95
GRAB8	9	1	97
PV16	21	1	98
QVI	10	1	99
HQVI	13	1	94
GOVI	30	1	99
R64	24	1	94
R74	26	1	89
CH4	2	1	89
CH5	3	1	82
R45	23	1	87
CH7	5	1	10
MSBI	15	1	99
SSBI	32	1	99
SB1	29	1	93
SNBI	31	1	71
CH6	4	1	80
BYVI	33	1	37
MYSI	14	1	76
NSI	19	1	92
R76	28	1	13
ELAI	8	1	82
VVI	36	1	59
MYVI	16	1	/

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Keith County - June 11, 1978 - Field

TRER PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD
AVAILABLE

NAME NO

AVI	(1)	99/98	97 98 95 95 94 97 97 96/90/93	90 96 96 93/88	95/89/89	82/46	75/28	63 77/46	70 20 18 15 17/13	26/	
PV17	(22)	97 96 97 94 93 93 96	96 95/89/94	91 96 97 93/88	94/91	66 79/45	74/27	63 76/49	72 15 13 10 13/15	27/	
CLA1	(8)	98 99 98 98/90/90	97 97/90/93	92 97 96 93/86	90/84/67	83/60	84/21	83 69/46	75 22 20 18 20/	2 15/	
QVSB	(11)	99/99	99/98/98	98 97/94/91	91 96 96 93/92	94/99/78	89/50	78/15	51 69/40	70 31 29 26 23/15	29/
LAI	(12)	99 99/98/98	98 97/93/94	92 97 96 96/90	92/82/72	87/56	81/17	51 68/44	74 26 24 21 21/10	22/	
ND6	(17)	99/99	97 97 96/97/92	91 96 94 94/88	90/76/74	90/60	84/12	44 63/40	73 30 28 26 24/	6 19/	
TV16	(24)	98/97	97 96/90/92	91 96 94 94/88	90/75/74	90/60	83/11	44 63/40	73 31 29 26 25/	7 19/	
R65	(20)	97 96 97/96/92	91 95 94 94/88	90/77/71	87/60	84/13	45 63/42	74 27 25 22 21/	3 10/		
ND7	(18)	99/99	95/88	85 93 92 91/86	94/99/77	91/49	82/31	62 78/31	63 37 35 32 34/	4 22/	
TV17	(30)	98/94/87	83 93 92 91/86	93/78/79	92/48	82/31	62 78/29	62 39 37 34 35/	5 23/		
R75	(27)	95/88	83 92 91 90/85	93/79/74	88/50	84/31	61 77/33	64 34 32 29 31/	1 20/		
OLA1	(20)	87 83 89 87 87/76	80/69/63	90/71	94/72	44 63/32	69 34 32 30 34/17				
GRAB8	(9)	99/97	97 97/87	84 90/49	68/63	73/1	36 51/70	91 6 8 11 9/13	16/		
PV16	(21)	97 97 98/89	83/87/51	67/61	68/10	27 43/72	92 7 9 12 14/21	22/			
OVI	(10)	99/99	94 91/88/65	77/53	71/3	43 58/60	83 7 6 2 0/23	30/			
HQVI	(13)	99/94	92/90/64	74 49 68/4	45 59/62	83 4 3 0 2/26	33/				
SOVI	(30)	95 91/88/64	74 51 67/2	39 34/63	84 4 2 0 4/27	33/					
R64	(24)	94/88/76	72/28	31 9 39 34/34	70 12 11 7 2/48	58/					
R74	(26)	83/81	80/53	60/23	66 70/37	57 27 26 22 10/34	51/				
CH7	(5)	39 49/33	52/20	58 63/72	77 21 23 26 21/25	29/					
CH4	(2)	87 4 47/18	53 67/11	16 71 70 67 33/33	37/						
CH5	(3)	48 82/30	31 70/1	40 68 66 64 62/	5 13/						
HVVI	(16)	81 7 14 3/38	72 0 2 1 0/32	37/							
R45	(23)	33 38 56/16	58 38 36 35 46/48	32/							
HNSI	(14)	84 77/42	28 42 43 43 62/45	22/							
NSI	(19)	96/10	0 38 38 36 46/	0 25/							
R76	(28)	6 13 48 48 45 33/	1 23/								

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1		1	99 87
PV17	22		27	97 67
CLA1	8		34	99 27
QVSB	11		11	99 26
LAI	12		34	99 97
ND6	17		6	98 70
TV16	24		29	95 52
R65	20		18	98 77
ND7	18		1	99 87
TV17	30		1	96 26
R75	27		1	94 75
OLA1	20		9	97 96
GRAB8	9		21	99 11
PV16	21		10	99 75
OVI	10		10	99 84
HQVI	13		1	92 81
SOVI	30		24	94 33
R64	24		1	82 97
R74	26		1	87 72
CH7	5		1	74 58
CH4	2		1	81 64
CH5	3		1	80 97
HVVI	16		1	75 58
R45	23		1	61 64
HNSI	14		1	80 97
NSI	19		1	97 96
R76	28		1	43 19
CH6	4		1	37 34
BYVI	33		1	68 46
HNSI	35		1	99 98
SSBI	35		1	99 89
NSI	35		1	33 11
NSI	35		1	91 90
ELA1	8		1	22 34
VVI	36		1	

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Keith County - June 21, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX CLUSTERING BY AVERAGE DISTANCE METHOD	
VARIABLE NAME	NU
AVI	(11) 97/94 93 95/00 02 70 71 69 60 00 77 66 74/60 00 36/11 26 63 36 39 21 7 30 10 4 3 3 11 30/27 32 52/
PV17	(22) 04 03 03/74 75 61 60 60 56 73 76 60 70/77 66 49/22 32 66 20 24 17/12 6 32 19 19 19 11 59/23 35 40/
ND7	(10) 99/99/03 84 77 78 77 79 02 71 59 62/53 48 10 5 15 51 43 57 25/20 57 16 33 32 32 30 7/26 23 51/
R75	(27) 99/04 05 78 70 78 00 02 71 59 61/52 47 10 6 14 50 46 58 26/31 59 10 34 34 34 40 3/26 21 50/
TV17	(33) 02 84 76 77 76 70 01 71 59 63/53 48 19 3 16 52 44 55 24/27 55 15 31 30 30 36 10/27 24 52/
CLAI	(61) 90/96 96 96/96/91/07 70 76/79 00 59 2 29 20 70 62 36/ 7 41 13 9 8 8 12 14 9 20 0/
LAI	(12) 98 90 97/93/77/73 06 03/77 02 54/17 43 42 57 50 19/17 42 13 11 10 10 10 13/19 26 0/
ND6	(17) 99/99/96/95/09 04 77/70 79 31/13 42 32 60 53 10/24 49 6 10 17 17 15 0/29 41 13/
TV16	(34) 99/96 95/89 04 70/70 79 31/14 42 33 60 53 10/24 49 7 10 17 17 15 0/29 40 13/
R65	(23) 96/94/00 02 76/69 70 50/11 41 30 61 54 19/23 50 3 19 10 18 16 1/29 42 14/
OLA1	(20) 83/75 67 61/62 67 43/13 17 13 76 74 40/23 59 8 30 29 29 32 12/11 35 6/
QV08	(11) 96 92 09/71 01 40/35 60 59 37 32 2/28 40 15 10 10 9 4 15/30 25 0/
QV1	(10) 90/97/03 92 65/49 70 62 30 17 7 0 16 31 13 14 15 20 36/30 27 9/
SQV1	(30) 97/79 92 65/61 00 63 18 2 21 9 7 43 20 20 21 30 37/52 35 20/
MGV1	(13) 84 92 69/62 78 71 15 1 17 2 3 54 31 31 32 38 53/59 19 7/
GRAB8	(9) 94/92/28 43 33 30 23 29/46 20 68 52 53 52 45 66/14 19 12/
PV16	(21) 88/46 65 40 39 12 6/25 12 65 43 43 43 45 52/44 42 32/
SYV1	(33) 30 40 10 44 8 20/63 44 03 70 71 71 65 67/30 30 40/
ELA1	(8) 92/73/58 75 79 4 41 57 43 44 46 65 47/53 17 26/
R64	(24) 74/37 53 70/15 20 52 32 32 34 53 37/75 34 33/
R74	(26) 44 40 59/26 3 25 12 12 13 24 45/15 32 37/
MYV1	(16) 91/87/18 40 8 16 15 17 33 14/20 30 10/
R45	(23) 82/10 66 43 49 48 50 63 37 40 8 17/
YV1	(36) 43 17 9 4 3 5 29 2/57 5 14/
CH4	(2) 00 75 86 06 05 69 73/19 7 14/
CH5	(3) 83 94 93 94 91/76/11 8 23/
CH6	(4) 96 96 96/95/07/24 17 36/
MSB1	(13) 99/99/95/88/16 1 26/
SB81	(32) 99/95/88/16 1 27/
SB1	(29) 96/88/18 1 27/
BNS1	(31) 81/40 14 39/
CH7	(3) 6 29 12/
MNS1	(14) 82 82/
NS1	(19) 92/
R76	(20) 1/

VARIABLE NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	20	30	26 00
PV17	2	1	5	26 11
ND7	3	35	10	26 16
R75	4	18	1	26 16
TV17	5	25	5	26 27
CLAI	6	13	10	26 31
LAI	7	6	10	26 37
ND6	8	17	9	26 37
TV16	9	17	9	26 37
R65	10	6	6	26 41
OLA1	11	6	6	26 41
QV08	12	10	10	26 41
QV1	13	10	10	26 41
SQV1	14	10	10	26 41
MGV1	15	10	10	26 41
GRAB8	16	10	10	26 41
PV16	17	10	10	26 41
SYV1	18	10	10	26 41
ELA1	19	10	10	26 41
R64	20	10	10	26 41
R74	21	10	10	26 41
MYV1	22	10	10	26 41
R45	23	10	10	26 41
YV1	24	10	10	26 41
CH4	25	10	10	26 41
CH5	26	10	10	26 41
CH6	27	10	10	26 41
MSB1	28	10	10	26 41
SB81	29	10	10	26 41
SB1	30	10	10	26 41
BNS1	31	10	10	26 41
CH7	32	10	10	26 41
MNS1	33	10	10	26 41
NS1	34	10	10	26 41
R76	35	10	10	26 41

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Keith County - June 29, 1978 - Field

TRIAL PRINTED OVER ADDITIVE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME

VARIABLE NAME	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	11	1	99
ND7	181	2	99
PV17	221	3	99
TV17	331	4	99
R75	271	5	99
CLA1	41	6	99
GRAD8	91	7	99
ND6	171	8	99
TV16	341	9	99
R63	231	10	99
CLA1	201	11	99
PV16	211	12	99
QV1	101	13	99
QV8	111	14	99
HQV1	131	15	99
SGV1	301	16	99
LAI	121	17	99
DYV1	331	18	99
CH3	31	19	99
ELA1	81	20	99
R64	241	21	99
R74	261	22	99
CH7	51	23	99
CH4	41	24	99
MYV1	161	25	99
R45	231	26	99
VV1	361	27	99
CH4	21	28	99
M881	131	29	99
SS91	321	30	99
SS1	291	31	99
SN51	311	32	99
MNS1	141	33	99
ND1	191	34	99
R76	201	35	99

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Keith County - July 27, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERED BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	(1) 97/99/97 97/95 93 93 93 93 93 93 93 93 91 90/77 91/69/60/23 64/59 74 5/36 82 41 39 30 30/34 8 12 63	1	1	32
PV17	(22) 99/97 97/95 93 92 93 93 95 95 93 95 92 91/78 91/72/70/30 70/59 73 4/51 77 34 32 31 32/34 7 13 63	28	28	99
TV17	(33) 98 96/94 92 92 92 91 94 94 92 94 90 09/76 90/67/66/23 63/58 73 5/55 81 40 39 38 38/34 5 15 63	27	27	99
ND7	(18) 99/96 94 93 94 95 95 95 93 96 91 90/70 91/71/72/27 66/59 76 6/53 80 37 36 35 33/52 8 11 62	21	21	98
R75	(27) 95 94 92 94 96 94 93 92 95 91 90/78 90/71/73/20 66/59 77 7/51 78 35 33 32 32/48 9 9 59	20	20	96
CLA1	(6) 99 99 99/98/97 96 96 98/97 97/80 83/84/63/37 62/72 80 13/46 78 30 28 28 27/53 24 14 40	17	17	99
ND6	(17) 99/99/98/98 97 97 98/96 98/84 84/83/63/59 60/68 75 8/49 77 30 28 27 23/61 34 21 33	17	17	99
TV16	(34) 99/97/98 97 97 98/96 98/84 83/84/63/40 59/68 75 8/49 78 30 28 27 23/62 35 23 31	20	20	99
CLA1	(20) 98/97 96 96 98/96 97/82 82/83/63/38 59/70 79 11/47 78 30 29 28 25/57 30 20 34	23	23	96
R65	(23) 96 96 95 98/95 96/84 83/81/71/39 61/66 77 8/48 76 29 27 26 23/36 29 14 37	10	10	99
QV1	(10) 99/99/99/94 97/89 90/77/65/36 62/58 68 3/57 79 34 32 31 24/69 35 13 40	13	13	99
HQV1	(13) 99/99/93 97/91 92/77/60/40 66/53 63 8/57 75 30 28 27 19/72 36 10 42	30	30	99
SGV1	(30) 99/92 97/92 90/76/66/38 61/53 62 10/59 77 32 30 29 19/74 42 16 36	11	11	99
QVSB	(11) 94 97/89 90/79/68/38 63/59 69 2/53 77 31 30 28 22/67 34 13 40	9	9	98
CRAB8	(9) 98/76 78/92/64/54 73/76 79 24/27 64 10 8 8 11/53 22 17 34	21	21	98
PV16	(21) 83 81/89/63/53 67/68 71 9/40 68 17 15 14 10/63 38 26 26	24	24	90
R64	(24) 90/63/63/45 58/22 31 41/62 38 20 19 16 4/89 63 21 23	26	26	90
R74	(26) 54/72/29 68/25 44 31/65 68 32 31 29 18/72 24 19 62	33	33	90
SYV1	(33) 50/75 71/80 72 39 3 37 20 22 22 16/42 29 41 4	12	12	99
LAI	(12) 31 60/29 48 6/33 45 12 11 10 9/35 8 15 47	4	4	98
CH6	(4) 76/29 15 12/39 25 74 75 76 75/41 37 37 19	5	5	98
CH7	(5) 34 39 10 8 10 38 40 41 35/43 1 20 47	16	16	93
MYV1	(16) 93/76 7 52 10 8 10 30/3 8 31 9	23	23	64
R45	(23) 64/12 68 29 27 29 48 2 18 7 36	36	36	59
YV1	(36) 59 0 19 21 18 16/61 53 8 1	82	82	81
CH4	(8) 79 83 83 82 58/59 36 8 37	82	82	81
CH5	(3) 82 81 81 76/38 12 1 47	81	81	76
MSB1	(15) 99/99/92/11 2 17 39	15	15	99
SSB1	(32) 97/91/11 2 18 38	32	32	99
SB1	(29) 92/ 8 4 18 38	29	29	99
SNS1	(31) 19 35 29 48	31	31	99
ELA1	(8) 74/26 6	8	8	97
MNS1	(14) 76 36	14	14	98
NS1	(19) 84	19	19	76
R76	(28) 1	28	28	70

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Yolo County - October 7, 1977 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	NO	CORRELATION MATRIX (Upper Triangle)																															
AV1	(1)	74	77	92/31	52/64	67	65	71	76	72	75	24	30	26	44	31	50	50	59	56	45	66	8	13	32	34	34	35	48	54	21	54	8
ND7	(18)	99/92/79	89/64	59	55	55	75	63	70	26	35	11	12	24	42	30	15	16	46	50	50	72	35	33	33	32	15	9	27	1/11			
R75	(27)	93/76	83/70	65	62	62	81	68	75	31	40	17	20	31	50	38	21	24	49	35	47	68	30	27	27	27	8	2	19	8/10			
PV17	(22)	59	73/70	69	66	69	82	76	81	32	43	24	33	43	57	46	39	41	52	64	26	49	5	2	1	1	16	23	1	29	2		
R74	(26)	84/31	21	19	9	39	21	36	1	1	22	27	11	7	2	45	36	0	8	57	85	67	66	66	66	67	56	49	33	34			
TV17	(35)	33	26	22	21	43	34	42	1	7	15	19	6	7	2	8	15	25	24	52	74	47	49	49	48	39	33	50	25	14			
CLA1	(6)	99/97/93/96/90	92/77	82	72	77	81	93	87	42	69	65/72	30	36	5	5	6	7	33	35	41	55	9										
OLA1	(20)	99/98/96/92	92/78	84	76	83	85	95	90/53	77	68/76	22	27	4	16	16	17	43	46	48	62	1											
TV16	(34)	96/94/90	91/78	84	76	85	86	96	91/51	78	65/74/19	24	6	18	18	19	45	47	52	65	5												
ELA1	(8)	93/92	89/75	83	76	85	84	93	88/67	84	73/80/15	17	15	23	25	27	51	55	49	65/13													
R76	(28)	89	92/66	74	60	60	73	87	79	46	65	64/75	28	40	3	5	5	6	31	35	36	50	6										
MNS1	(14)	97/84	91	81	80	87	91	86/59	79	82/71/33	34	0	10	10	12	40	45	41	58/10														
NS1	(19)	79	85	73	75	84	91	85/45	70	69/68/31	40	4	6	6	8	35	39	40	58	9													
QV1	(10)	98/96/83	87	86	87/37	71	75	48/43	29	16	2	2	0	28	28	32	49	2															
SGV1	(30)	96/87	91	90	90/48	75	31	57/50	26	8	5	5	7	36	38	53	55	9															
MGV1	(13)	91	92	86	88/53	83	74	50/2	7	8	21	22	23	49	49	67	63/17																
QVSD	(11)	96/93	96/64	94	61/58/	6	14	33	47	47	48	71	71	80	83/10																		
PV16	(21)	95	96/55	88	61/58/	0	3	26	40	40	41	66	66	77	84	2																	
ND6	(17)	98/52	84	64	66/13	15	12	25	26	27	53	54	65	74	6																		
R65	(25)	50	86	58/57	6	5	17	31	32	33	58	57	73	78	9																		
R45	(23)	84/69/63/19	32	57	58	58	60	70	77	40	56/70																						
R64	(24)	69/63/14	24	48	58	58	59	79	81	72	81/34																						
YV1	(36)	61/52	33	11	6	6	4	19	28	11	22/57																						
LA1	(12)	11	14	16	21	21	22	39	45	26	45/22																						
CH4	(2)	91/90	87	87	86	69	45/53	52	2																								
CH7	(5)	89	86	86	86	70	66/56	47/25																									
CH5	(3)	98	98	98/89	88/63	69/28/																											
MSB1	(15)	99/99/94	93/75	80/21/																													
SSB1	(32)	99/94	93/75	80/20/																													
SBI	(29)	95	93/76	80/22/																													
CH6	(4)	99/86	93/20/																														
SNS1	(31)	80	90/30/																														
GRAB5	(9)	93/12/																															
SYV1	(33)	7/																															
MYV1	(16)																																

VARIABLE NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1	16	1	17
ND7	18	18	1	19
R75	27	18	1	26
PV17	22	31	1	31
R74	26	31	1	34
TV17	35	31	1	48
CLA1	6	31	1	55
OLA1	20	31	1	62
TV16	34	31	1	65
ELA1	8	31	1	65
R76	28	31	1	66
MNS1	14	31	1	68
NS1	19	31	1	70
QV1	10	31	1	79
SGV1	30	31	1	85
MGV1	13	31	1	87
QVSD	11	31	1	83
PV16	21	31	1	84
ND6	17	31	1	85
R65	25	31	1	87
R45	23	31	1	87
R64	24	31	1	87
YV1	36	31	1	88
LA1	12	31	1	90
CH4	2	31	1	92
CH7	5	31	1	93
CH5	3	31	1	98
MSB1	15	31	1	99
SSB1	32	31	1	99
SBI	29	31	1	99
CH6	4	31	1	99
SNS1	31	31	1	100
GRAB5	9	31	1	100
SYV1	33	31	1	100
MYV1	16	31	1	100

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Yolo County - November 12, 1977 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

CLUSTER NO	VARIABLE NAME	NO
1	AVI	1
2	PV17	2
3	MNSI	3
4	NSI	4
5	R76	5
6	CH4	6
7	CH5	7
8	CH6	8
9	MSDI	9
10	SSDI	10
11	SBI	11
12	SNSI	12
13	CH7	13
14	ELAI	14
15	R64	15
16	R74	16
17	R45	17
18	GRABS	18
19	SVVI	19
20	GVSB	20
21	ND6	21
22	TV16	22
23	R65	23
24	DLAI	24
25	PV16	25
26	QVI	26
27	SGVI	27
28	HCVI	28
29	ND7	29
30	R75	30
31	TV17	31
32	CLAI	32
33	LAI	33
34	HYVI	34
35	VVI	35

VARIABLE NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1		1	
PV17	2		2	
MNSI	3		3	
NSI	4		4	
R76	5		5	
CH4	6		6	
CH5	7		7	
CH6	8		8	
MSDI	9		9	
SSDI	10		10	
SBI	11		11	
SNSI	12		12	
CH7	13		13	
ELAI	14		14	
R64	15		15	
R74	16		16	
R45	17		17	
GRABS	18		18	
SVVI	19		19	
GVSB	20		20	
ND6	21		21	
TV16	22		22	
R65	23		23	
DLAI	24		24	
PV16	25		25	
QVI	26		26	
SGVI	27		27	
HCVI	28		28	
ND7	29		29	
R75	30		30	
TV17	31		31	
CLAI	32		32	
LAI	33		33	
HYVI	34		34	
VVI	35		35	

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Yolo County - January 28, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE	NAME	NO
AVI	(11	99/96 95 97 96 97/90 96/93/83 89/83 83 94 94 91 90 96 94 94 97/63/24 58 60 61 62/26 53 50/44 3 37/29/
PV17	(221/96 95 97 96 97/91 96/93/85 90/83 80 94 92 90 89 95 93 93 96/64/28 62 63 65 65/22 48 46/45 3 36/30/	
GRAB8	(91 99/98 98 98/93 92/94/93 98/84 81 94 93 91 91 91 89 93 91/74/33 72 73 75 76/ 9 40 43/60 18 37/24/	
PV16	(211/99 99 99/95 92/92/93 98/85 80 95 94 92 94 90 88 93 90/72/35 71 72 74 77/14 41 41/67 25 31/30/	
QVI	(101 99/99/96 95/92/89 95/86 82 96 95 94 93 93 91 95 94/68/32 65 66 68 72/24 48 44/63 16 39/33/	
SOVI	(301/99/97 94/92/90 95/85 81 96 94 93 92 92 90 94 93/66/35 66 68 69 74/24 46 42/66 19 36/30/	
MOVI	(131/96 96/93/91 95/84 80 96 94 92 91 92 90 94 93/63/35 68 69 70 74/22 45 41/62 14 40/37/	
R64	(241 95/89/90 90/75 71 93 89 87 86 85 83 89 87/51/48 68 69 70 79/29 37 25/74 22 30/35/	
R74	(261/93/84 85/73 71 92 88 85 84 91 89 89 92/46/41 62 63 65 69/31 42 31/50 6 36/31/	
CH7	(31/94 91/66 63 84 81 77 76 83 81 81 85/35/47 82 83 84 82/ 2 19 22/46 3 32/32/	
CH6	(41 96/63 38 81 77 75 74 72 70 77 74/60/55 91 92 92 94/13 6 12/69 20 21/32/	
BYVI	(331/80 75 89 88 87 86 82 81 88 83/77/37 80 81 82 82/ 3 28 36/68 32 22/50/	
CLAI	(61 96/89 94 95 94 89 87 92 88/83/11 31 33 34 37/35 75 79/49 24 23/ 5	
OLA1	(201/90 95 95 95 91 91 92 89/80/11 26 27 29 30/37 77 83/42 18 33/ 3	
OV88	(111 99 98 98/96 96/96 94/68/28 53 54 56 60/34 59 53/60 17 40/33/	
LAI	(121 99 99/97 96/96 94/75/17 48 49 50 54/34 65 61/37 18 38/24/	
ND6	(171 99/96 95/96 93/73/15 44 46 47 52/36 67 64/59 22 34/23/	
TV16	(341/95 95/95 91/76/15 44 45 47 51/36 66 63/39 23 33/22/	
ND7	(181 99/95 97/67/14 43 44 46 47/37 67 63/41 2 58/24/	
TV17	(351/92 94/67/15 41 43 44 46/36 66 62/39 2 58/22/	
R65	(251 97/73/13 47 49 50 55/35 64 63/37 17 37/26/	
R75	(271/66/13 46 47 49 50/35 63 62/41 3 56/26/	
MYVI	(161/13 41 42 42 36/11 49 72/38 39 8/38/	
ELA1	(81 66 65 66 71/18 43 62/46 13 4/55/	
MSBI	(151 99/99/96/47 32 17/34 23 11/21/	

VARIABLE	NAME	NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
SSBI	(321/99/96/46 31 16/55 23 11/21/	AVI	1	33	99
SB1	(291/97/44 29 15/56 23 12/24/	PV17	1	13	99
SNSI	(311/27 24 18/71 33 5/42/	GRAB8	1	10	99
		PV16	1	10	99
CH4	(21 75 36/17 9 22/55/	QVI	1	10	99
		SOVI	1	10	99
CH5	(31 84/12 2 33/ 3/	MOVI	1	10	99
		R64	1	10	99
R45	(231/ 1 3 27/34/	R74	1	10	99
		CH7	1	10	99
MNSI	(141 78 37/52/	CH6	1	10	99
		BYVI	1	10	99
NSI	(191 78/ 1/	CLAI	1	10	99
		OLA1	1	10	99
R76	(281/11/	OV88	1	10	99
		LAI	1	10	99
YVI	(361/	ND6	1	10	99
		TV16	1	10	99
		ND7	1	10	99
		TV17	1	10	99
		R65	1	10	99
		R75	1	10	99
		MYVI	1	10	99
		ELA1	1	10	99
		MSBI	1	10	99
		SSBI	1	10	99
		SB1	1	10	99
		SNSI	1	10	99
		CH4	1	10	99
		CH5	1	10	99
		R45	1	10	99
		MNSI	1	10	99
		NSI	1	10	99
		R76	1	10	99
		YVI	1	10	99

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Yolo County - February 28, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
AV1	(11	99/97/97	96	98	98	97/92	93/93	94	96	92	91	91	93	92	94/00	93/00	01	02	01/66	03	01/13	08	20	30	40/24	63																																																																											
PV17	(221/98/90	96	98	98	97/93	93/93	93	95	91	90	94	92	91	94/00	92/02	02	04	02/66	02	59/11	35/21	30	40/24	63																																																																													
CH7	(31/97	95	96	95/93	94	87	87	84	83	87	86	84	87/03	89/90	90	91	08/63	72	49	0	39/20	20	39/23	60																																																																													
GRABS	(91	99/99	90	90/97	98/95	92	95	91	91	91	90	91	90/87	88/87	88	89	88/75	82	60	3	50/20	25	51	6	48																																																																												
PV16	(211/99	99	99/97	98/94	93	93	92	92	91	90	92	90/90	89/86	87	88	89/72	81	57	9	52/25	31	59	0	42																																																																													
CV1	(101	99/99/95	96	95	93	96	94	93	93	92	92	92/83	83	85	87/67	82	57	16	56/27	36	56	6	49																																																																														
PGV1	(131/99/96	96	94	95	96	93	92	93	92	93	92/84	84	85	88/66	80	53/16	54/29	38	55	0	50																																																																																
SGV1	(301/95	96	94	95	96	93	93	93	91	93	91/94	92/83	83	85	88/66	80	53/10	53/29	39	59	3	46																																																																															
CH6	(41	98/84	85	87	83	82	81	80	82	80/86	83	93	96	96/69	69	44	6	31/34	29	59	2	36																																																																															
SYV1	(331/92	88	91	88	87	86	85	87	84/84	81/91	91	92	91/79	79	58	5	43/19	19	57	5	36																																																																																
CLAI	(61	96	98	97	97	96/96	95/83	85/71	72	73	71/78	94	77/14	71	1	17	43	9	52																																																																																		
CVS8	(111	99/99	99/98	98/93	93/92	92/67	68	69	73/62	88	63/33	72/23	40	54	7	32																																																																																					
LAI	(121/99	99/98	98/93	94/89	90/70	71	72	74/70	91	68/24	71/16	31	50	8	33																																																																																						
ND6	(171	99/98	98/93	93/87	87/64	63	66	69/70	92	71/29	76/12	30	53	2	48																																																																																						
TV16	(341/97	98/94	92/87	86/64	64	66	69/69	92	70/29	75/13	30	53	1	40																																																																																							
ND7	(181	99/95	96/86	90/63	64	66	66/66	92	72/29	76/10	30	41/18	62																																																																																								
TV17	(351/93	93/83	88/63	63	63	66/63	91	70/29	75/12	29	41/17	62																																																																																									
R63	(231	98/88	89/64	63	66	69/68	91	74/30	75	6	32	52	4	46																																																																																							
R73	(271/86	91/63	64	63	66/63	90	73/29	74	4	31	38/22	61																																																																																									
R64	(241	96/69	70	72	82/41	67	36/43	56/48	65	69	0	39																																																																																									
R74	(261/68	68	70	76/39	70	42/42	59/41	60	50/24	60																																																																																											
MSB1	(131	99/99/96/63	51	29/31	3/33	15	47	0	30																																																																																												
SSB1	(321/99/96/63	52	30/31	4/34	13	47	0	30																																																																																													
S81	(291/96/64	53	30/28	6/33	18	48	0	31																																																																																													
SNS1	(311/54	50	21	8	11/51	39	67	11	22																																																																																												
MYV1	(161	81	81/36	42/36	38	28/18	17																																																																																														

NAME	VARIABLE NO.	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1		1	59
PV17	2		1	59
CH7	3		1	59
GRABS	4		1	59
PV16	5		1	59
CV1	6		1	59
PGV1	7		1	59
SGV1	8		1	59
CH6	9		1	59
SYV1	10		1	59
CLAI	11		1	59
CVS8	12		1	59
LAI	13		1	59
ND6	14		1	59
TV16	15		1	59
ND7	16		1	59
TV17	17		1	59
R63	18		1	59
R73	19		1	59
R64	20		1	59
R74	21		1	59
MSB1	22		1	59
SSB1	23		1	59
S81	24		1	59
SNS1	25		1	59
MYV1	26		1	59
CLAI	27		1	59
R43	28		1	59
CH4	29		1	59
CH5	30		1	59
ELAI	31		1	59
YV1	32		1	59
MWSI	33		1	59
NSI	34		1	59
R76	35		1	59

ORIGINAL PAGE IS
OF POOR QUALITY

Yolo County - March 27, 1978 - Area

FILE PRINTED OVER ABSOLUTE CORRELATION MATRIX

CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	(1) 97/98 97 99 98 97/98 98 98 98 97 97 97/93 97/94 93 96/84 93 93/83 84/84/73 86/62 8 30 32 36 47 1 33/	1	1	28 99
PV17	(22) 98 97 99 98 99/98 98 98 98 97 96 96 93 98/93 93 96/86 93 96/83 83/84/70 84/62 8 33 36 40 50 2 33/	2	2	99 93
GRABS	(9) 99/99 99 99/97 96 96 97 96 93 93/96 93/93 93 94/92 98 97/88 82/74/62 78/72 7 43 47 51 61 3 48/	3	3	99 46
PV16	(21) 99 99 99/97 93 97 97 96 96 93/97 93/92 93 94/92 98 96/87 81/72/64 79/75 11 44 46 50 61 6 31/	4	4	99 81
QVI	(10) 99/99/98 97 98 98 97 97 96/97 97/93 93 93/88 96 93/83 82/77/70 83/72 4 36 39 43 53 6 35/	5	5	99 95
SGVI	(30) 99/97 97 98 98 97 97 93 98 97/93 93 94/89 96 93/83 81/76/69 82/73 6 38 40 44 56 8 36/	6	6	99 96
HQVI	(13) 98 97 98 98 97 96 93/97 97/93 93 93/89 96 96/84 81/77/69 82/72 3 30 41 45 56 7 36/	7	7	98 61
CLAI	(6) 99/98 99 99 98/97/93 93/97 97 96/82 93 91/89 90/80/72 89/63 0 26 29 32 43 8 43/	8	8	99 71
ND7	(18) 99 99 99 98/98/94 96 97 96 96/79 90 90/84 88/83/77 90/60 8 21 24 28 39 3 31/	9	9	99 27
QVSB	(11) 99/99 99/98/93 96/93 93 94/81 91 91/84 83/81/77 89/67 0 24 27 31 44 2 35/	10	10	99 68
LAI	(12) 99 99/98/94 93/96 93 94/81 92 91/83 86/81/76 89/63 1 24 27 31 43 0 32/	11	11	99 62
ND6	(17) 99/98/94 94/97 93 94/80 91 89/86 88/79/77 90/67 2 22 24 28 41 2 30/	12	12	99 87
TV16	(34) 99/93 93/96 93 93/79 90 88/86 86/79/77 90/66 1 20 23 27 39 1 30/	13	13	99 16
TV17	(33) 91 93/93 91 92/73 87 88/82 83/86/79 91/39 8 16 19 23 33 0 31/	14	14	97 33
R64	(24) 98/88 93 93/88 93 93/76 74/72/71 78/77 7 38 41 45 59 17 67/	15	15	98 19
R74	(26) 89 94 93/84 90 93/74 77/83/73 81/64 1 33 35 39 52/12 63/	16	16	98 69
QLAI	(20) 97 96/73 88 83/90 96/76/71 89/38 0 18 21 24 34/23 33/	17	17	98 83
R73	(27) 81 90 91/83 91/79/68 83/38 7 28 31 33 44/13 46/	18	18	99 41
CH6	(4) 96/94/78 62/54/33 49/79 23 73 76 79 86/19 44/	19	19	93 56
SYVI	(33) 93/89 78/63/49 68/78 21 37 39 63 71 3 41/	20	20	96 84
CH7	(5) 79 73/77/31 66/64 3 37 39 62 69/12 30/	21	21	93 56
MYVI	(16) 89/53/44 73/61 25 33 38 40 44/30 7/	22	22	96 89
R43	(23) 69/62 85/42 3 8 11 14 19/49 14/	23	23	89 83
R76	(28) 71 78/17 36 3 3 9 13 0 46/	24	24	75 14
CH4	(2) 92/41 21 34 32 28 8 7 69/	25	25	75 10
CH3	(3) 44 14 19 16 12 1/16 46/	26	26	74 63
MNSI	(14) 63/31 33 33 72/34 37/	27	27	47 90
MSI	(19) 36 36 33 42 9 7/	28	28	63 97
MSDI	(15) 99/99/93/28 8/	29	29	99 96
SSDI	(32) 99/93/27 9/	30	30	99 81
S8T	(29) 96/29 13/	31	31	99 96
SNSI	(31) 40 35/	32	32	99 81
ELAI	(8) 63/	33	33	37 07
YVI	(36) 1/	34	34	28 79

OF POOR QUALITY

Yolo County - May 11, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE	NO	NAME
AVI	(1)	99/99/90 98 97 97 96/97 96 98 98 98 97/97/93 97/92 92 93/88/76 71/64 83 78 51/46/40 86/ 2 0 3 16 39 49/
PV17	(22)	98/98 98 96 97 94/97 97 98 98 98 97/97 94 97/90 91 94/89/73 67/69 87 81 54/47/42 86/ 4 6 10 22 75 44/
ND7	(18)	99 98 98 98 97/96 95 97 96 96/96/93 96/94 95 97/86/79 76/58 78 74 46/44/36 83/ 9 7 3 9 45 57/
CLA1	(6)	98 99 99/98/97 97 98 97 97/95/92 94/94 96 96/90/75 73/62 79 73 43/49/27 78/ 5 3 0 12 50 58/
QVSB	(11)	99 99/97/97 98 99 99 98/97/96 97/92 94 95/90/77 72/65 81 81 53/56/28 79/ 1 0 3 18 40 48/
ND6	(17)	99/99/97 97 98 97 97/95/93 94/94 96 96/90/77 76/61 76 75 45/55/21 75/ 7 6 2 11 50 57/
TV16	(34)	98/97 98 98 98 97/96/94 94/92 95 95/90/76 74/63 78 78 47/56/23 76/ 4 2 0 14 47 53/
OLA1	(20)	95 95 96 95 94/93/89 90/93 97 96/89/75 78/57 73 68 36/49/19 73/11 9 6 6 37 64/
GRAB5	(9)	99/98 98 98/95/93 93/89 92 92/96/64 62/76 87 79 48/56/25 76/13 15 18 30 43 47/
PV16	(21)	99 99 99/95/95 94/89 92 91/96/67 62/75 86 82 53/62/21 73/11 13 17 30 40 44/
QV1	(10)	99/99/96/96 96/91 93 93/92/75 68/70 85 82 56/59/28 78/ 4 5 9 24 38 44/
SOV1	(30)	99/96/97 97/90 92 92/92/74 65/72 86 85 59/62/27 77/ 7 8 12 28 34 41/
HGV1	(13)	96/97 97/89 91 92/92/72 63/74 88 85 60/60/31 80/ 9 11 15 30 32 39/
TV17	(35)	92 94/65 87 90/87/72 65/67 83 83 55/48/40 86/ 4 5 9 22 33 41/
R64	(24)	97/86 89 89/87/75 59/73 84 88 70/69/26 74/10 11 15 33 21 29/
R74	(26)	88 89 92/84/78 64/67 85 85 66/54/43 85/ 3 5 9 25 22 34/
LA1	(12)	95 95/81/77 80/47 66 60 54/42/23 70/19 17 14 2 34 64/
R65	(25)	98/85/74 80/51 67 61 34/49/15 67/16 15 11 0 38 68/
R75	(27)	82/78 80/50 70 63 37/40/29 76/17 15 11 0 32 65/
SYV1	(33)	45 46/84 87 76 41/63/ 9 61/50 32 35 44 44 41/
CH4	(2)	87/14 38 37 51/40/26 65/52 31 47 26 26 43/
CH5	(3)	2 22 28 6/17/11 53/69 68 65 33 68 79/
CH6	(4)	92/81 63/66/18 49/73 74 77 84 4 9/
CH7	(3)	88 67/51/48 78/31 52 55 65 2 6/
ELA1	(8)	86/70/35 71/56 36 40 38 12 10/
YV1	(36)	66/38 53/34 34 38 59 57 42/

VARIABLE	NO	NAME	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
MNS1	(14)	35 10/31 32 54 34 1 8/		14	27 34
NS1	(19)	79 6 6 8 8 30 9/		19	49 76
R76	(28)	0 1 4 13 9 26/		28	98 85
MS01	(15)	99/99/95/44 55/		15	98 64
SS01	(32)	99/95/42 54/		32	99 47
SD1	(29)	96/43 54/		29	99 82
SNS1	(31)	47 36/		31	99 88
HYV1	(16)	93/		16	95 85
R45	(23)			23	97 85
AVI				1	97 80
PV17				22	98 91
ND7				18	97 60
CLA1				6	98 87
QVSB				11	92 72
ND6				17	87 41
TV16				34	71 61
OLA1				20	70 48
GRAB5				9	64 12
PV16				21	64 81
QV1				10	64 40
SOV1				30	50 19
HGV1				13	49 78
TV17				35	49 99
R64				24	49 83
R74				26	43 74
LA1				12	27 54
R65				25	27 34
R75				27	27 34
SYV1				33	27 34
CH4				2	27 34
CH5				3	27 34
CH6				4	27 34
CH7				3	27 34
ELA1				8	27 34
YV1				36	27 34

ORIGINAL LISTING OF POOR QUALITY

Yolo County - May 12, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER CLUSTER	BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1			1	73
PV17	22			2	99
PV17	22			2	98
PV17	22			2	98
GRAB8	9			3	99
PV16	21			4	99
TVI	10			5	99
SVVI	30			6	99
MGVI	13			7	99
CLAI	6			8	99
ND6	17			9	99
TV16	34			10	99
QVSD	11			11	99
ND7	18			12	99
CLAI	20			13	99
R64	24			14	99
R74	26			15	99
LAI	12			16	99
R65	23			17	99
R75	27			18	99
SVVI	33			19	99
CH6	4			20	99
CH7	5			21	99
CH4	2			22	99
CH5	3			23	99
ELAI	8			24	99
YVI	36			25	99
MNSI	14			26	99
NSI	19			27	99
R76	28			28	99
MSDI	13			29	99
SSDI	32			30	99
SBI	29			31	99
SNSI	31			32	99
HYVI	16			33	99
R45	23			34	99

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OF POOR QUALITY

Yolo County - May 20, 1978 - Area

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX

CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE

NAME

NO

VARIABLE NAME NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45																																																							
AVI	(1)	99/99	98/98	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1	
ND7	(18)	99/99	99/99	97/96	96/95	95/94	94/93	93/92	92/91	91/90	90/89	89/88	88/87	87/86	86/85	85/84	84/83	83/82	82/81	81/80	80/79	79/78	78/77	77/76	76/75	75/74	74/73	73/72	72/71	71/70	70/69	69/68	68/67	67/66	66/65	65/64	64/63	63/62	62/61	61/60	60/59	59/58	58/57	57/56	56/55	55/54	54/53	53/52	52/51	51/50	50/49	49/48	48/47	47/46	46/45	45/44	44/43	43/42	42/41	41/40	40/39	39/38	38/37	37/36	36/35	35/34	34/33	33/32	32/31	31/30	30/29	29/28	28/27	27/26	26/25	25/24	24/23	23/22	22/21	21/20	20/19	19/18	18/17	17/16	16/15	15/14	14/13	13/12	12/11	11/10	10/9	9/8	8/7	7/6	6/5	5/4	4/3	3/2	2/1	
PV17	(22)	99/99	99/99	97/96	96/95	95/94	94/93	93/92	92/91	91/90	90/89	89/88	88/87	87/86	86/85	85/84	84/83	83/82	82/81	81/80	80/79	79/78	78/77	77/76	76/75	75/74	74/73	73/72	72/71	71/70	70/69	69/68	68/67	67/66	66/65	65/64	64/63	63/62	62/61	61/60	60/59	59/58	58/57	57/56	56/55	55/54	54/53	53/52	52/51	51/50	50/49	49/48	48/47	47/46	46/45	45/44	44/43	43/42	42/41	41/40	40/39	39/38	38/37	37/36	36/35	35/34	34/33	33/32	32/31	31/30	30/29	29/28	28/27	27/26	26/25	25/24	24/23	23/22	22/21	21/20	20/19	19/18	18/17	17/16	16/15	15/14	14/13	13/12	12/11	11/10	10/9	9/8	8/7	7/6	6/5	5/4	4/3	3/2	2/1	
R75	(27)	99/99	99/99	97/96	96/95	95/94	94/93	93/92	92/91	91/90	90/89	89/88	88/87	87/86	86/85	85/84	84/83	83/82	82/81	81/80	80/79	79/78	78/77	77/76	76/75	75/74	74/73	73/72	72/71	71/70	70/69	69/68	68/67	67/66	66/65	65/64	64/63	63/62	62/61	61/60	60/59	59/58	58/57	57/56	56/55	55/54	54/53	53/52	52/51	51/50	50/49	49/48	48/47	47/46	46/45	45/44	44/43	43/42	42/41	41/40	40/39	39/38	38/37	37/36	36/35	35/34	34/33	33/32	32/31	31/30	30/29	29/28	28/27	27/26	26/25	25/24	24/23	23/22	22/21	21/20	20/19	19/18	18/17	17/16	16/15	15/14	14/13	13/12	12/11	11/10	10/9	9/8	8/7	7/6	6/5	5/4	4/3	3/2	2/1	
CLAI	(6)	99/99	98/98	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1
ND6	(17)	99/99	99/99	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1
TV16	(34)	99/99	99/99	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1
OLAI	(20)	99/99	99/99	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1
R65	(25)	99/99	99/99	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1
GRAB8	(9)	99/99	99/99	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/33	32/32	31/31	30/30	29/29	28/28	27/27	26/26	25/25	24/24	23/23	22/22	21/21	20/20	19/19	18/18	17/17	16/16	15/15	14/14	13/13	12/12	11/11	10/10	9/9	8/8	7/7	6/6	5/5	4/4	3/3	2/2	1/1
PV16	(21)	99/99	99/99	97/97	96/96	95/95	94/94	93/93	92/92	91/91	90/90	89/89	88/88	87/87	86/86	85/85	84/84	83/83	82/82	81/81	80/80	79/79	78/78	77/77	76/76	75/75	74/74	73/73	72/72	71/71	70/70	69/69	68/68	67/67	66/66	65/65	64/64	63/63	62/62	61/61	60/60	59/59	58/58	57/57	56/56	55/55	54/54	53/53	52/52	51/51	50/50	49/49	48/48	47/47	46/46	45/45	44/44	43/43	42/42	41/41	40/40	39/39	38/38	37/37	36/36	35/35	34/34	33/3																																

ORIGINAL PAGE IS
OF POOR QUALITY

Yolo County - June 16, 1978 - Area

SEE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD
VARIABLE

NAME	NO																															VARIABLE NO.	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED		
AVI	(1)	96	92	91	91	92	94	95	95	93	89	84	88/68	83	76	81	80	79/50	80/43	87	1	18	18	17	15	18	25	3	21	15	22	82	1				
CLAI	(6)	97	97	97	97/96	97	96/97	94	91	93	75	71	80	85	81	85/88	76	26	22	15	2	2	1	0	32	44	12	17	10	24	49	2					
ND6	(17)	99/99	99/93	95	94	98	97	93	96	89	77	82	86	85	90/27	71	10	13	24	6	6	7	10	39	52	27	11	1	31	47	3						
TV16	(34)	99/98	95	95	94/98	97	94	96/82	79	83	87	86	91/27	71/16	11	26	8	8	9	12	41	34	30	9	0	33	44	4									
OLAI	(20)	99/93	95	93/96	96	92	94/79	75	80	86	84	88/27	70/18	14	23	5	5	6	9	37	51	25	13	4	29	47	5										
R65	(25)	95	96	93/96	95	90	93/76	73	79	83	82	86/26	69/23	19	18	0	0	1	4	33	47	22	16	8	26	33	6										
ND7	(18)	99/99/96	97	94	94/83	80	90	92	84	86/53	88/16	9	26	9	10	10	13	45	49	16	1	7	39	44	7												
R75	(27)	97/95	95	91	93/79	76	87	89	81	84/51	83/20	14	21	4	4	5	7	40	45	12	4	0	36	50	8												
PV17	(22)	96	96	95	95/80	80	90	92	85	87/55	88/15	7	28	11	11	12	15	47	50	6	2	9	41	39	9												
QV1	(10)	98	96	98/83	82	87	88	85	90/35	76/20	11	26	7	8	9	12	43	51	30	1	7	42	40	10													
QV8	(11)	98	90/91	89	93	93	90	94/39	80/6	2	39	21	22	23	26	54	61	37	10	19	50	35	11														
HQV1	(13)	99/94	93	95	92	93	96/39	79/3	13	49	32	32	33	37	63	68	45	2	30	58	26	12															
SOV1	(30)	90	89	92	90	89	94/34	75/8	1	30	20	20	21	26	33	60	42	11	20	53	32	13															
ELA1	(8)	97/96/89/89	71/41	76/19	33	83	49	49	58	59	75	73	38	45	35	74	14																				
R64	(24)	96/83/87	90/36	72/22	38	67	33	33	34	39	78	74	66	32	60	81	15																				
R74	(26)	92/86	88/57	88/10	25	35	41	41	42	46	71	64	44	42	48	73	17	16																			
TV17	(35)	85	86/54	87/2	12	44	29	29	30	33	61	60	38	29	34	20	17																				
GRAB8	(9)	98/27	88/32	35	68	54	54	55	56	78	87	90	21	32	47	15	18																				
PV16	(21)	23	67/22	27	62	46	47	47	50	72	82	55	20	31	31	19	19																				
NS1	(19)	84/7	3	11	7	7	8	8	32	5	32	33	25	37	10	20																					
R76	(28)	3	4	30	18	18	19	21	32	39	0	26	26	49	24	21																					
CH4	(2)	96	86	93	93	93	90/76	72/48	59	61	27/50	22																									
CH5	(3)	92	97	97	97/83	73/61	78	80	52/54	23																											
CH6	(4)	98	98	98/97	92/72	72	78	63/36	24																												
MSB1	(15)	99/99/99/92	85/66	75	79	56/43	25																														
SSB1	(32)	99/99/92	85/66	74	79	56/43	26																														
SB1	(29)	99/93	85/67	75	79	57/43	27																														
SN51	(31)	93	85/72	78	83	64/43	28																														
CH7	(5)	92/83	71	76	68/26	29																															
SYV1	(33)	68	43	34	48/14	30																															
MNS1	(14)	59	69	71/28	31																																
MYV1	(16)	96/86/50	32																																		
R45	(23)	87/51	33																																		
YV1	(36)	23	34																																		
LAI	(12)		35																																		

ORIGINAL PAGE IS
OF POOR QUALITY

Yolo County - All Dates Combined - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO																																								
AVI	(1)	97	95	93	97/76	83/76	92	91	91	92	00	94	91	86	85	85	87	79/83	37	25	55/52	39	38	39	38	39	38	64	10	0	38	16/17									
QVI	(10)	99/98	97/83	92/97	92	92	92	90	00	93	09	86	83	89	86	73	86/56	42	40/39	26	25	25	23	23	23	2	12	84	24/23												
GGVI	(30)	99/97	97/80	94/96	92	91	91	88	87	91	09	05	02	90	86	73/84	60	44	37/35	20	19	19	18	48	7	17	88	27/22													
MGGVI	(13)	98/92	97/94	90	00	89	86	84	00	87	02	00	91	86	67/79	59	39	37/24	9	8	8	7	38	18	28	66	34/23														
PVI7	(22)	87	91/94	90	00	00	00	04	09	89	82	81	88	88	69/78	43	24	31/31	17	16	17	16	45	9	23	57	29/23														
GRADD	(9)	98/79	73	70	72	65	6	67	70	64	60	76	70	44	69/63	43	17	12	25	26	26	27	3	31	59	89	46/42														
PVI6	(2)	86	01	00	00	74	73	77	77	73	69	85	76	35/77	68	50	20/3	10	11	11	12	19	38	45	81	40/37															
CLA1	(6)	98	98	98/96	96/96	95/92	91/91	90/83	83/50	37	3/46	32	31	32	30	38	3	4	43	16/18																					
QV00	(11)	99	99/98	97/95	97/94	93/94	93/84	74/51	33	49/47	33	32	33	31	57	8	2	39	19/4																						
ND6	(17)	99	98	98/96	96/94	93/92	91/88	78/51	37	46/51	38	37	37	35	61	12	3	36	13/8																						
TVI6	(34)	97	97/95	96/92	90/91	90/85	78/52	37	45/49	36	35	35	33	59	10	1	38	18/9																							
ND7	(18)	98	96	96/95	96/91	94/90	72/40	24	59/55	42	41	42	40	64	10	6	29	3/0																							
OLA1	(20)	93	93/96	93/89	89/92	73/48	36	43/32	39	38	39	37	61	15	3	32	2/7																								
LA1	(12)	98	94	93/88	88/90	82/46	36	47/58	46	45	45	44	68	21	10	30	2/11																								
TVI7	(33)	87	87/88	91/80	70/40	22	60/46	33	32	32	30	55	8	3	37	22/4																									
R65	(25)	98	91	91/92	71/48	33	44/51	38	37	37	35	59	14	5	31	3/1																									
R73	(27)	98	93	91/65	39	22	84/53	40	39	40	38	60	18	6	25	6/4																									
R64	(24)	96	70	62/61	32	40/29	13	12	13	9	38	11	21	32	32/4																										
R74	(26)	73	56/40	11	61/37	23	22	22	20	45	0	14	39	23/11																											
R45	(23)	75	31	33	45/68	60	60	60	59	76	40	33	6	34/10																											
MYVI	(16)	48	62	15	45	39	38	38	39	62	15	11	40	0/38																											
MNSI	(14)	85/35	5	16	17	17	21	2	36	28	63	31/11																													
NDI	(19)	54	3	2	2	2	0	17	12	1	43	4/44																													
R76	(28)	45	38	37	38	38	44	38	10	13	3/27																														
CHA	(2)	98	98	98/97	97/90	83/54	38/25																																		
MNDI	(13)	99	99/99	95/95	91/63	47/19																																			
DDI	(29)	99	99/93	96	91/63	47/19																																			
DDDI	(32)	99	95	96	91/63	47/19																																			
DNDI	(31)	94	96	91/66	49/15																																				
CH5	(3)	83	76	39/35	6/1																																				
CH6	(4)	97	83	56/27																																					
CH7	(5)	84	59/23																																						
SYVI	(33)	55	48																																						
ELA1	(8)																																								
VVI	(36)																																								

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1		1	
QVI	10		10	97
GGVI	30		30	99
MGGVI	13		13	98
PVI7	22		22	87
GRADD	9		9	98
PVI6	2		2	86
CLA1	6		6	98
QV00	11		11	99
ND6	17		17	99
TVI6	34		34	97
ND7	18		18	98
OLA1	20		20	93
LA1	12		12	98
TVI7	33		33	87
R65	25		25	98
R73	27		27	98
R64	24		24	96
R74	26		26	73
R45	23		23	75
MYVI	16		16	48
MNSI	14		14	85
NDI	19		19	54
R76	28		28	45
CHA	2		2	98
MNDI	13		13	99
DDI	29		29	99
DDDI	32		32	99
DNDI	31		31	94
CH5	3		3	83
CH6	4		4	97
CH7	5		5	84
SYVI	33		33	55
ELA1	8		8	
VVI	36		36	

ORIGIN OF POOR QUALITY

Yolo County - October 7, 1977 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
 CLUSTERING BY AVERAGE LINKAGE METHOD
 VARIABLE

NAME	NO																														
AVI	(1)	77	77	90	74/36	31	27	26	28	22	21	72	60	61	7	4	37/42	50	32	39	39	39	41	12	15	18/28	43	60/22	10	11	39
ND7	(18)	99/93	93/51	66	56	55	56	53	58	60	61	75	33	36	75/17	12	29	23	23	23	20	49	62	36/19	34	53/15	13	8	7		
R75	(27)	93/72	51	66	56	55	57	53	58	60	61	75	33	36	75/17	12	30	23	23	24	21	49	63	36/20	34	53/16	13	7	7		
PV17	(22)	89/40	56	47	46	40	43	40	74	65	74	19	22	63/3	9	9	1	2	2	0	30	49	10/23	39	57/20	12	1	19			
TV17	(33)	46	61	51	51	51	48	52	65	59	71	29	32	70/10	6	23	17	17	17	15	41	53	29/16	32	53/11	9	4	7			
CLA1	(6)	84	95	95	93	93	86/76	75	74/32	53	27/23	12	39	27	27	27	20	30	76	61/41	55	30/37	55	25	19						
QV00	(11)	76	76	93	96/93	76	81	80/83	85	70/30	41	64	53	53	54	58	62	84	72/31	39	22/19	15	0	27							
ND6	(17)	99/99	99/99	76	79	82/72	74	40/36	32	58	46	46	49	49	84	73/52	55	37/20	37	14											
TV16	(34)	99/99	99/99	76	78	81/73	73	48/36	32	58	46	46	49	49	84	73/52	55	38/27	37	14	7										
R63	(25)	90/93	77	80	83/71	74	47/36	31	37	43	46	46	49	49	84	73/52	55	36/31	38	19											
CLA1	(20)	92/72	76	79/70	77	50/36	34	50	47	47	47	51	50	81	71/54	54	40/29	32	10	13											
PV16	(21)	70	74	81/70	76	34/52	49	73	62	62	63	65	66	93	85/49	32	30/29	36	20	11											
QV1	(10)	90/93	46	52	51/20	19	8	5	5	5	0	10	49	23/41	21	0/30	10	25	3												
QV1	(30)	76	38	66	56/15	9	18	3	3	4	12	16	51	20/36	30	10/26	0	34	11												
NOV1	(13)	64	72	72/3	9	35	21	21	22	29	38	65	42/46	19	1/23	0	25	17													
ELA1	(8)	76/71	39	36	68	60	60	61	70	61	59	60/66	40	36	3	23	27	71													
R64	(24)	74/40	58	72	62	62	63	73	64	63	64	72	43	35/0	25	31	70														
R74	(26)	27	44	53	48	48	54	60	52	40/16	24	35/8	40	33	58																
CH4	(2)	94	91	93	93	89	80/73	88/0	24	18/0	33	60	21																		
CH5	(3)	95	90	90	90	97/92	64	82/17	22	20/10	1	30	52																		
CH6	(4)	98	98	90/90	95/83	94/30	35	26/1	13	31	45																				
M001	(15)	99/99	98/95	76	90/20	27	21/3	12	36	44																					
B001	(32)	99/98	95/76	90/20	27	21/2	12	37	44																						
B01	(29)	98/95	76	90/20	27	21/3	11	35	45																						
DNS1	(31)	93/74	88/54	33	27/5	0	21	54																							
CH7	(5)	81	86/7	5	3/2	5	30	42																							
GRAB8	(9)	93/21	35	14/25	47	45/3																									
QV1	(33)	28	48	33/17	43	50/17																									
MND1	(14)	79	74/6	21	47	51																									
ND1	(19)	93/22	36	11/6																											
R76	(28)	10	23	4/16																											
LA1	(12)	38	21	34/																											
MV1	(16)	87/76/																													
YV1	(36)	60/																													
R45	(23)	/																													

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1		1	48
ND7	18		2	88
R75	27		3	93
PV17	22		4	87
TV17	33		5	53
CLA1	6		6	64
QV00	11		7	21
ND6	17		8	89
TV16	34		9	93
R63	25		10	73
CLA1	20		11	51
PV16	21		12	82
QV1	10		13	77
QV1	30		14	17
NOV1	13		15	24
ELA1	8		16	81
R64	24		17	67
R74	26		18	63
CH4	2		19	50
CH5	3		20	53
CH6	4		21	50
M001	15		22	31
B001	32		23	34
B01	29		24	99
DNS1	31		25	81
CH7	5		26	89
GRAB8	9		27	81
QV1	33		28	96
MND1	14		29	83
ND1	19		30	89
R76	28		31	86
LA1	12		32	69
MV1	16		33	86
YV1	36		34	86
R45	23		35	40

ORIGINAL PAGE IS
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Yolo County - November 12, 1977 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD
VARIABLE

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1		1	100
PV17	2		2	99
ND7	3		3	99
R73	4		4	99
TV17	5		5	99
MYV1	6		6	99
YV1	7		7	99
R43	8		8	99
CH4	9		9	99
CH5	10		10	99
CH6	11		11	99
MSB1	12		12	99
SSB1	13		13	99
SBI	14		14	99
SNS1	15		15	99
CH7	16		16	99
ELA1	17		17	99
R64	18		18	99
MNS1	19		19	99
NS1	20		20	99
R76	21		21	99
CLA1	22		22	99
QV3B	23		23	99
ND6	24		24	99
TV16	25		25	99
R65	26		26	99
OLA1	27		27	99
GRABS	28		28	99
PV16	29		29	99
SVV1	30		30	99
CV1	31		31	99
MGV1	32		32	99
SGV1	33		33	99
R74	34		34	99
LAI	35		35	99

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Yolo County - January 23, 1978 - Field

PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD
VARIABLE NO

VARIABLE NAME	NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
AV1	(1)	99/98	94/97	92/91	94/91	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	93/95	
YV1	(36)																																						

VARIABLE NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1		1	23 75
PV17	22		2	99 93
ND7	18	35	1	99 54
TV17	27	1	1	98 19
R75	27	1	1	97 41
CLAI	26	25	1	95 01
CLAI	26	25	1	95 01
GRAB8	20	25	1	95 01
PV16	21	25	1	95 01
CV1	10	30	1	95 14
MV1	13	10	1	99 78
SGV1	30	9	1	99 89
QVSB	11	34	1	98 68
LA1	12	34	1	98 13
ND6	17	34	1	99 50
TV16	34	9	1	99 90
R65	23	1	1	97 31
CH7	3	1	1	93 67
R74	26	26	1	91 76
R64	24	1	1	89 01
CH6	4	1	1	89 20
BYV1	33	33	1	96 35
CH5	3	1	1	85 67
MYV1	16	23	1	77 10
R45	15	21	1	86 99
MSB1	32	31	1	70 24
SSB1	32	15	1	95 40
SBI	29	15	1	95 97
SNS1	31	15	1	99 88
MNS1	14	28	1	84 43
NS1	19	28	1	78 50
R76	28	28	1	90 51
CH4	2	28	1	85 72
ELA1	8	36	1	85 49
YV1	36	1	1	85 75

ORIGINAL PAGE IS
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Yolo County - February 28, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	NO	ABSOLUTE CORRELATION MATRIX (Upper Triangle)																			
AVI	(1)	97/97	89/90	76/94	97/97	96/95	93/95	95/95	90/95	95/91	95/64	91/72	61/82	69/75	76/77	73/26	25/54	26/14	20/20		
PV17	(22)	90/90	90/96	94/94	97/97	96/94	92/94	89/89	94/92	91/94	84/90	70/61	81/67	77/77	79/74	25/23	54/54	24/13	20/20		
CH7	(5)	89/94	92/94	95/93	87/87	84/87	80/80	86/84	83/88	80/80	87/55	56/71	57/85	85/87	80/22	27/54	13/5	20/20			
CH6	(4)	97/97	95/95	95/85	83/83	85/81	81/79	78/84	80/83	78/50	68/70	55/93	93/94	94/53	10/19	7/2	19/19				
BYVI	(33)	98/98	95/95	95/92	87/90	88/87	84/83	89/84	80/74	62/81	82/69	87/88	88/88	86/53	16/16	5/20	5/5				
GRAB5	(9)	97/98	98/98	95/92	95/91	91/91	91/90	92/91	84/83	68/74	84/84	71/83	84/85	82/43	0/33	13/17	12/12				
PV16	(21)	99/99	98/99	94/93	95/92	92/90	90/93	89/88	84/84	69/72	82/67	82/83	84/85	82/8	23/21	12/19					
QVI	(10)	99/99	95/95	96/94	93/93	92/94	92/91	89/72	66/82	66/79	80/81	82/47	0/34	29/8	23/8						
MGVI	(13)	99/99	95/96	92/92	93/92	93/92	91/90	71/64	80/64	80/80	82/83	46/3	37/29	5/28							
BOVI	(30)	94/95	96/93	93/92	91/93	91/92	89/71	65/80	64/79	80/81	84/51	2/31	31/5	29/5							
CLAI	(6)	95/98	97/97	96/96	95/95	79/80	84/78	74/84	84/66	67/68	64/34	3/39	22/34	3/3							
QVDC	(11)	99/98	98/98	98/95	94/90	90/87	61/87	71/59	60/62	66/46	1/38	47/11	29/29								
LAI	(12)	99/99	98/98	98/95	94/86	86/86	69/90	76/64	65/66	67/41	2/39	36/20	18/18								
ND6	(17)	99/97	98/96	93/85	83/90	71/92	78/57	50/60	62/46	5/31	39/24	17/17									
TV16	(34)	97/98	94/91	84/82	90/70	91/78	56/57	59/61	46/6	31/40	23/17										
ND7	(18)	99/95	97/84	88/89	64/91	78/56	57/59	58/30	13/49	40/24	18/18										
TV17	(35)	93/94	83/83	86/90	64/90	77/54	55/57	57/31	11/48	41/23	18/18										
R63	(25)	97/86	84/84	69/92	80/62	63/64	66/44	2/32	35/28	17/17											
R75	(27)	83/88	83/61	90/79	60/61	62/60	26/19	51/35	27/18												
R64	(24)	94/67	36/62	40/63	63/66	79/62	4/26	39/23	61/61												
R74	(26)	69/29	63/44	59/60	62/69	34/26	34/57	18/36													
CH5	(3)	57/87	79/18	19/21	25/29	0/35	35/35	12/12													
MYVI	(16)	83/86	60/61	60/48	31/31	3/29	67/49														
QLAI	(20)	96/49	50/51	44/26	2/31	16/58	15/15														
R45	(23)	38/39	39/26	9/1	28/2	77/39															
MSBI	(15)	99/99	93/39	5/14	22/0	6/5															

VARIABLE NAME	NO	OTHER CLUSTER	BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OF SIMILARITY WHEN CLUSTER FORMED
AVI	1			1	23
PV17	22			2	80
CH7	5			3	99
CH6	4			4	97
BYVI	33			5	84
GRAB5	9			6	97
PV16	21			7	69
QVI	10			8	98
MGVI	13			9	95
BOVI	30			10	35
CLAI	6			11	99
QVDC	11			12	94
LAI	12			13	84
ND6	17			14	99
TV16	34			15	91
ND7	18			16	41
TV17	35			17	20
R63	25			18	98
R75	27			19	27
R64	24			20	16
R74	26			21	99
CH5	3			22	96
MYVI	16			23	67
QLAI	20			24	87
R45	23			25	20
MSBI	15			26	50
SSBI	32			27	94
SBI	29			28	90
SNSI	31			29	78
MNSI	14			30	90
NSI	19			31	53
R76	28			32	60
CH4	2			33	85
ELAI	8			34	31
YVI	36			35	98

ORIGINAL PAGE IS
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Yolo County - March 27, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NO

AVI	(1)	99/97/97	95	97	97	96/97	96	98	95	94	97	96	94	96/90	95/88	91/80	81	76	73/69	70	72	68/43	6	64/47	23	27
PV17	(22)	98/97	95	97	98	97/96	96	97	94	94	96	95	93	93/90	90/89	91/78	86	75	72/71	72	74	70/43	6	64/43	23	28
CH7	(31)	96/94	96	96	95/91	91	92	97	97	90	89	88	90/89	94/93	92/65	78	65	67/81	82	83	79/45	5	61/34	12	31	
GRABS	(9)	99/99	99	99/96	96	97	95	94	94	93	94	93/92	91/95	90/74	87	75	81/80	81	82	80/59	13	46/36	23	24		
PV16	(21)	99/99	99	99/95	96	96	93	94	92	91	94	91/94	91/96	98/73	85	72	80/80	82	83	82/63	22	40/38	19	29		
CVI	(10)	99/99/96	97	97	96	95	95	94	94	93/95	94/94	96/76	86	72	76/77	78	79	79/60	13	48/43	18	33				
MGVI	(13)	99/95	97	97	95	94	94	93	94	93/93	93/95	96/75	84	71	74/77	78	80	80/60	12	49/46	16	35				
SGVI	(20)	95	97	97	95	95	94	93	94	92/96	94/95	97/75	84	70	75/78	79	80	81/63	16	45/46	15	33				
CLAI	(6)	97	99	98	98	98	97/97	97/86	89/85	92/87	95	87	84/84	65	66	62/45	4	53/43	41	13						
QVSB	(11)	99/99	99/98	98/95	94	92	93/86	91/87	90	78	76/83	64	66	66/54	8	53/56	26	30								
LAI	(12)	99	99/99	98/91	95/90	92/87	52/86	92	81	79/64	66	67	66/50	6	53/50	31	23									
ND6	(17)	99/98	98/96	94/89	89/84	91/89	94	83	82/60	61	63	62/53	13	49/52	35	20										
TV16	(34)	98	98/95	93/88	88/84	91/89	93	83	81/59	61	62	62/53	13	49/52	34	20										
ND7	(18)	99/96	97/87	92/81	87/90	94	84	76/56	58	59	57/40	4	63/54	37	20											
TV17	(35)	94	94/86	90/80	86/91	92	82	75/54	56	57	55/40	3	63/55	35	21											
NS5	(23)	98/88	89/84	91/86	95	87	71/71	63	64	63/51	11	48/48	42	18												
R73	(27)	86	91/81	87/86	94	86	75/58	60	61	58/38	5	61/49	42	19												
R64	(24)	93/90	89/69	73	55	58/72	73	75	81/70	17	40/60	3	57													
R74	(26)	85	84/74	75	60	54/66	66	69	70/47	9	63/62	3	52													
CH6	(4)	97/53	72	57	74/92	93	94	93/71	29	29/23	4	32														
SYVI	(33)	66	83	71	85/85	86	87	85/68	30	31/25	22	20														
CH5	(3)	91	87/68/20	21	23	23/26	6	56/67	53	9																
DLAI	(20)	97/88/47	49	50	44/36	7	48/37	63	6																	
R45	(23)	88/33	35	35	27/19	2	45/25	80	27																	
MYVI	(16)	60	62	61	33/46	36	18	0	63	30																
MSBI	(15)	99/99/96/65	32	14	6	9	24																			

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	36	1	30
PV17	22	1	1	59
CH7	31	1	1	77
GRABS	9	30	9	33
PV16	21	30	9	60
CVI	10	30	10	81
MGVI	13	10	10	94
SGVI	20	10	10	75
CLAI	6	27	6	67
QVSB	11	35	11	52
LAI	12	11	11	60
ND6	17	11	11	94
TV16	34	11	11	26
ND7	18	35	18	38
TV17	35	5	35	50
NS5	23	27	23	50
R73	27	1	27	64
R64	24	26	24	60
R74	26	1	26	53
CH6	4	33	4	42
SYVI	33	33	33	26
CH5	3	16	3	85
DLAI	20	23	20	13
R45	23	3	23	04
MYVI	16	16	16	32
MSBI	15	31	15	48
SB1	29	15	29	33
SNSI	31	15	31	93
MNSI	14	18	14	57
NSI	19	14	19	17
R76	28	1	28	81
CH4	2	36	2	41
ELAI	8	36	8	33
YVI	36	1	36	92

ORIGINAL PAGE IS
OF POOR QUALITY

Yolo County - May 2, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE

NAME NO

AV1	(11	99/95	92	95/93	93	90	91	93	87	85/87	84	92	92	89/71	83/30	67	2	4	37	63/52	69	78	9	10	12	13	23	9	38	
PV17	(221/	93	90	93/	94	91	88	88	93	83	82/87	86	92	93	90/71	82/24	61	4	3	37	60/57	72	83	16	18	19	20	26	10	37
ND7	(181/	98/98	94	90	94	93	95	92	91/76	75	86	84	82/69	82/47	84	8	2	34	73/52	56	58	16	14	13	9	19	3	41		
R73	(271/	94/92	92	91	90	93	93	91/74	72	83	81	79/67	80/43	82/14	3	32	73/30	34	26	15	14	13	9	17	4	40				
TV17	(331/	94	94	93	94	94	88	89/76	75	86	85	83/68	80/48	84	3	1	33	69/52	56	58	16	14	12	8	20	6	41			
CLA1	(61	94	96	96	97	94/93/91	89	93	91	90/67	68/22	72/14	21	76	79/34	77	68	8	10	11	12	31	29	18						
QVSB	(111	98	98/90/95/89/84	87	94	93	93/84	82/48	78/10	9	36	62/48	68	60	2	1	0	11	47	30	1									
ND6	(171	99/98/97/94/86	88	93	91	92/78	73/39	79/2	4	67	72/48	73	56	1	0	1	9	47	37	8										
TV16	(341/	98/96/94/86	88	93	91	92/77	73/40	80/0	4	67	71/48	72	56	2	0	0	9	47	37	9										
LA1	(121/	96/92/89	89	95	94	93/77	78/35	74/0	4	65	70/53	74	66	4	6	8	14	42	30	17										
R63	(231/	94/84	83	90	88	89/76	71/37	77/8	6	66	73/47	71	54	1	0	1	9	46	38	6										
DLA1	(201/	80	78	82	79	79/55	55/26	81/33	31	78	90/37	67	47	8	6	5	6	27	30	13										
CRADB	(91	98/95	95	95/70	59/4	41/2	21	79	59/83	93	84	47	48	49	30	34	30	3												
PV16	(211/	97	97	97/78	62/4	42/13	9	74	33/84	93	79	44	46	47	33	66	38	14												
QV1	(101	99/99/85	76/23	56/17	1	65	54/73	86	77	28	30	31	40	39	44	2														
MOV1	(131/	99/86	79/22	53/22	3	61	49/74	85	80	31	32	34	43	39	42	4														
SCV1	(301/	88	76/23	53/23	6	62	49/75	86	76	30	32	34	44	65	48	2														
R64	(241	86/53	49/36	31	22	16/36	39	35	12	13	16	39	73	41	5															
R74	(261/	63	61/43	49	7	22/31	37	61	10	9	6	9	30	6	44															
CH4	(31	71/36	68	34	3/38	26	19	74	74	71	48	10	21	34																
CH3	(311/	19	3	33	70/12	19	8	60	39	38	30	6	2	36																
ELA1	(81	83/49	70/26	2	18	19	18	21	47	52	14	13																		
YV1	(361/	71	62/13	30	9	23	24	21	7	31	11	6																		
MYV1	(161	82/60	83	48	36	38	37	25	31	56	23																			
R45	(231/	16	30	27	15	13	14	27	3	15	17																			

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1	28	33	34
PV17	22	28	33	34
ND7	18	35	33	34
R73	27	18	33	34
TV17	35	1	33	34
CLA1	11	20	33	34
QVSB	11	20	33	34
ND6	17	34	33	34
TV16	34	11	33	34
LA1	12	11	33	34
R63	23	1	33	34
DLA1	20	1	33	34
CRADB	9	30	33	34
PV16	21	9	33	34
QV1	10	30	33	34
MOV1	13	10	33	34
SCV1	30	1	33	34
R64	24	2	33	34
R74	26	1	33	34
CH4	31	3	33	34
CH3	31	3	33	34
ELA1	8	3	33	34
YV1	36	3	33	34
MYV1	16	3	33	34
R45	23	3	33	34
CH6	4	3	33	34
SYV1	33	4	33	34
CH7	33	4	33	34
MSB1	15	31	33	34
SDB1	32	15	33	34
SBI	29	15	33	34
SNSI	31	14	33	34
MNSI	14	28	33	34
NS1	19	14	33	34
R76	28	1	33	34

OF POOR QUALITY

Yolo County - May 11, 1978 - Field

THESE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

VARIABLE NAME	NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
AVI	1																													
PV17	2	99/98																												
ND7	3	99/97	96/96																											
TV17	4	99/97	96/95	95/95																										
R75	5	99/97	96/95	95/94	93/93																									
CLAI	6	99/98	98/98	97/97	92/91	96/94																								
LAI	12	99/99	99/98	97/97	92/91	97/95	93/93																							
GVSB	11	99/99	98/96	89/91	98/96	96/91	86/83	78/78																						
ND6	17	99/99	98/91	91/97	94/93	93/75	79/67	80/84	82/66																					
TV16	34	98/98	98/91	91/97	94/93	93/75	78/67	81/84	83/66	85/55																				
R65	23	98/98	98/91	96/93	94/76	79/67	79/84	81/64	83/53	51/51	48/4																			
OLA1	20	87/87	87/92	88/89	64/71	65/87	92/46	61/86	57/56	36/57	11/15	0/4																		
GRAB5	9	98/95	95/74	73/68	89/78	73/33	58/17	17/17	31/33	21/25	29/17																			
PV16	21	96/96	97/81	71/89	74/67	24/38	38/18	17/17	14/32	49/31	38/38																			
QVI	10	99/99	85/84	74/71	72/19	59/73	39/38	37/34	11/39	33/24	19/30																			
MOV1	13	99/88	86/76	65/65	12/35	67/32	30/30	25/19	47/39	28/18	29/28																			
BOVI	30	100/88	84/77	66/66	12/56	68/33	32/31	26/18	42/40	33/24	24/24																			
R64	24	87/58	29/29	32/32	59/48	20/20	18/5	25/42	72/34	25/12																				
R74	26	36/30	44/20	76/68	47/47	45/37	7/37	33/8	20/58																					
BYVI	33	68/31	34/6	22/20	22/22	20/64	61/19	50/58	24/24																					
MYVI	16	94/80	28/70	43/41	42/30	7/2	32/2	32/13																						
R45	23	74/47	83/62	61/62	69/29	3/38	22/6	40/40																						
YVI	36	12/36	24/23	25/42	17/12	76/41	10/11																							
CH4	2	86/88	88/87	77/62	30/27	8/22	59/59																							
CH5	3	90/89	89/87	57/24	5/20	10/38																								
MSDI	13	99/99	97/86	56/16	40/30	64/64																								
SSBI	32	99/97	86/56	16/40	31/64																									
SB1	29	97/87	57/18	41/30	64/64																									
SNS1	31	87/54	35/55	37/68																										
CH6	4	77/38	63/50	59/59																										
CH7	5	39/20	2/4																											
ELA1	8	62/16	11/11																											
MNS1	14	84/75																												
NSI	19	84/84																												
R76	28																													

VARIABLE NAME	NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1		1	99
PV17	2	28	2	99
ND7	3	27	3	99
TV17	4	18	4	99
R75	5	15	5	99
CLAI	6	27	6	97
LAI	12	20	12	97
GVSB	11	26	11	97
ND6	17	23	17	97
TV16	34	17	34	97
R65	23	26	23	97
OLA1	20	6	20	97
GRAB5	9	9	9	96
PV16	21	30	21	96
QVI	10	30	10	96
MOV1	13	13	13	96
BOVI	30	30	30	96
R64	24	1	24	96
R74	26	26	26	96
BYVI	33	33	33	96
MYVI	16	16	16	96
R45	23	23	23	96
YVI	36	36	36	96
CH4	2	2	2	96
CH5	3	3	3	96
MSDI	13	13	13	96
SSBI	32	32	32	96
SB1	29	29	29	96
SNS1	31	31	31	96
CH6	4	4	4	96
CH7	5	5	5	96
ELA1	8	8	8	96
MNS1	14	14	14	96
NSI	19	19	19	96
R76	28	28	28	96

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Yolo County - May 12, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AVI	1	28	1	27 96
PV17	22	18	1	99 00
ND7	18	27	1	99 72
TV17	33	18	1	98 00
R75	27	30	1	96 25
CLAI	61	30	1	98 60
DLAI	20	26	1	98 93
QVSB	11	30	1	99 80
LAI	12	34	1	99 96
ND6	17	34	1	99 35
TV16	34	11	1	98 23
R65	25	30	1	99 63
QVI	10	30	1	99 19
MOV1	13	30	1	98 23
SOVI	30	21	1	91 22
GRAB8	9	21	1	90 48
PV16	21	26	1	82 98
R64	24	23	1	84 43
R74	26	23	1	77 20
MYVI	16	23	1	65 86
R45	23	23	1	77 20
SVVI	33	1	1	90 61
CH4	2	31	1	96 89
CH5	3	31	1	99 97
MNSI	15	31	1	99 97
SSDI	32	31	1	87 17
SBI	29	31	1	91 22
SNSI	31	31	1	91 22
CH6	4	31	1	90 61
CH7	5	31	1	96 89
ELAI	8	31	1	99 97
YVI	36	31	1	99 97
MNSI	14	31	1	99 97
NSI	19	31	1	99 97
R76	28	31	1	99 97

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Yolo County - May 20, 1978 - Field

TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX
CLUSTERING BY AVERAGE DISTANCE METHOD
VARIABLE

NAME	VARIABLE NO	OTHER BOUNDARY OF CLUSTER	NUMBER OF ITEMS IN CLUSTER	DISTANCE OR SIMILARITY WHEN CLUSTER FORMED
AV1	1		1	
TV17	2		2	
PV17	3		3	
ND7	4		4	
R75	5		5	
CLA1	6		6	
LA1	7		7	
ND6	8		8	
TV16	9		9	
R65	10		10	
OLA1	11		11	
GV1	12		12	
QVBB	13		13	
MGV1	14		14	
SGV1	15		15	
GRABS	16		16	
PV16	17		17	
BYV1	18		18	
CLA1	19		19	
R64	20		20	
R74	21		21	
CH4	22		22	
CH5	23		23	
MSB1	24		24	
SB1	25		25	
MSB1	26		26	
SB1	27		27	
CH6	28		28	
MYV1	29		29	
R45	30		30	
YV1	31		31	
MNS1	32		32	
NS1	33		33	
R76	34		34	
CH7	35		35	

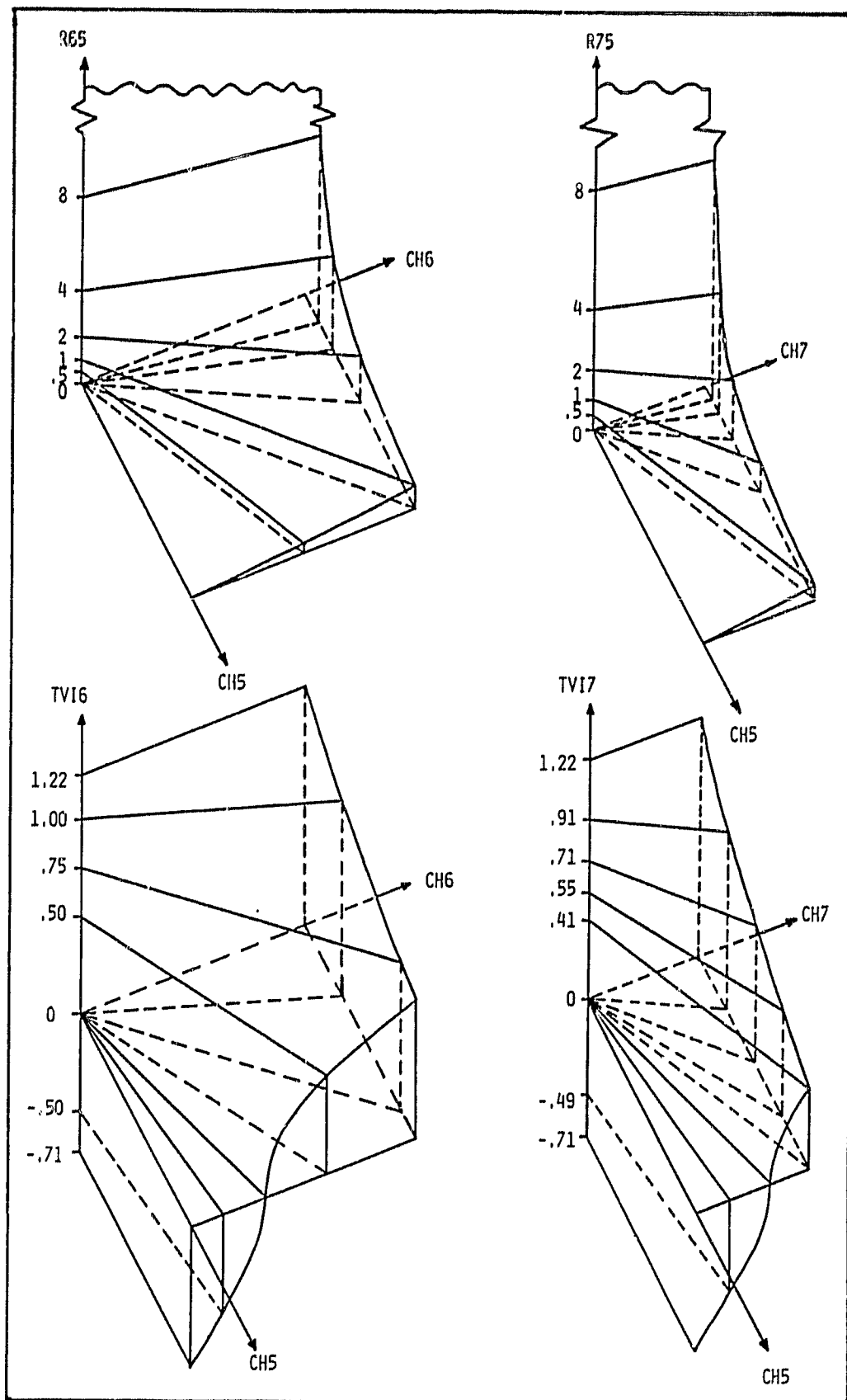
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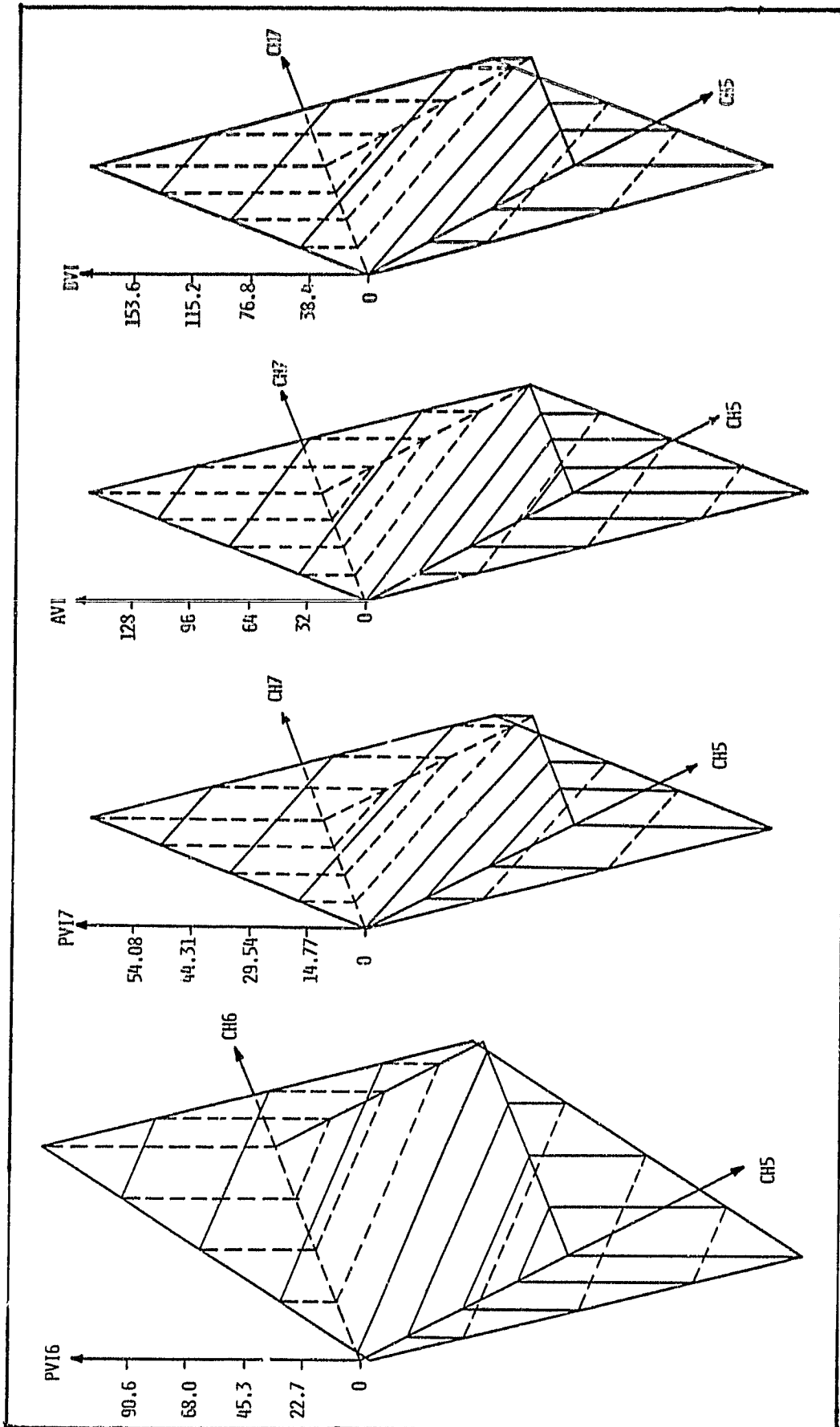
APPENDIX C

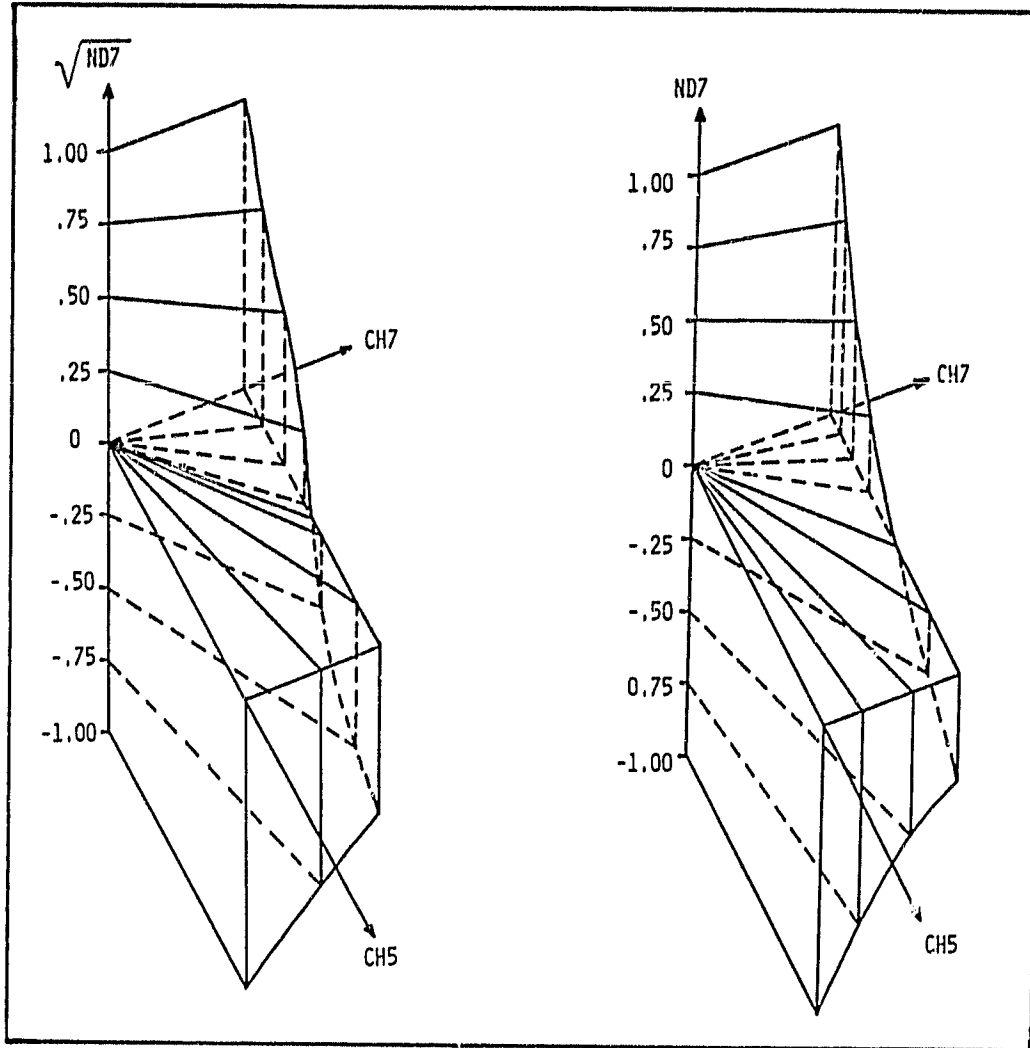
GRAPHICAL REPRESENTATION OF VEGETATION INDICES

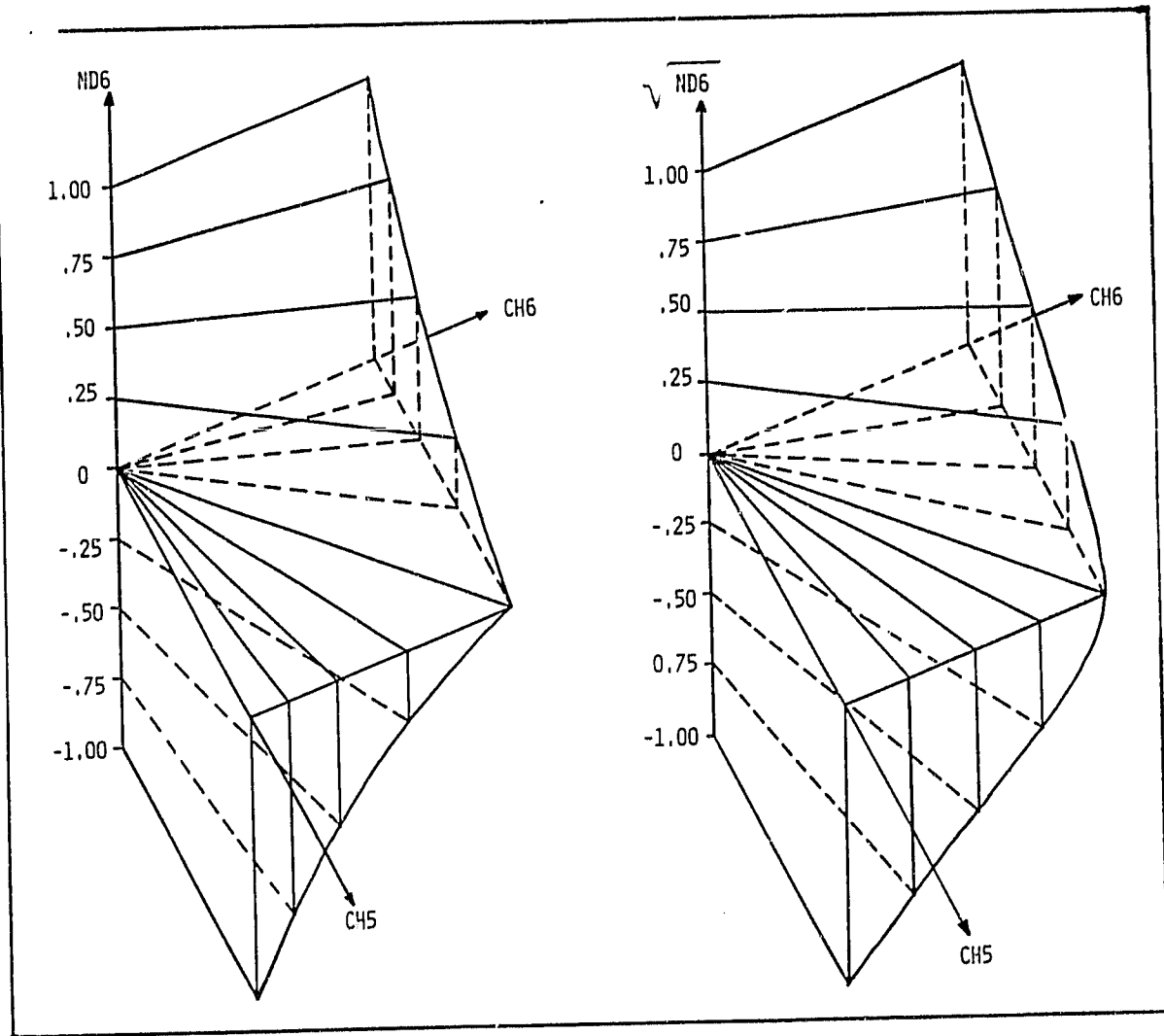
Part 1. Graphical representation of response surfaces and equivalent classes associated with VIs involving two MSS channels.

Graphs for the square root of ND6 and ND7 are included in this appendix. They probably have been studied by other investigators; however, we found no specific reference to them.









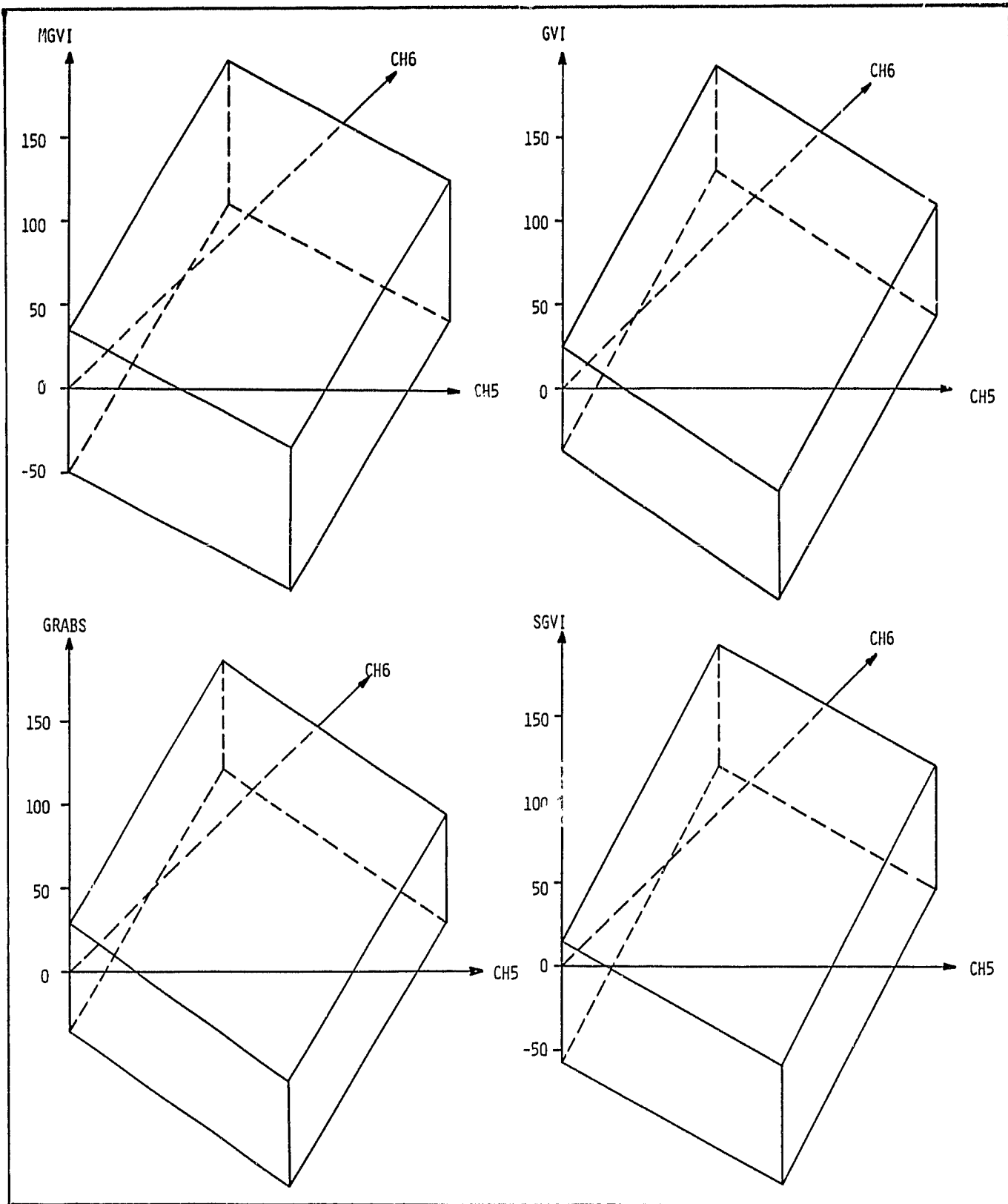
C-2

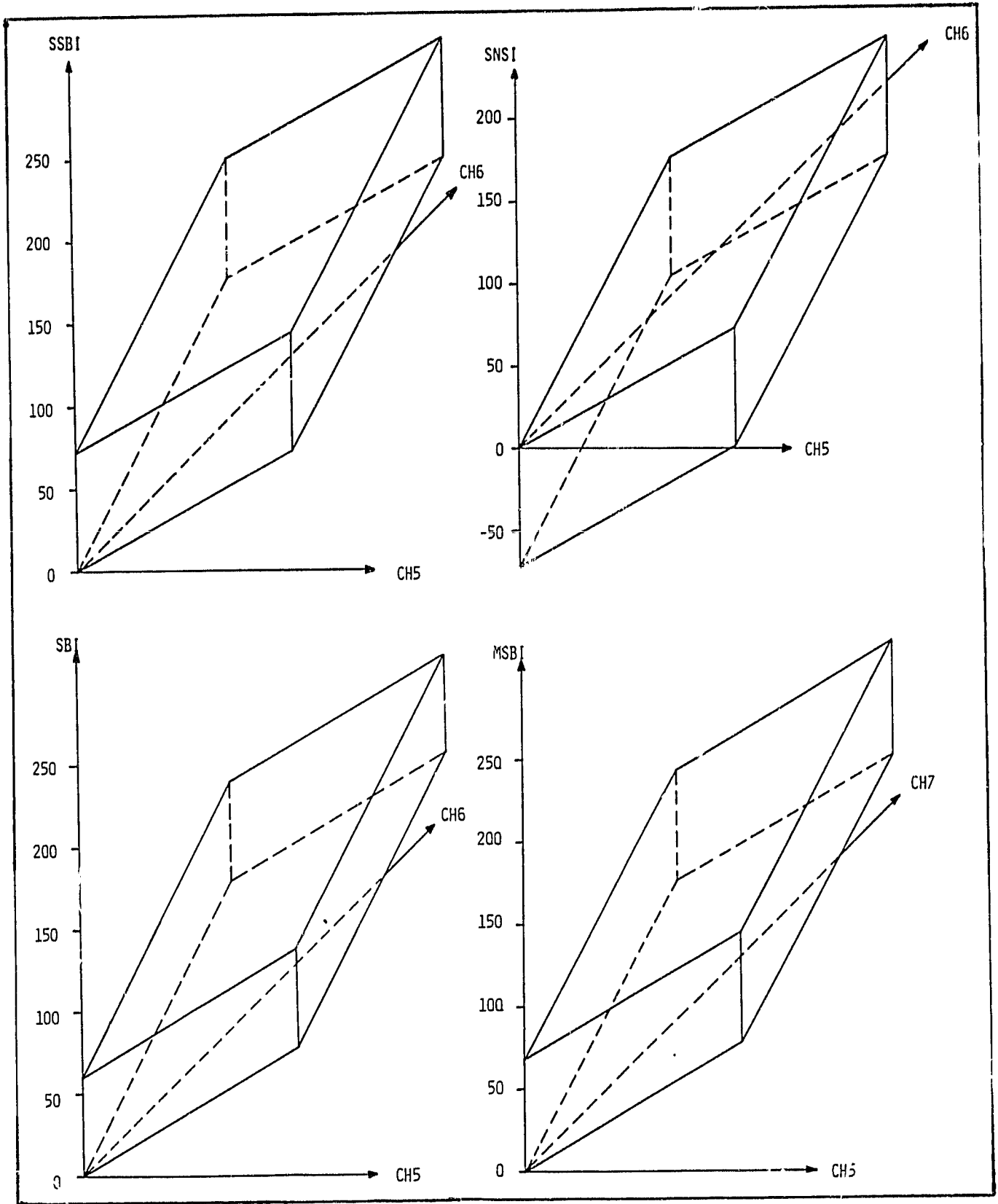
APPENDIX C

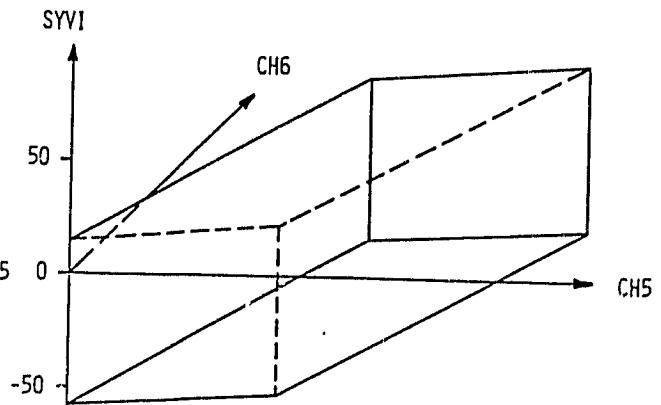
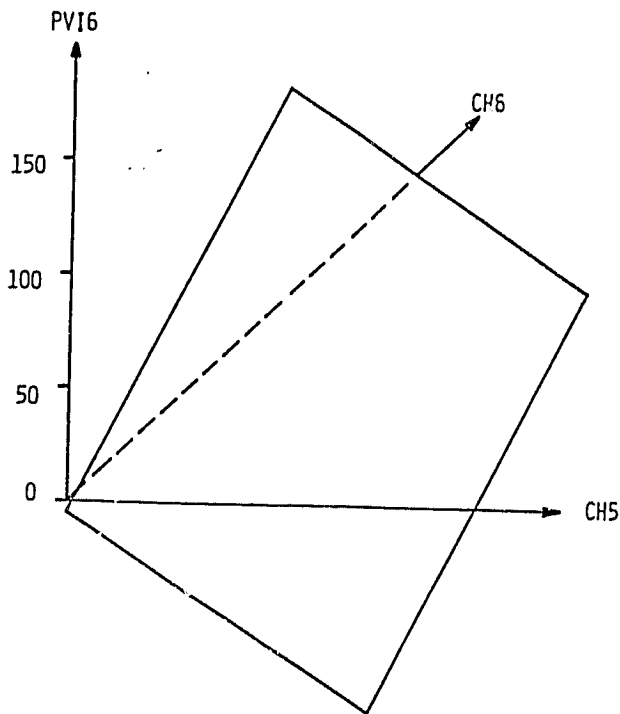
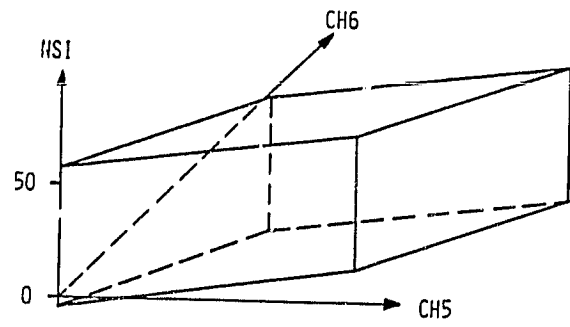
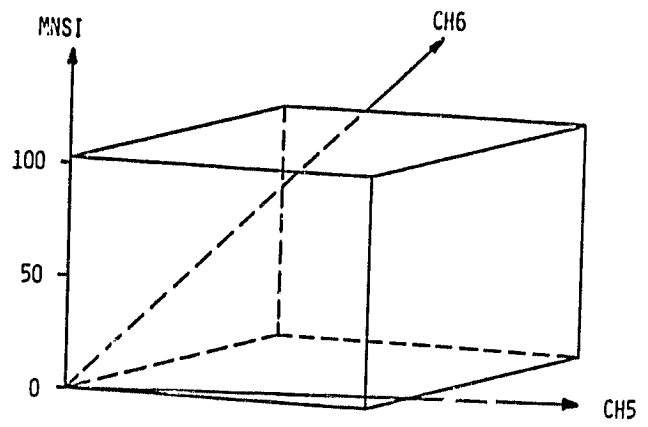
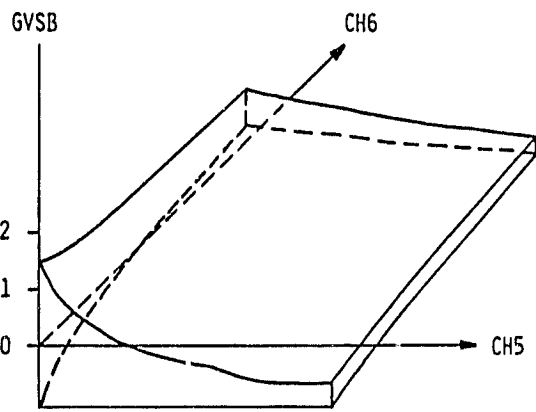
GRAPHICAL REPRESENTATION OF VEGETATION INDICES

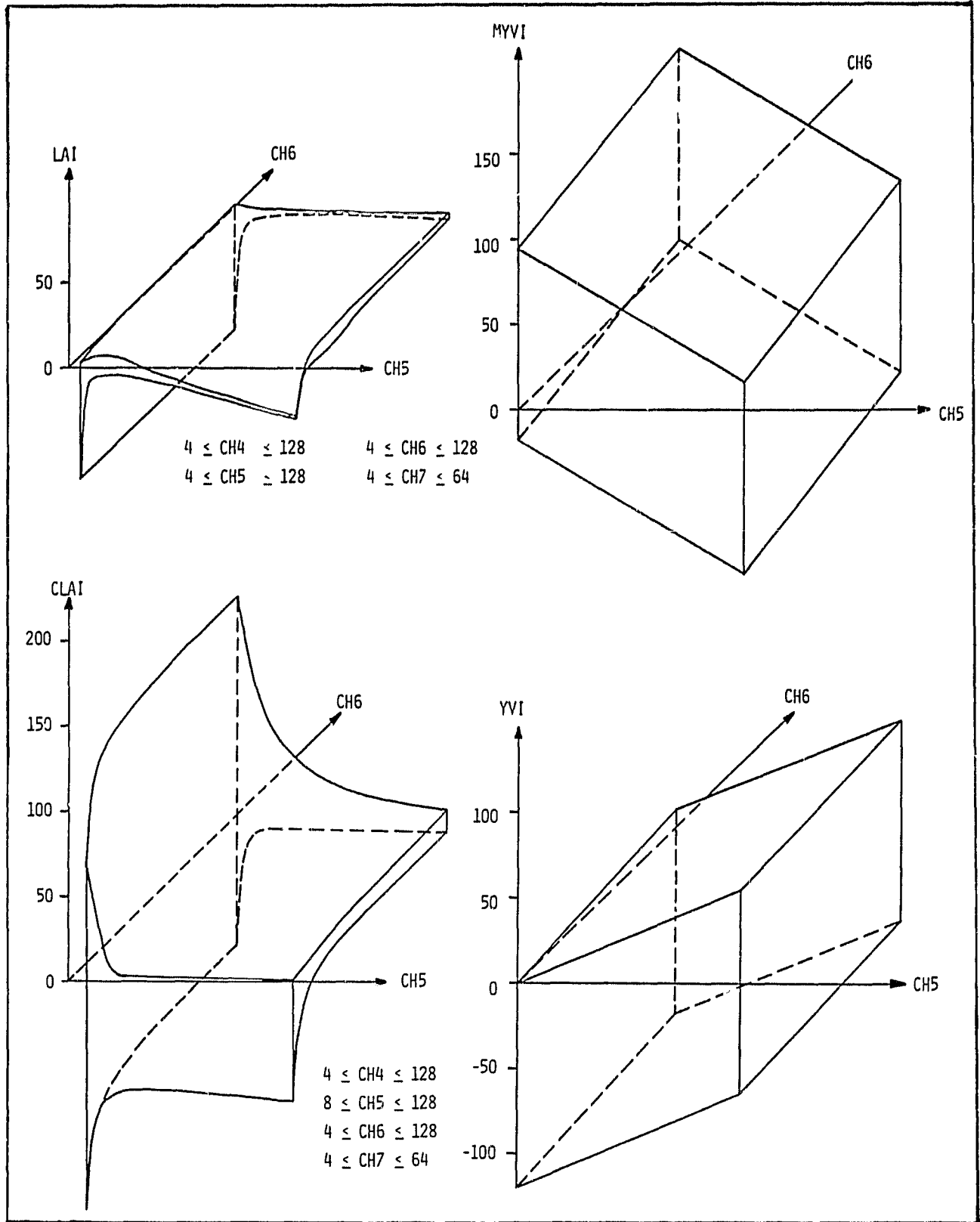
Part 2. Generalized representation of VIs involving more than two MSS channels.

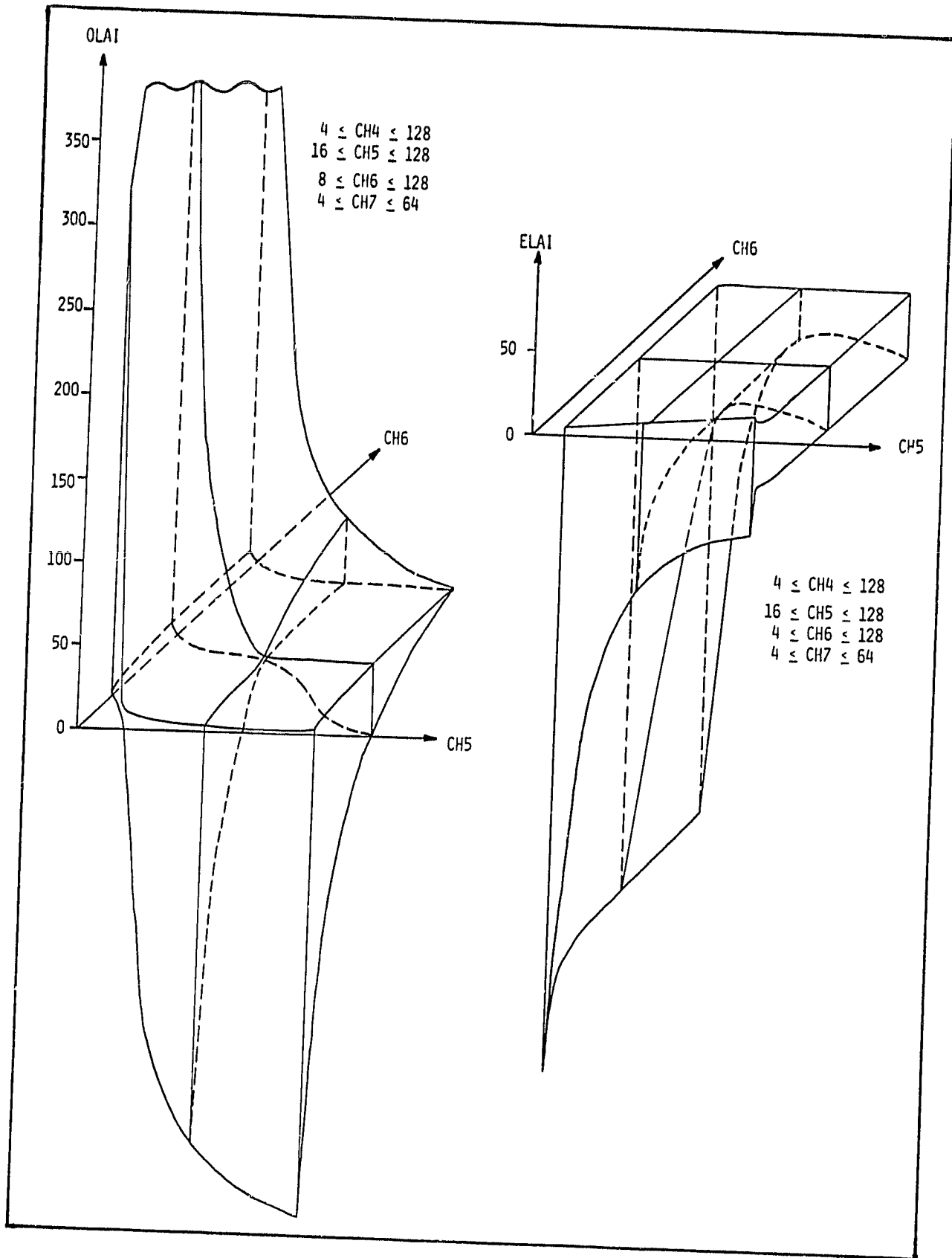
Representation in 3 dimension of vegetative indices involving more than two MSS channels is not possible. However, insight into this behavior is obtained by studying their range as a function of two MSS channels. In these graphs, the VI's range is represented on the vertical axis for fixed two-dimensional subsets of the MSS data. Care should be used in interpreting these graphs, and consideration should be given to the high correlations that are known to exist between (CH4 and CH5) and (CH6 and CH7). Even with these limitations, these graphs show the close relationship between the soil brightness components and greenness components of the Kauth-Thomas and the two Misra-Wheeler transformations.

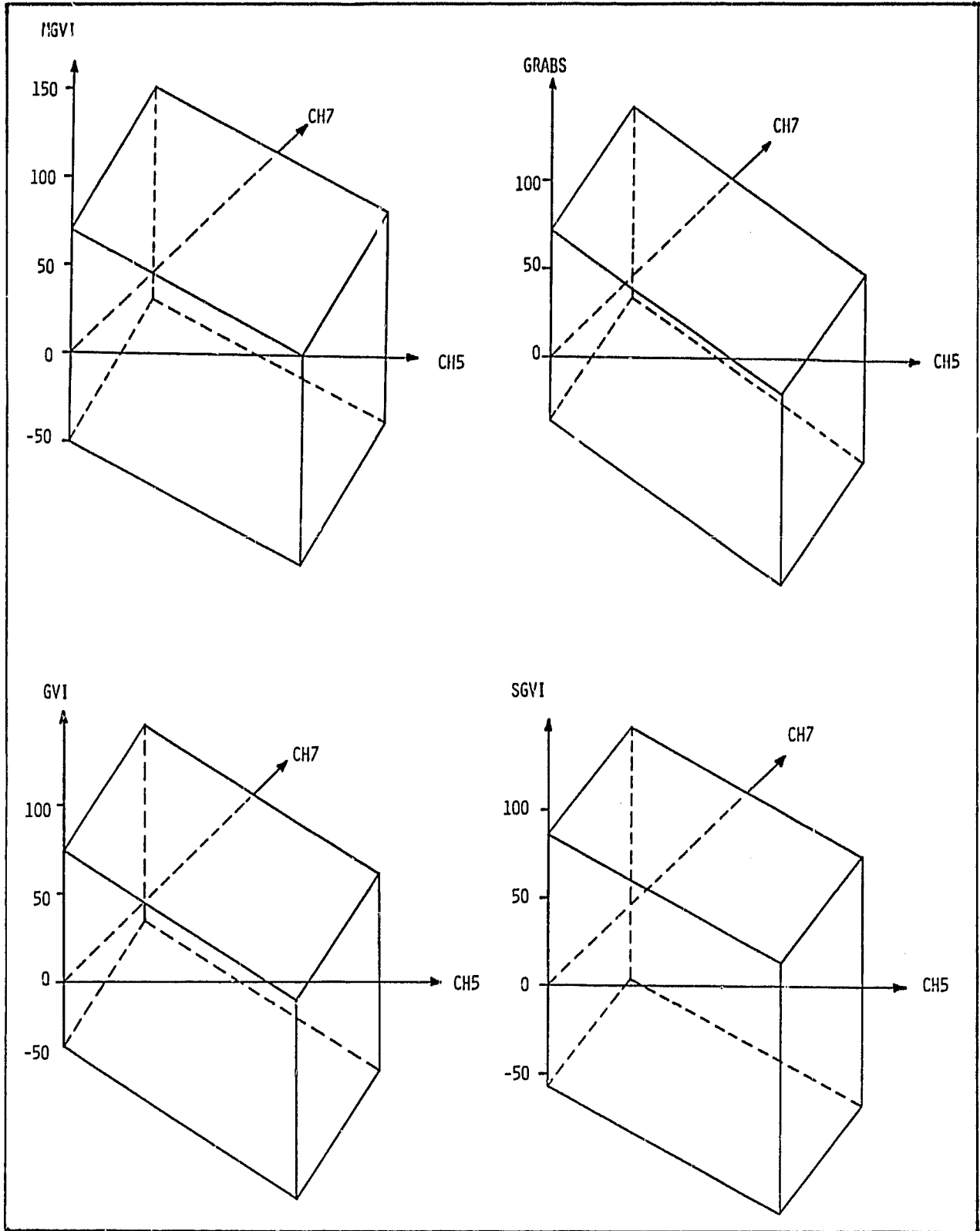


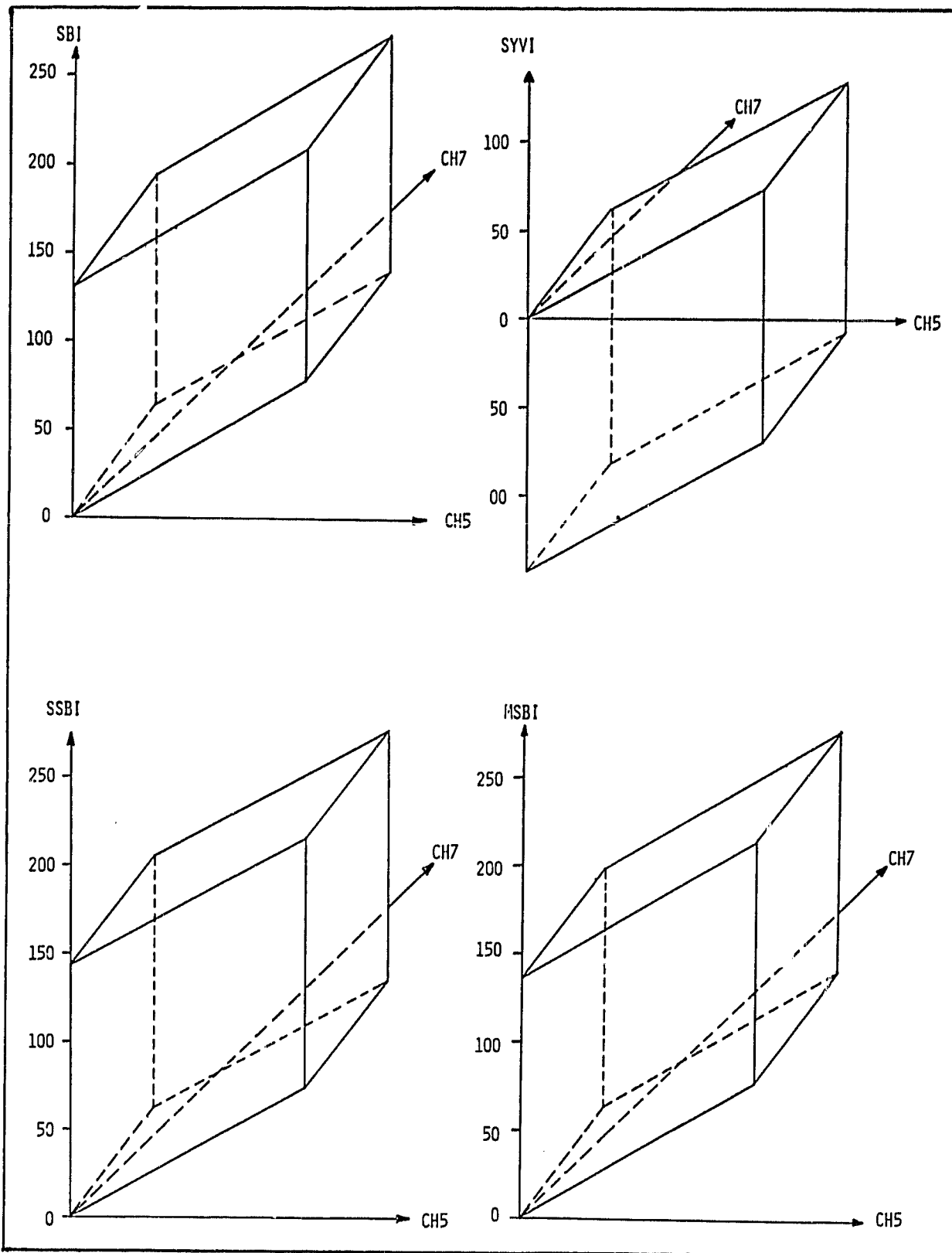


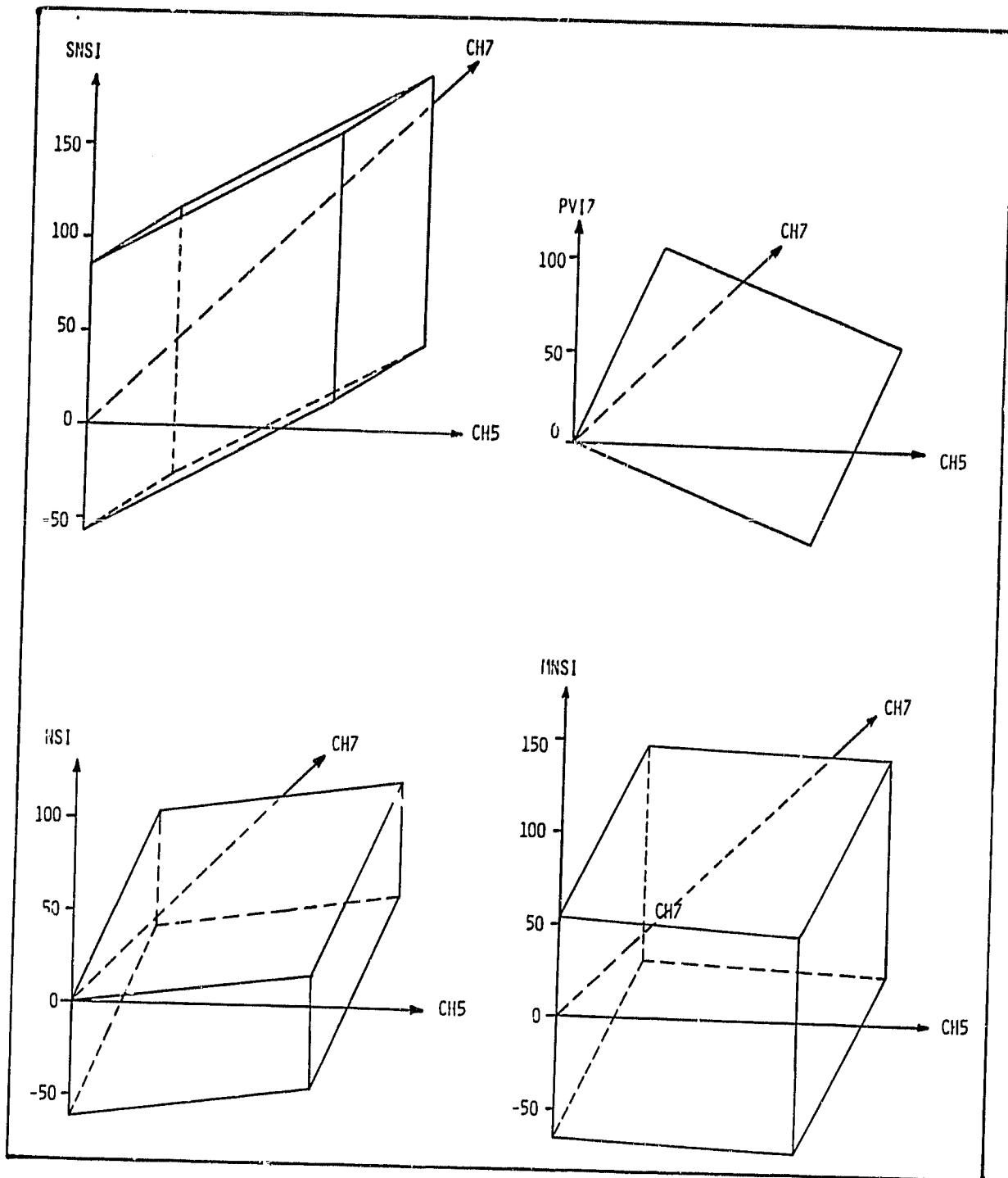


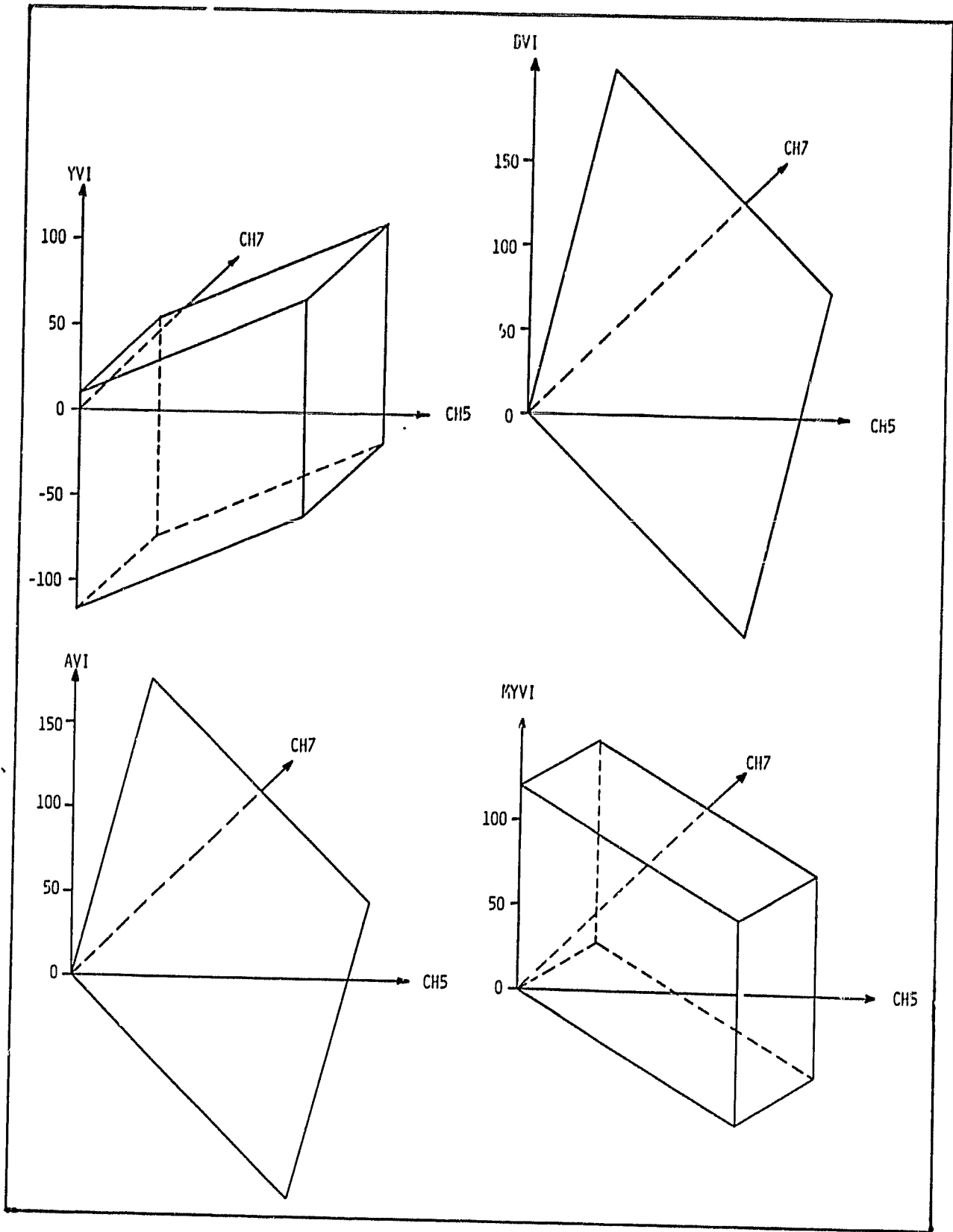












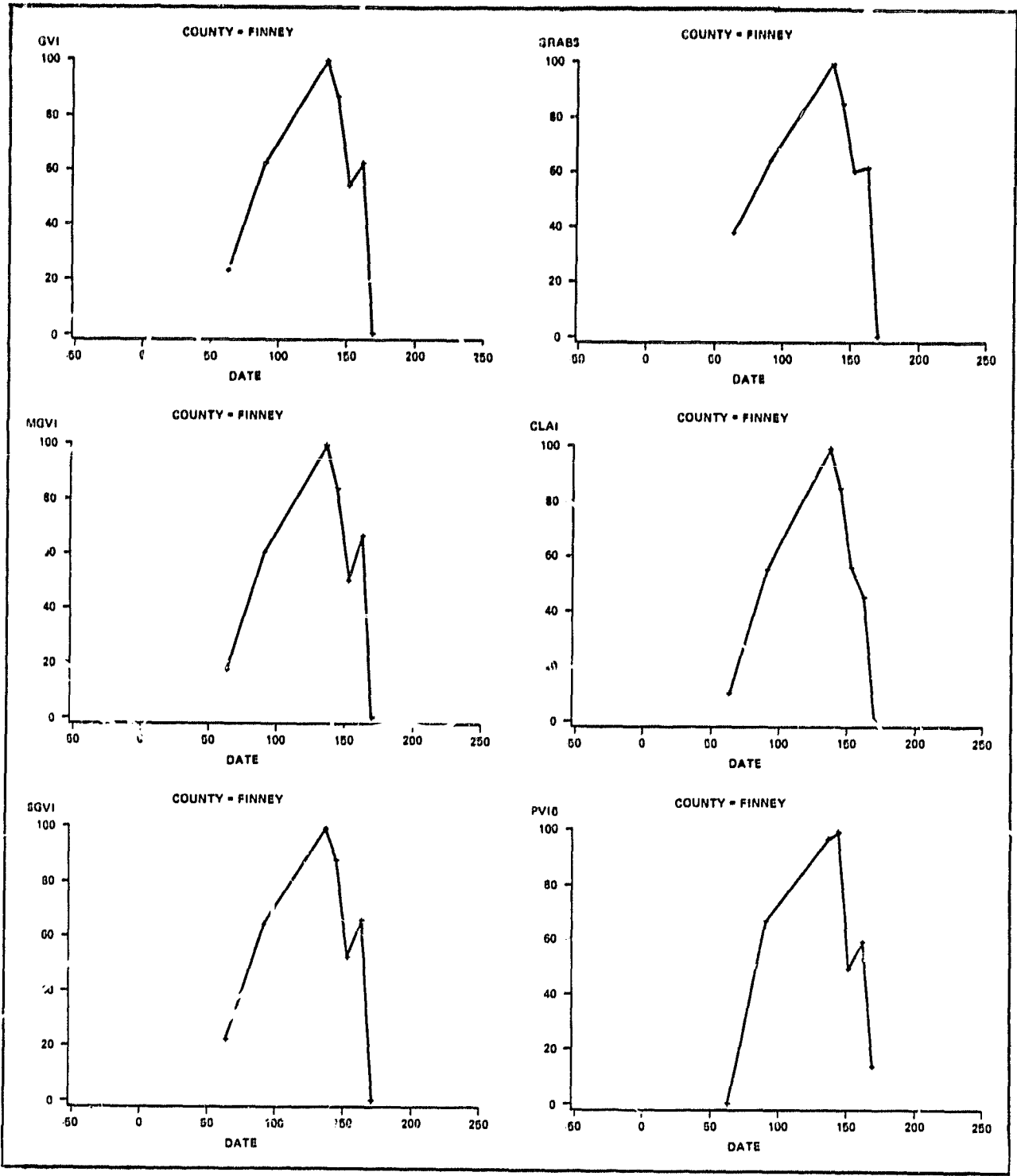
APPENDIX D

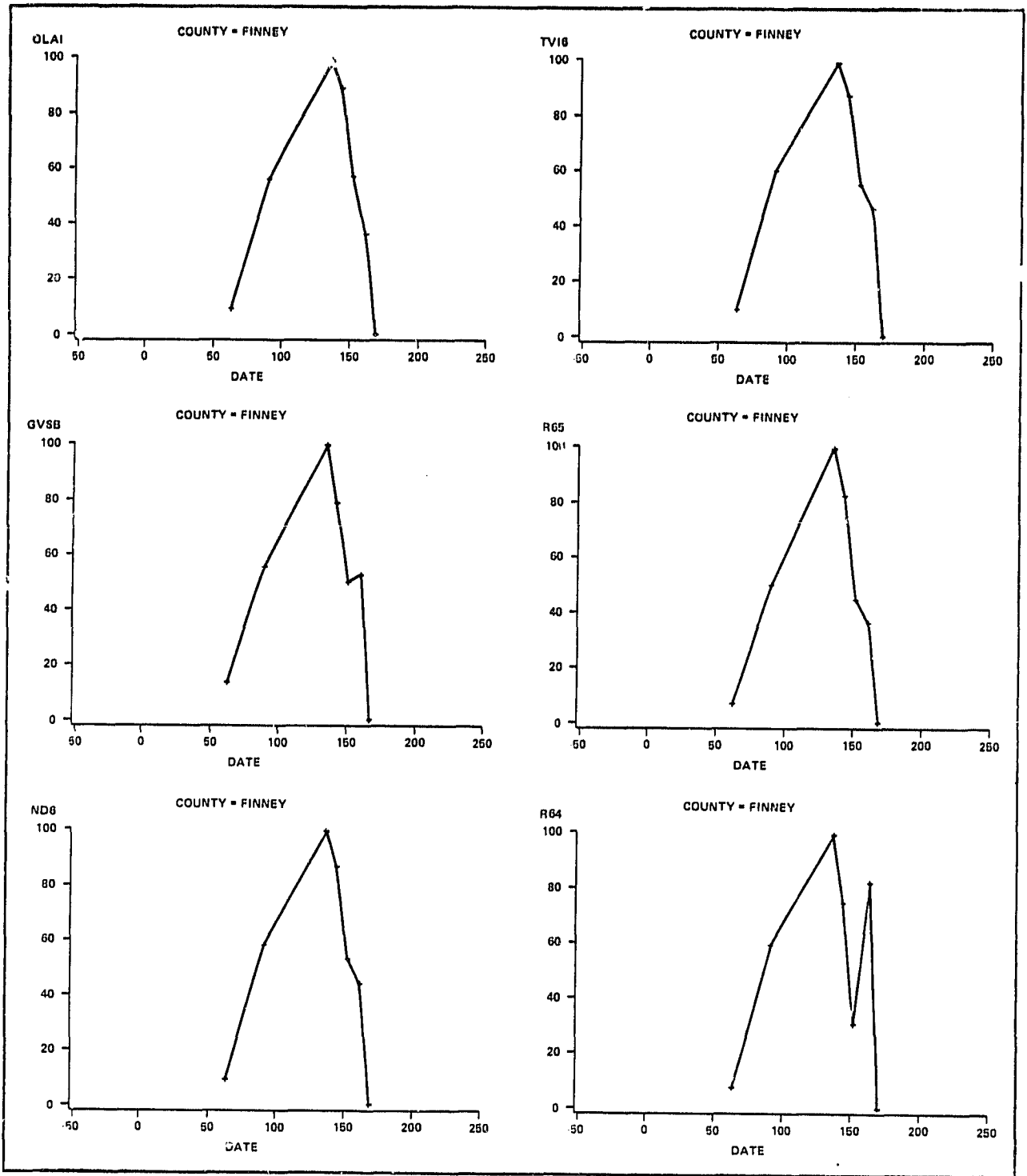
VEGETATION INDICES TRAJECTORIES

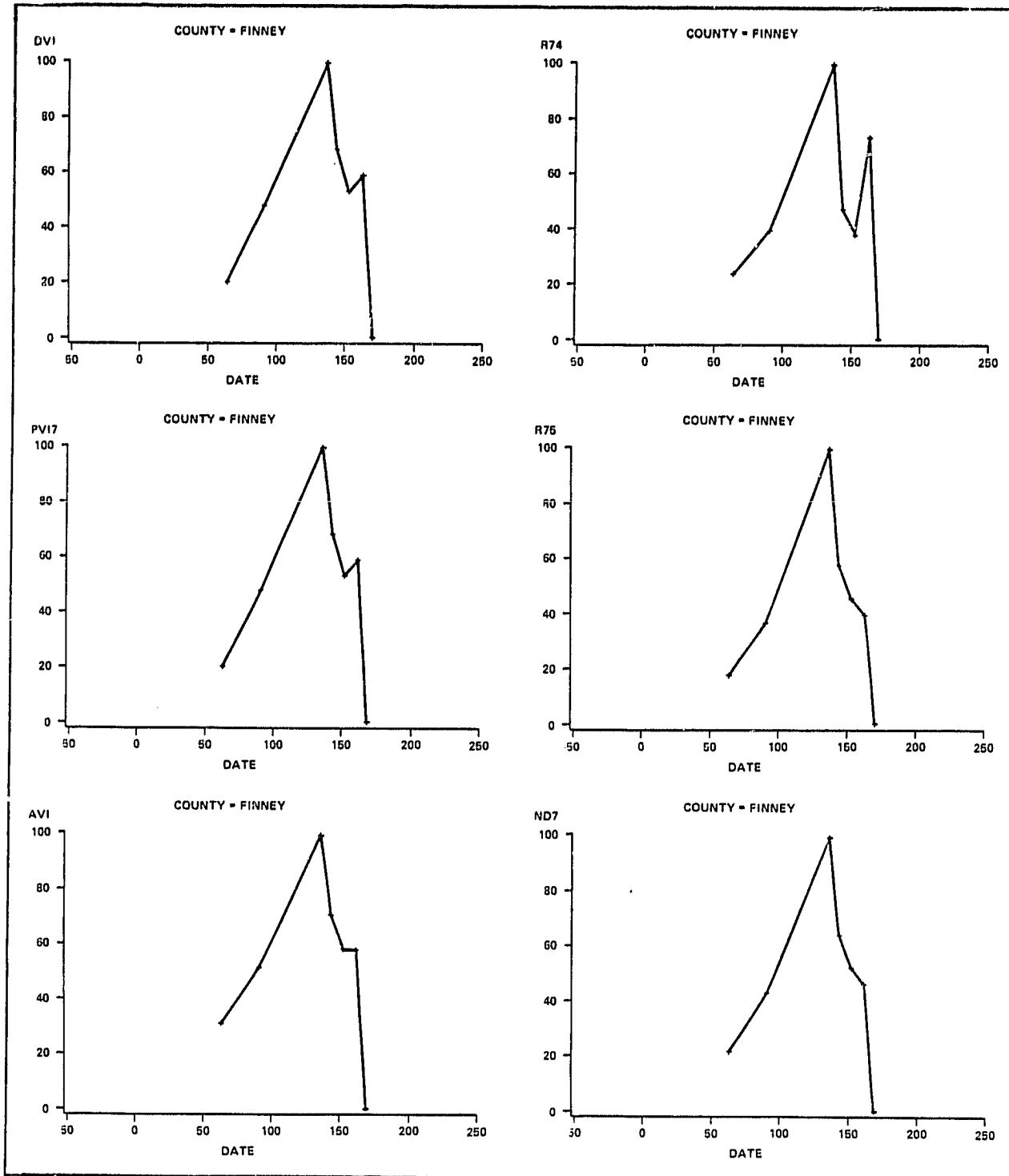
It is well known that two quantities may be functionally related and yet have zero linear correlation. This possibility was studied by graphing VIs over time. All VIs were rescaled to range from 0 to 100 to facilitate interpretations.

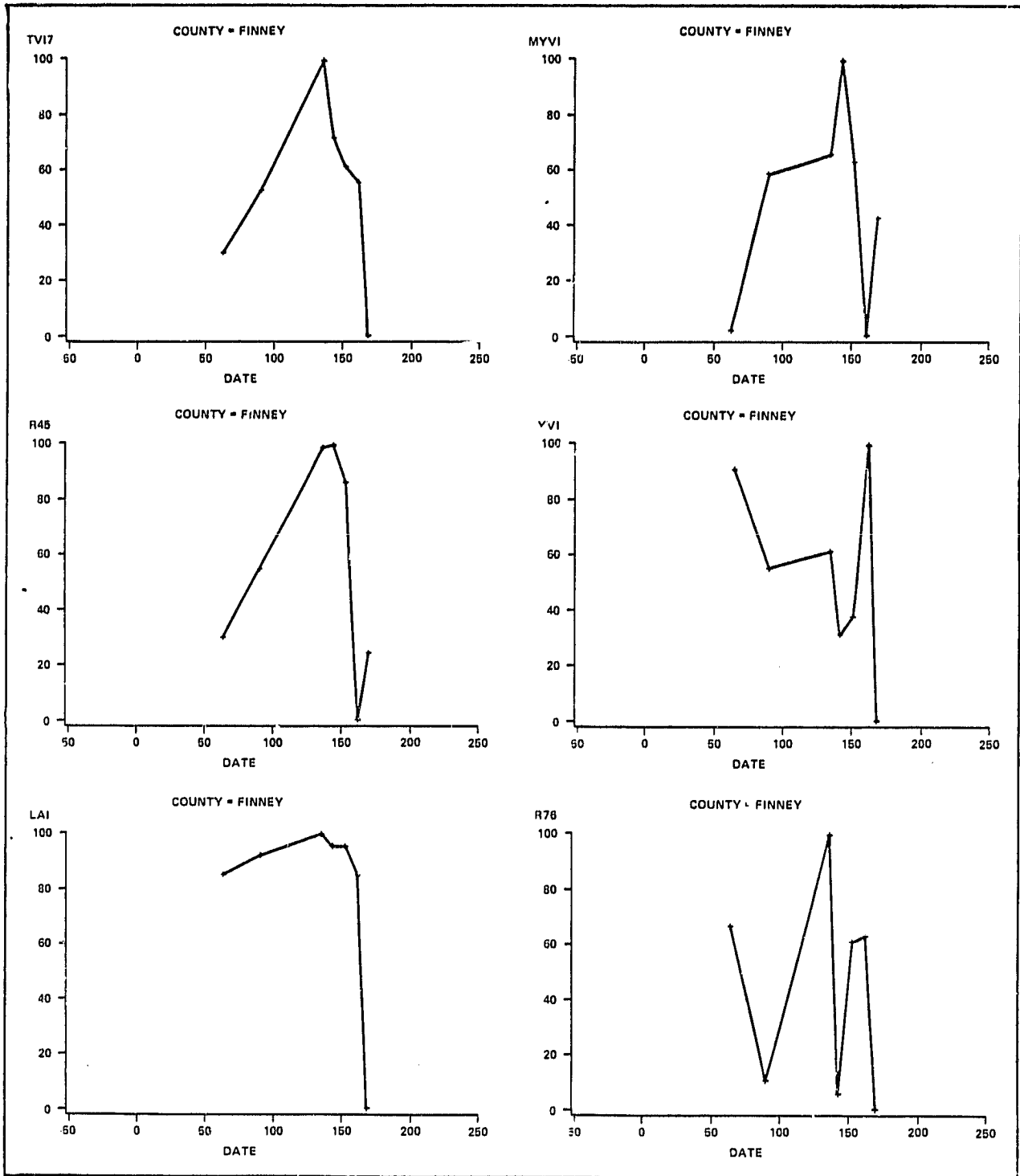
This analysis revealed that some VIs were more closely related than their bivariate correlations had indicated. In some cases, the relationships appear to be close but nonlinear; in others, the correlations break down outside the period of spring greenup to harvest.

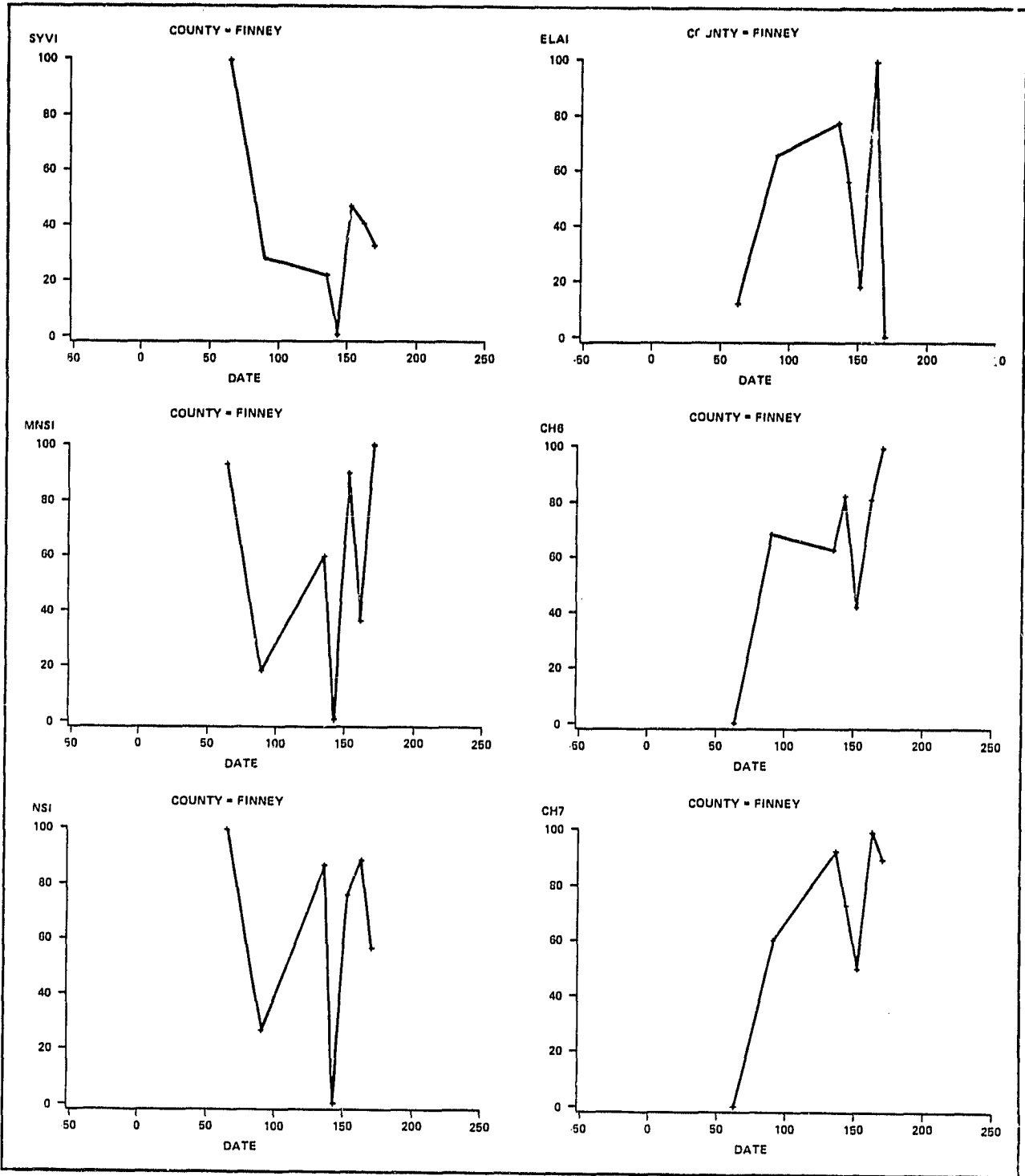
The graphs presented in this appendix are for the four sites with good acquisition histories (Yolo, Finney, Keith, and Grant counties). The trajectories are based on the field data described in Appendix A.

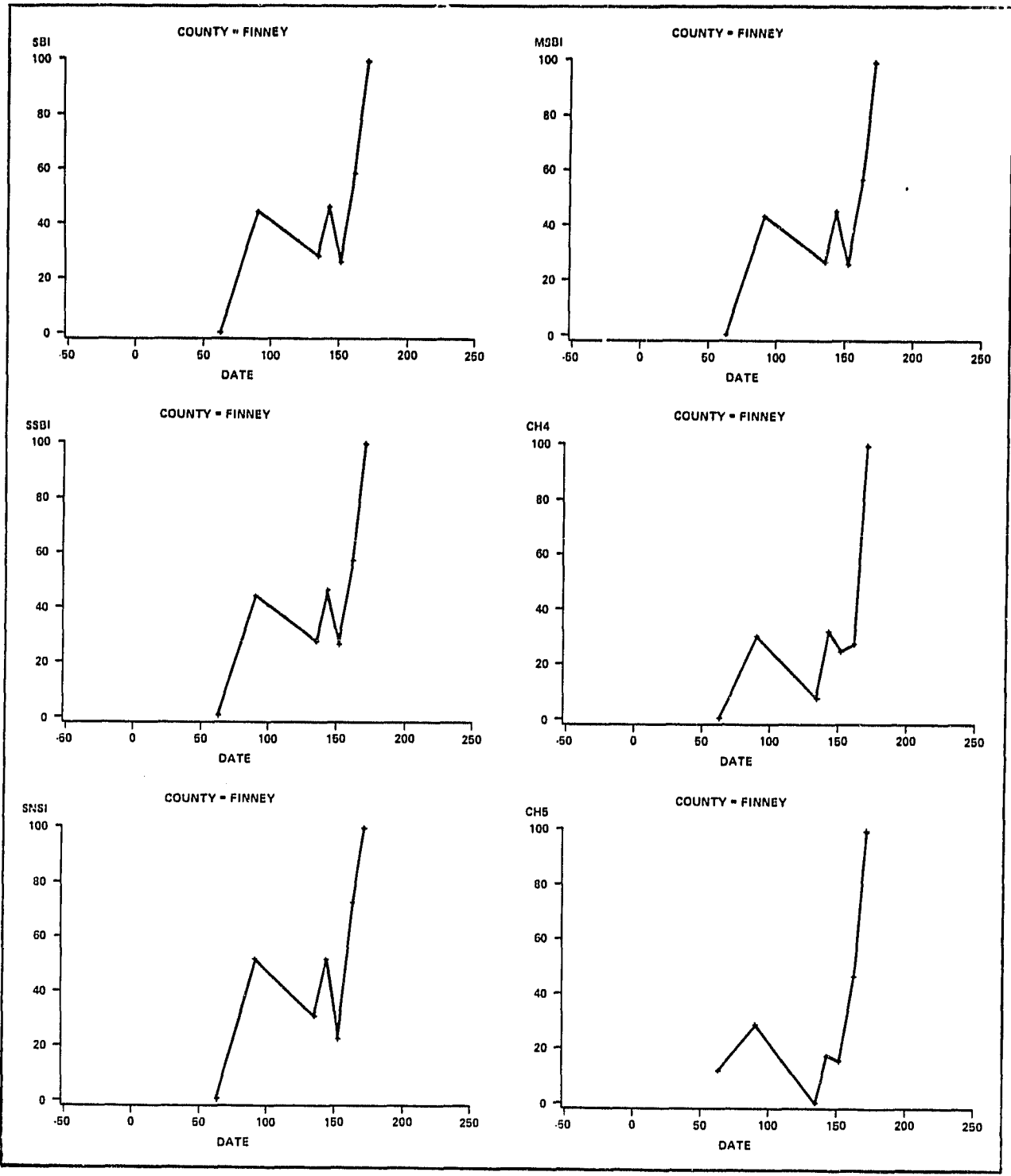


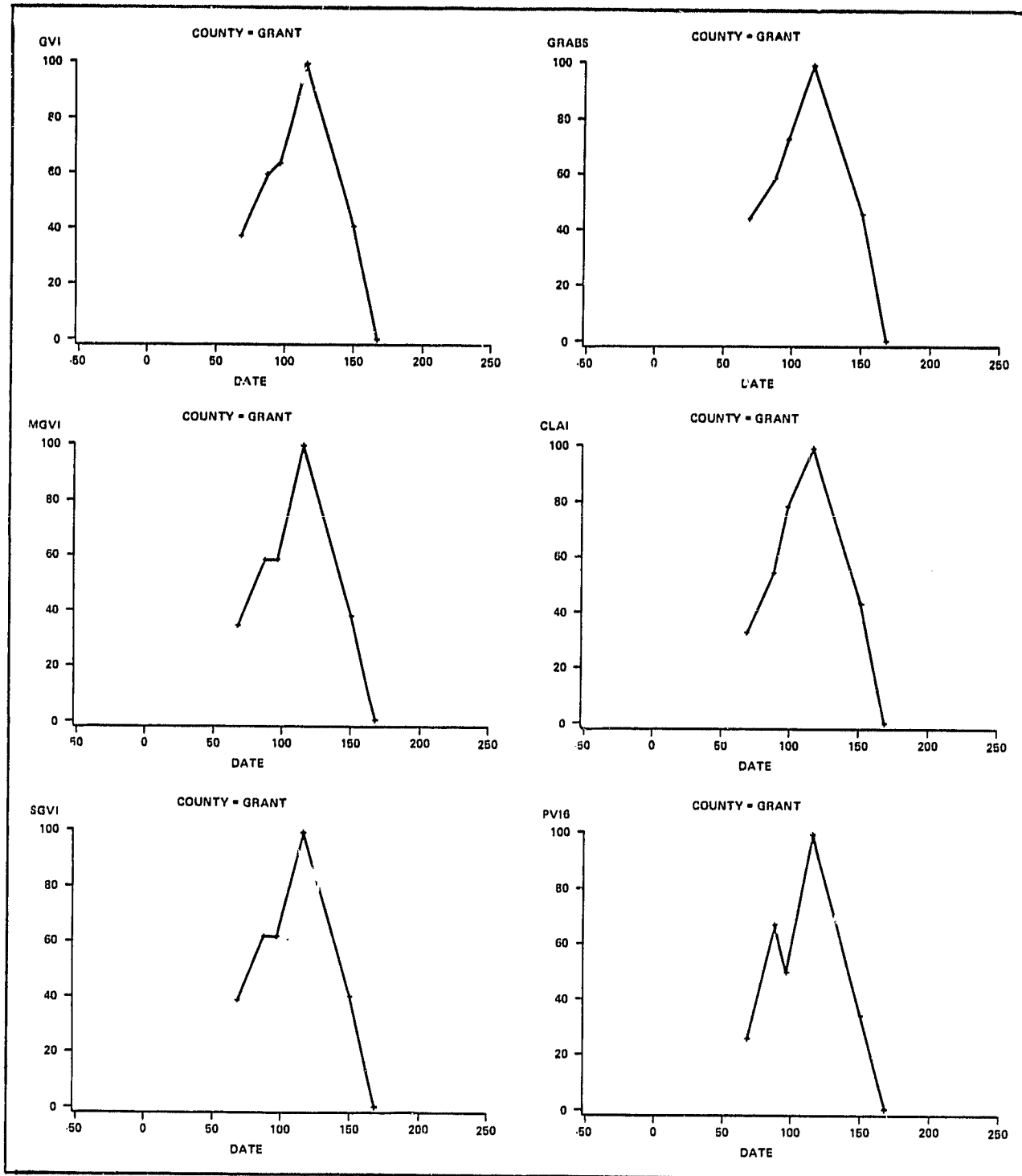


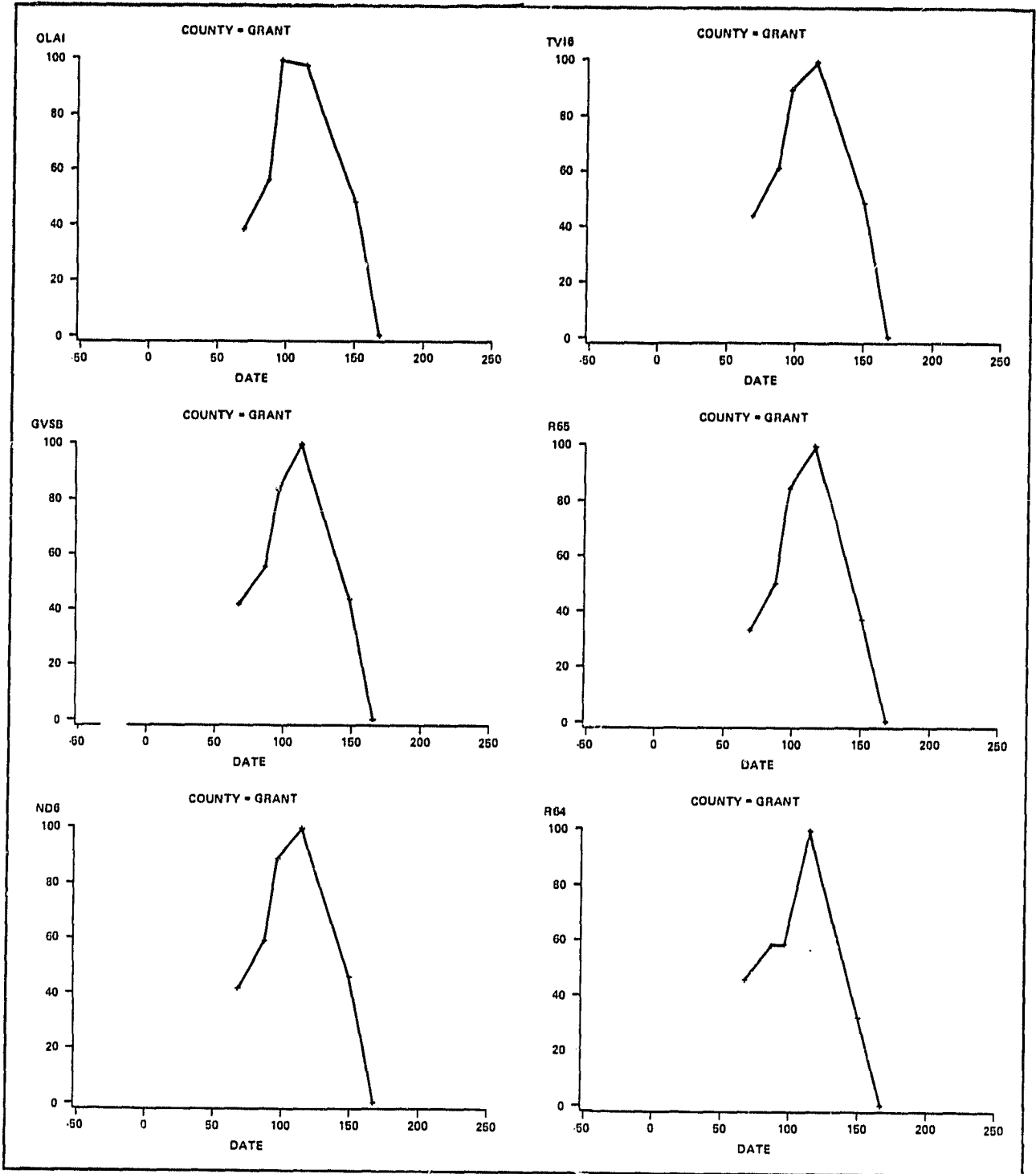


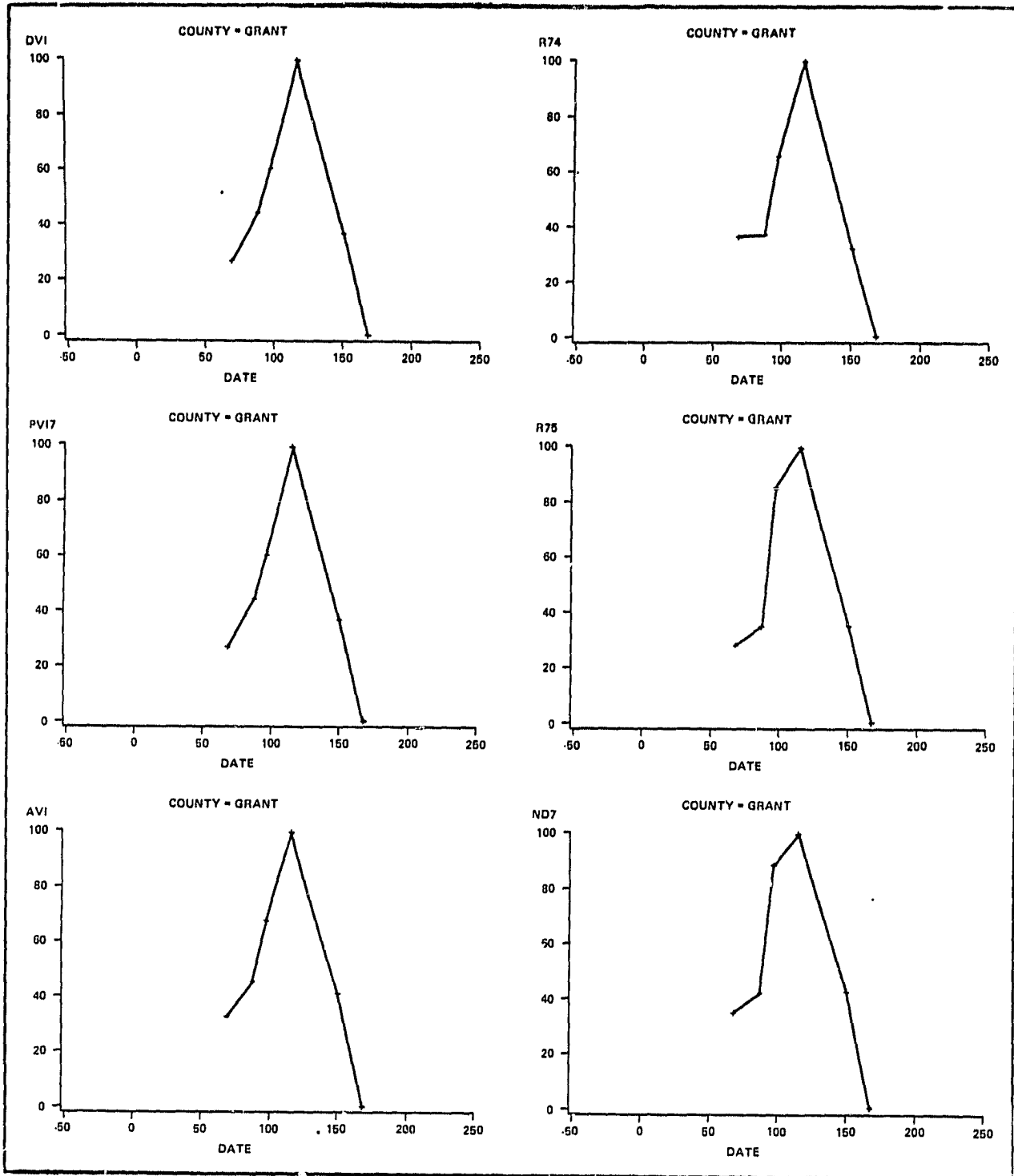


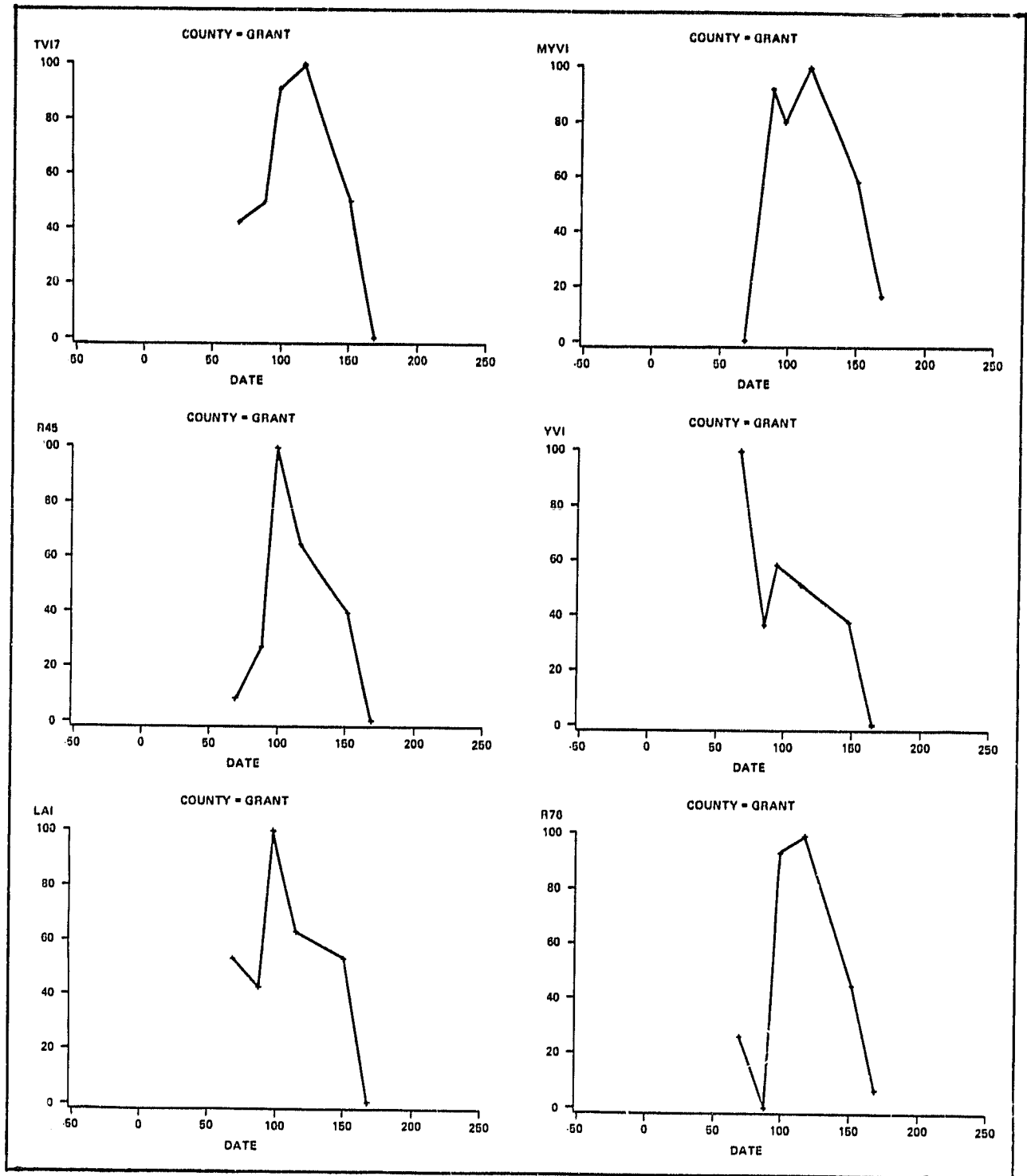


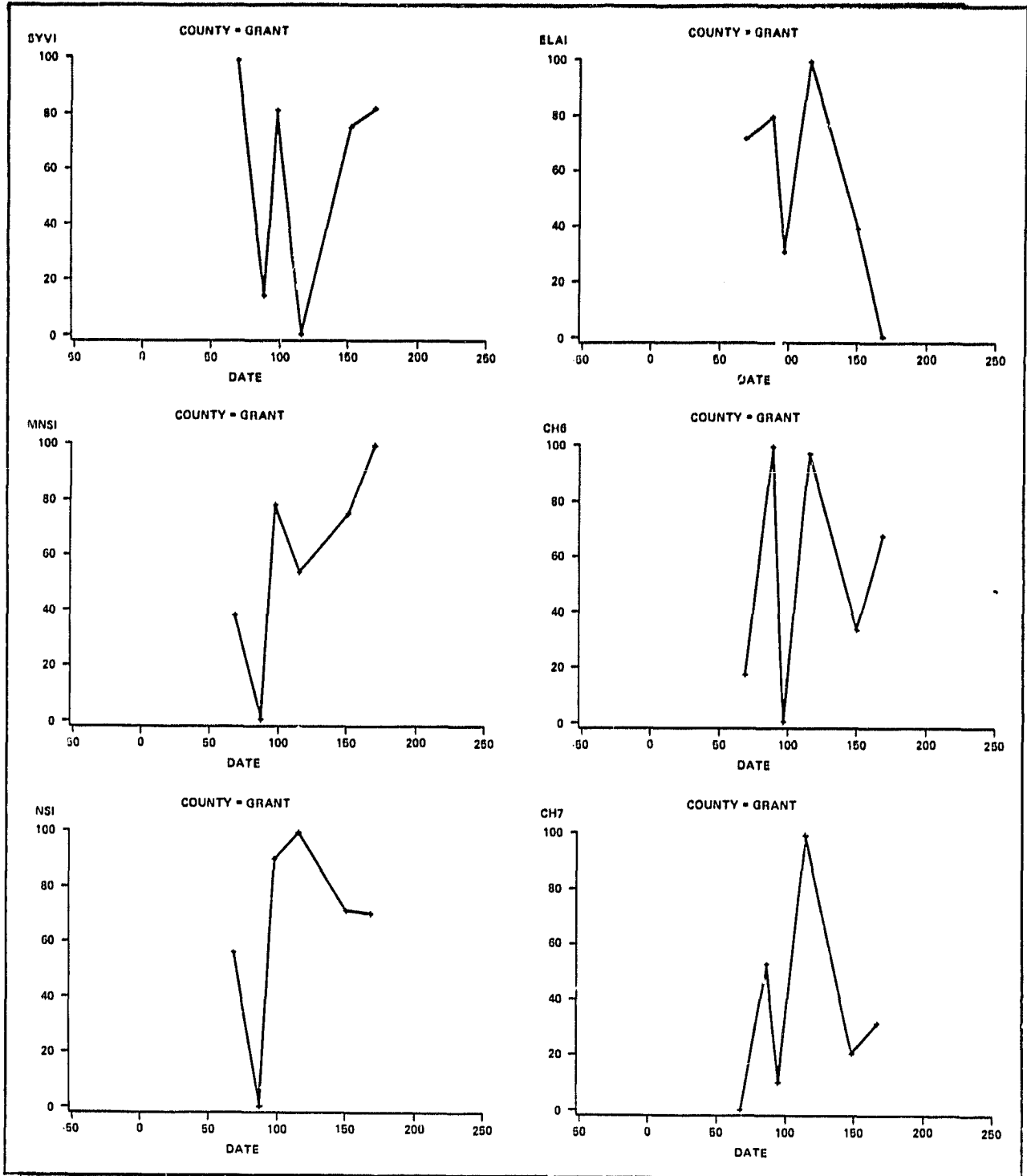


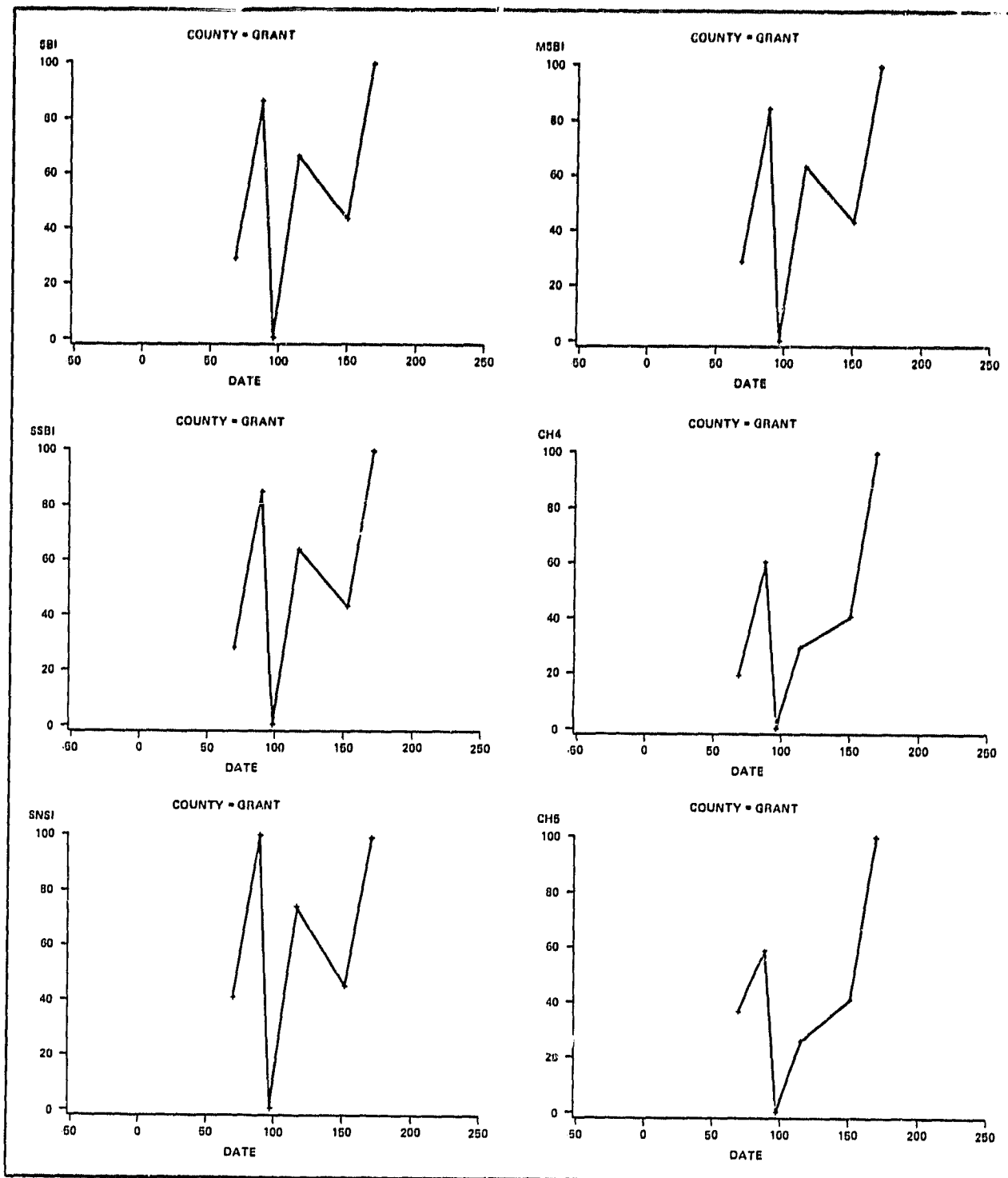


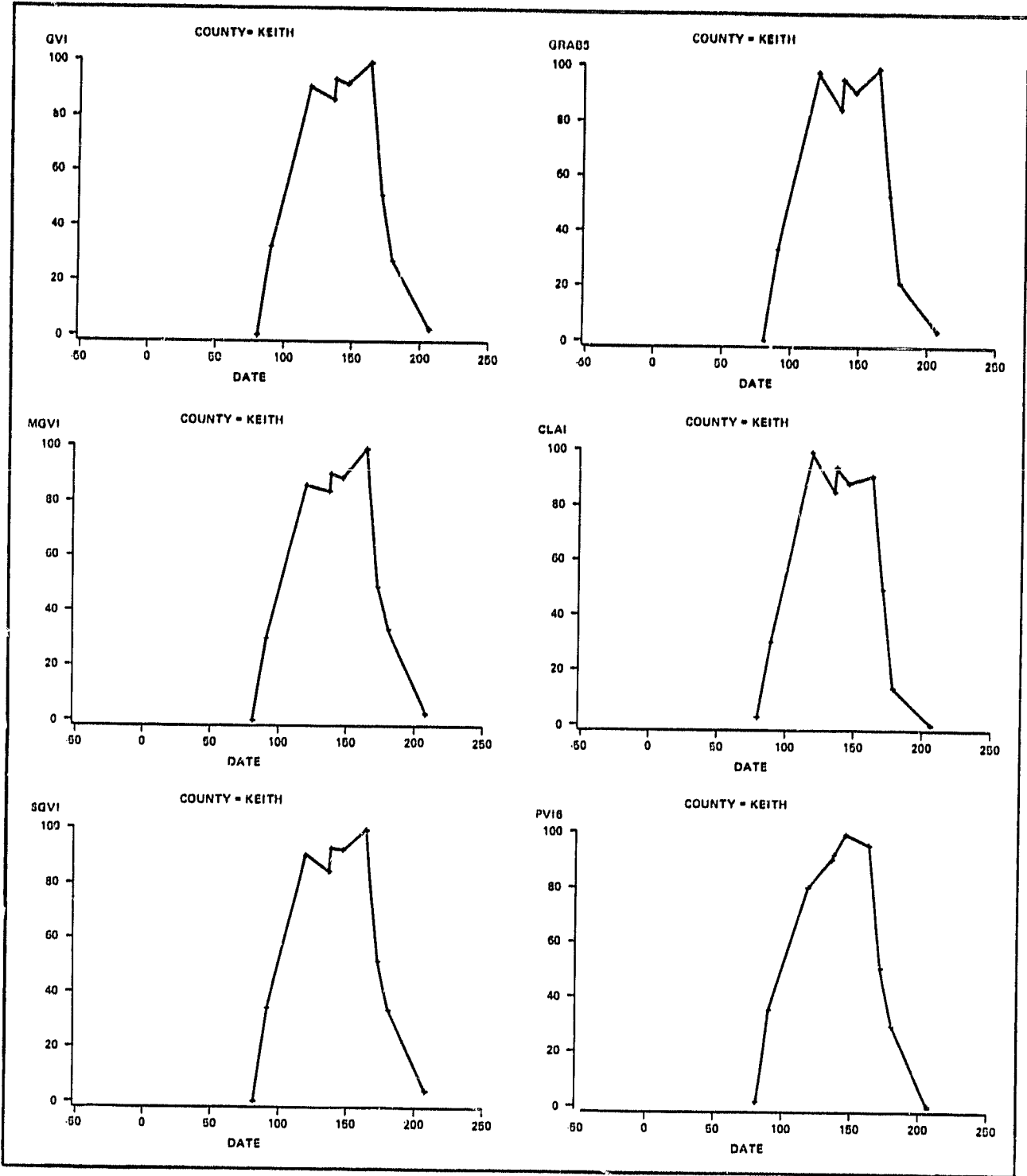


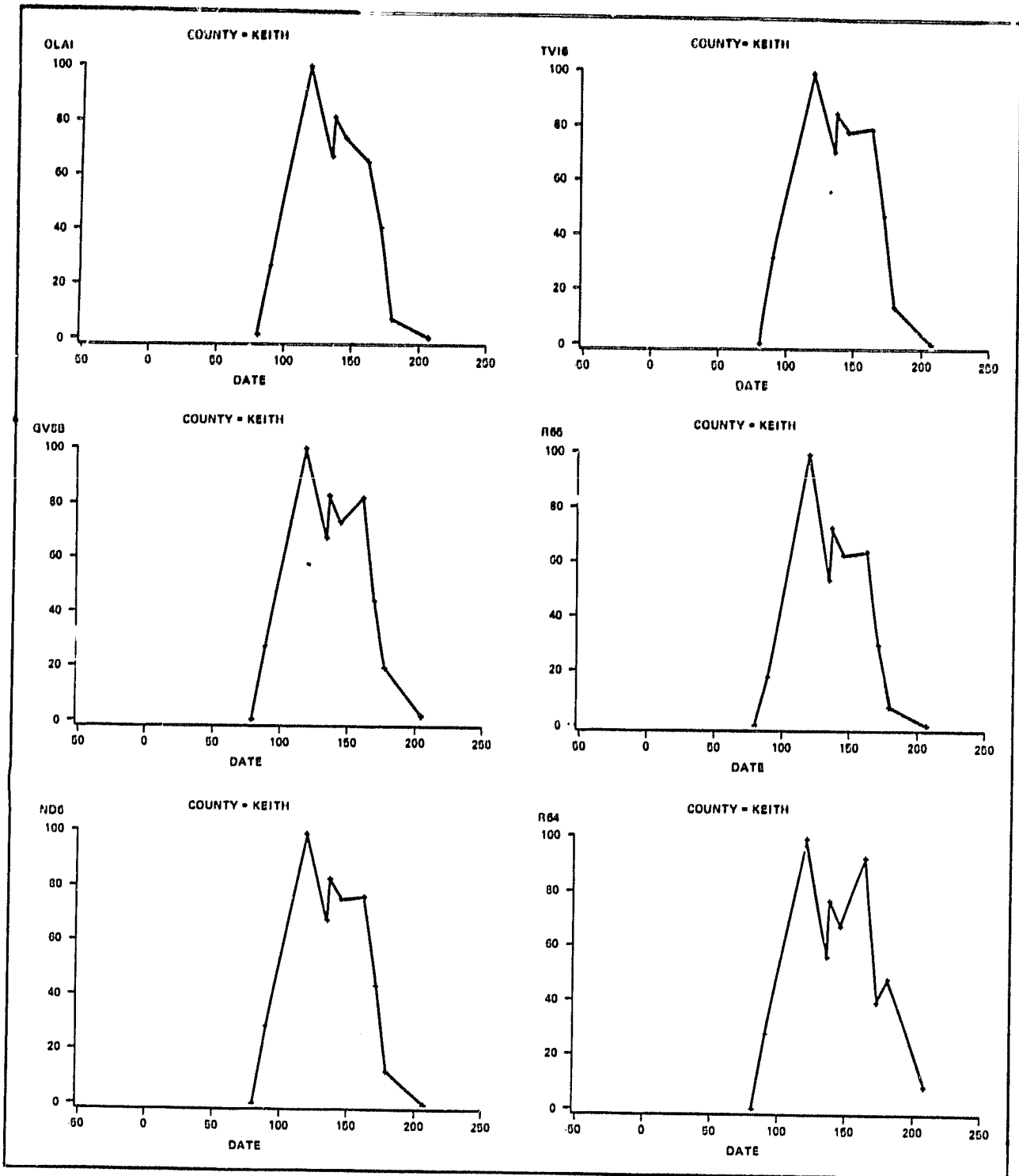


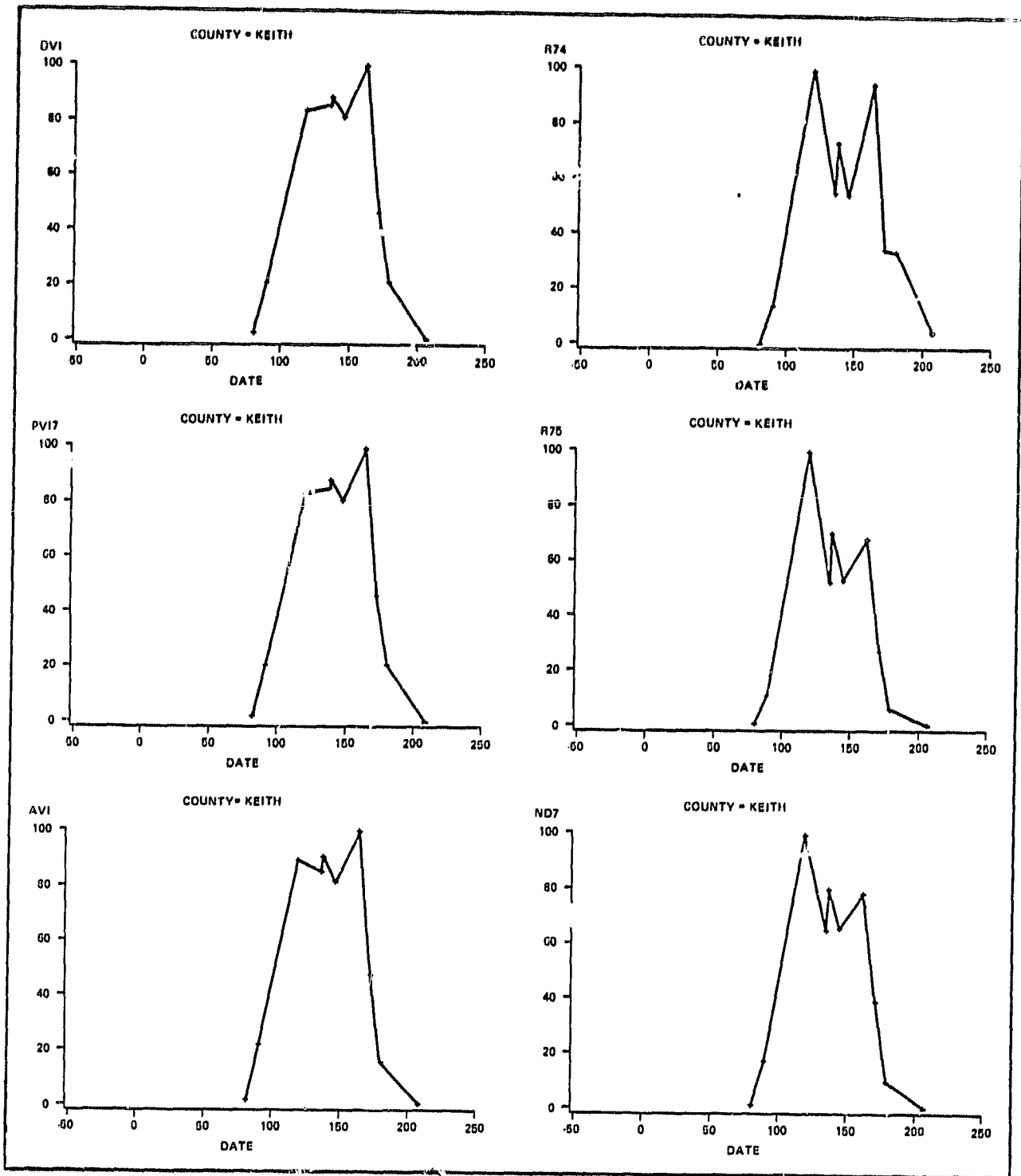


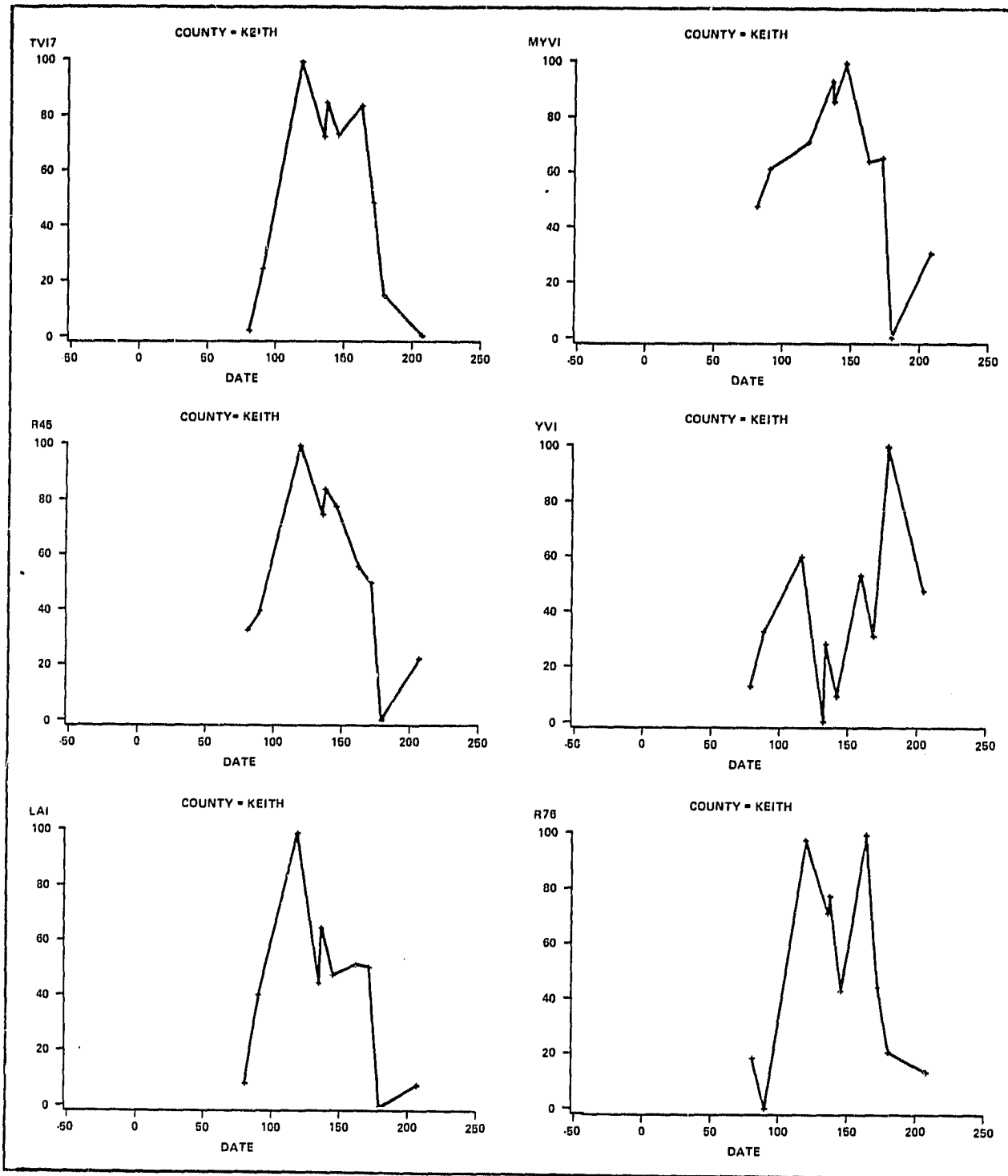


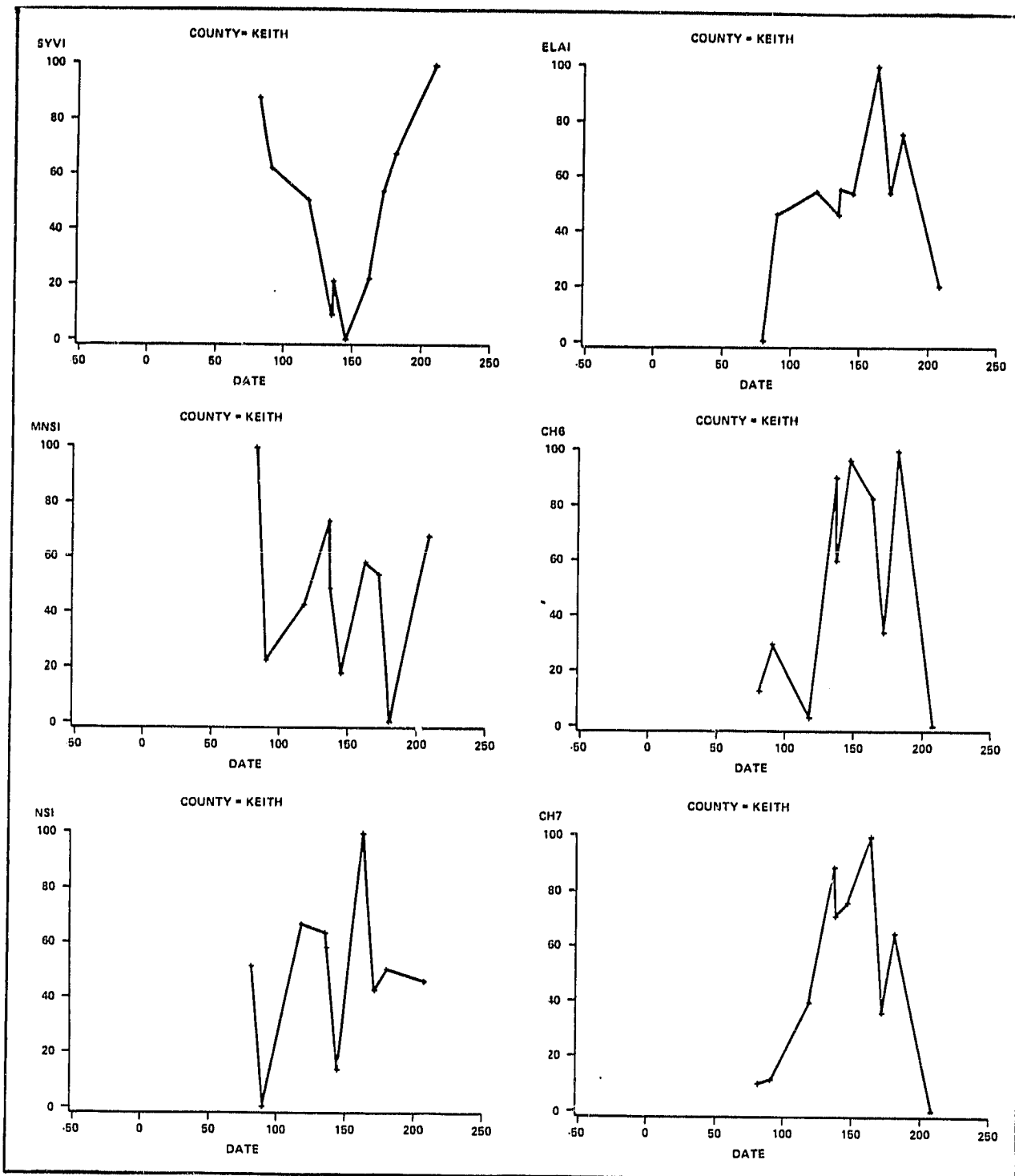


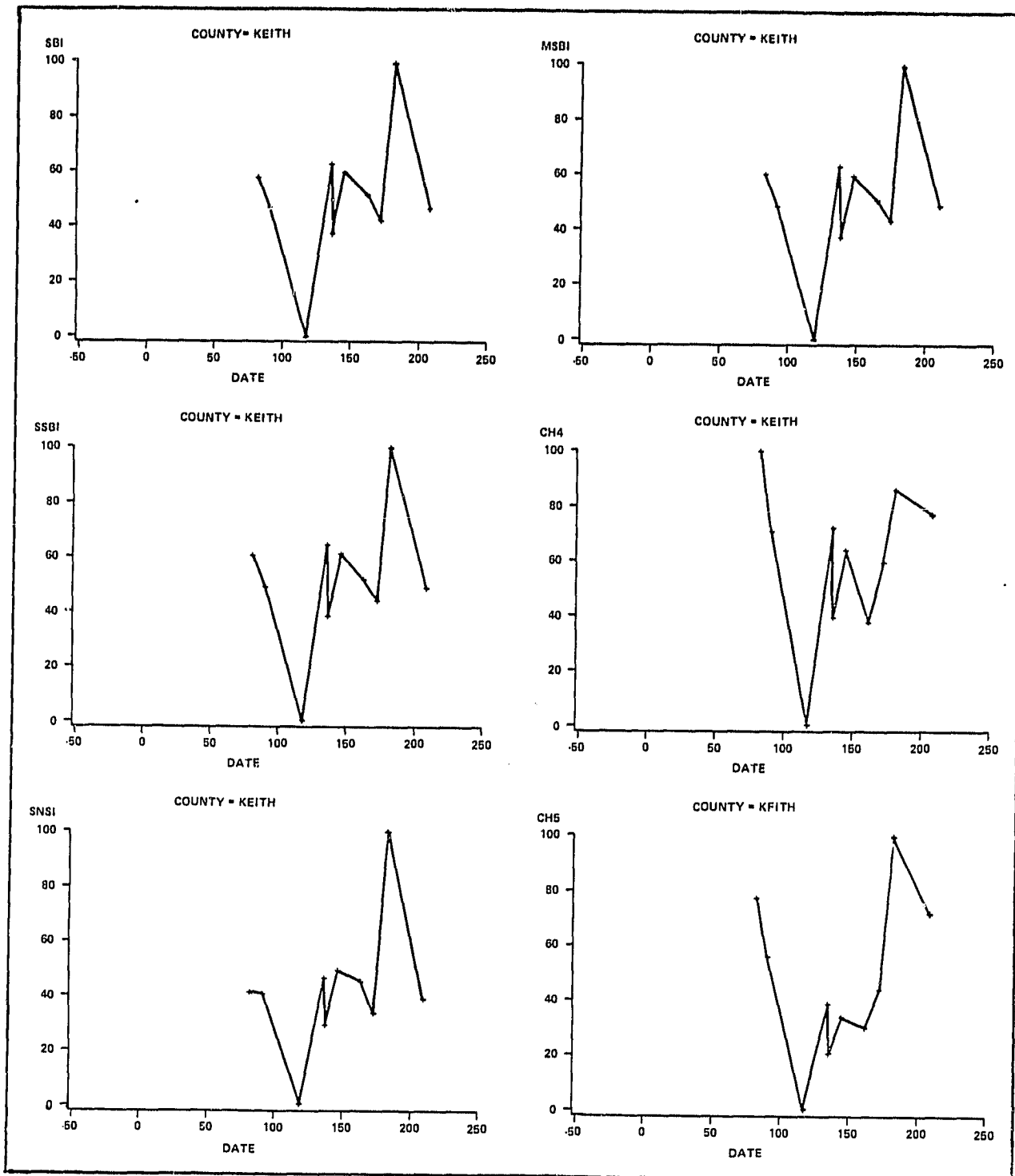


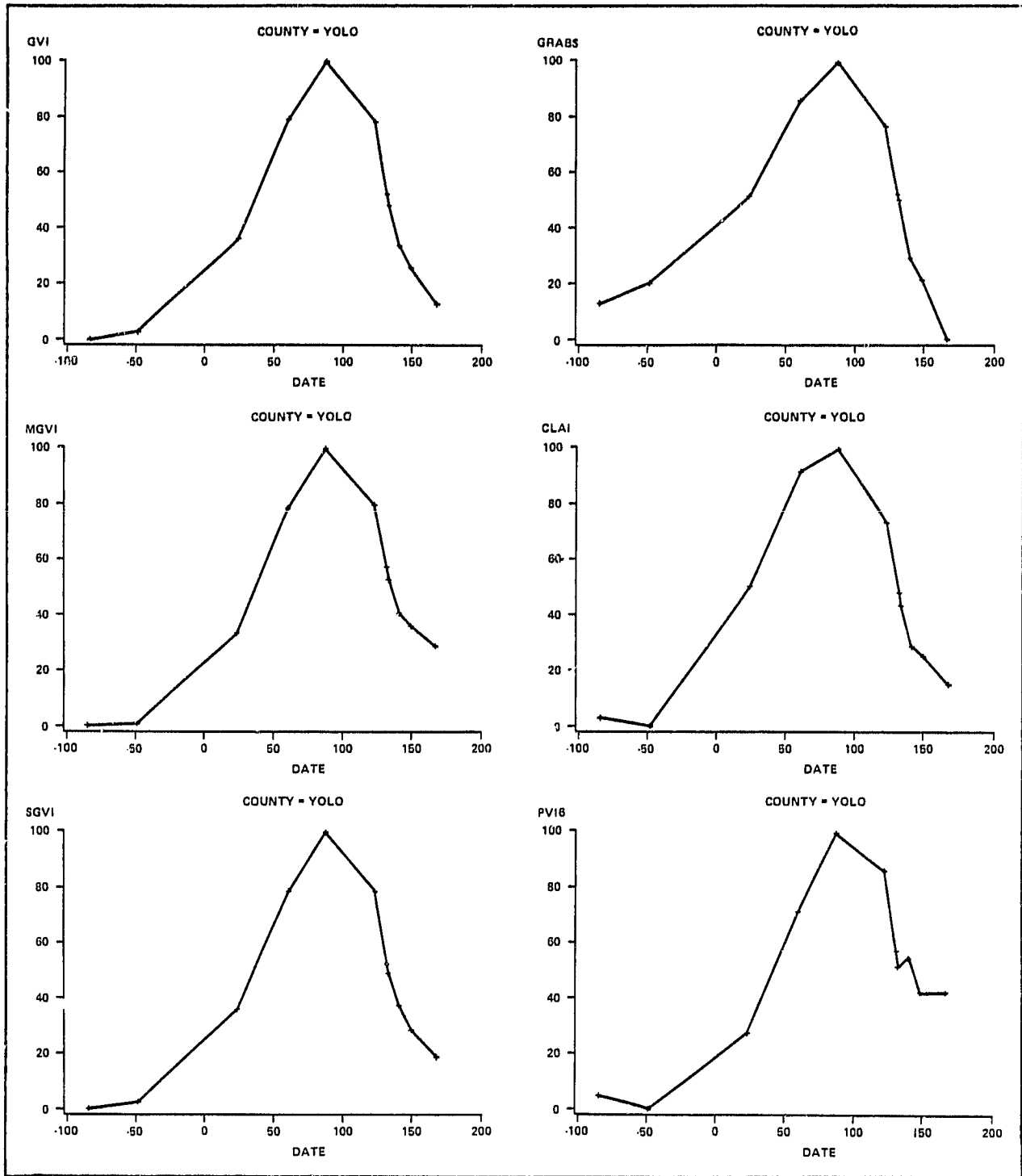


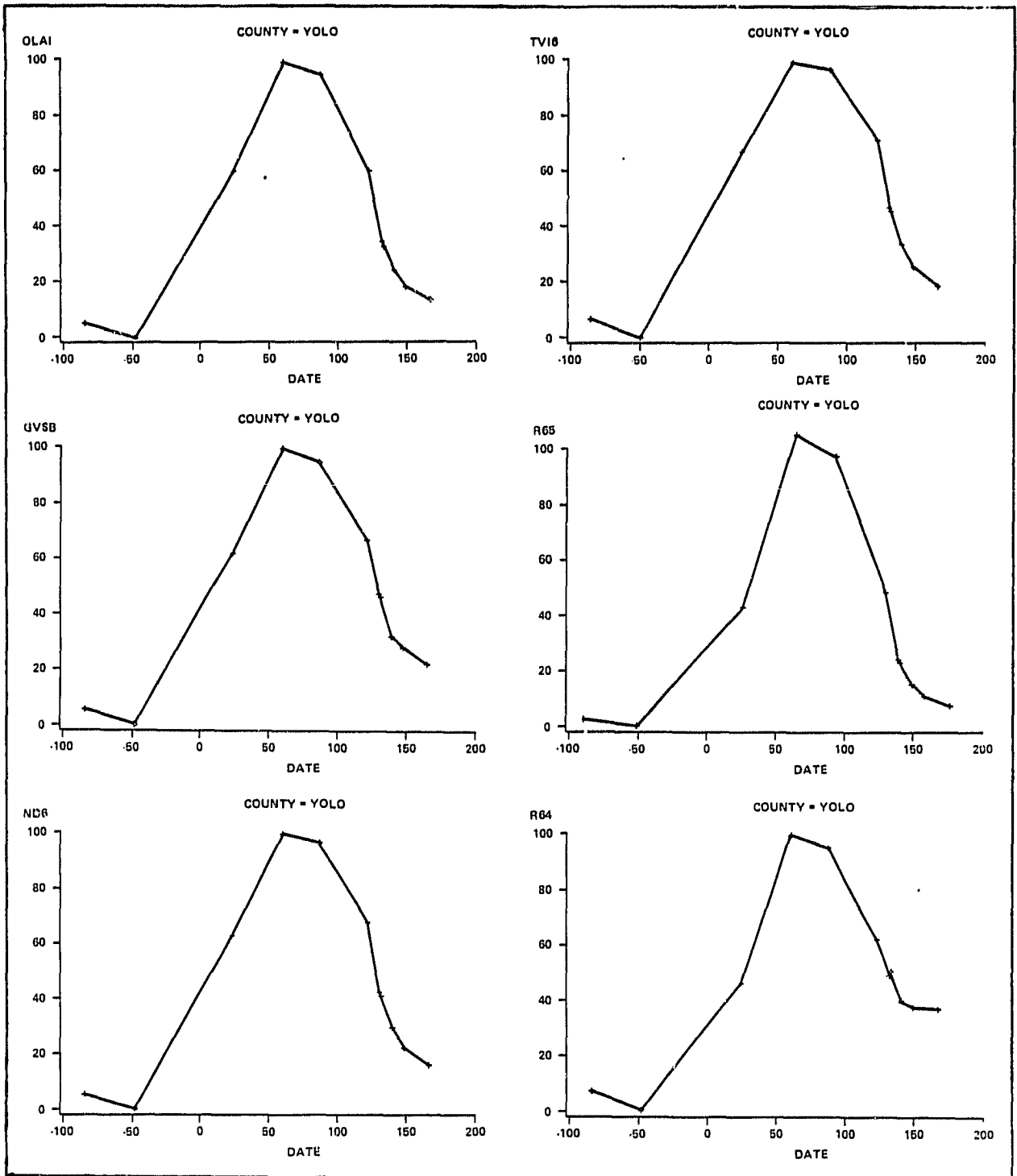


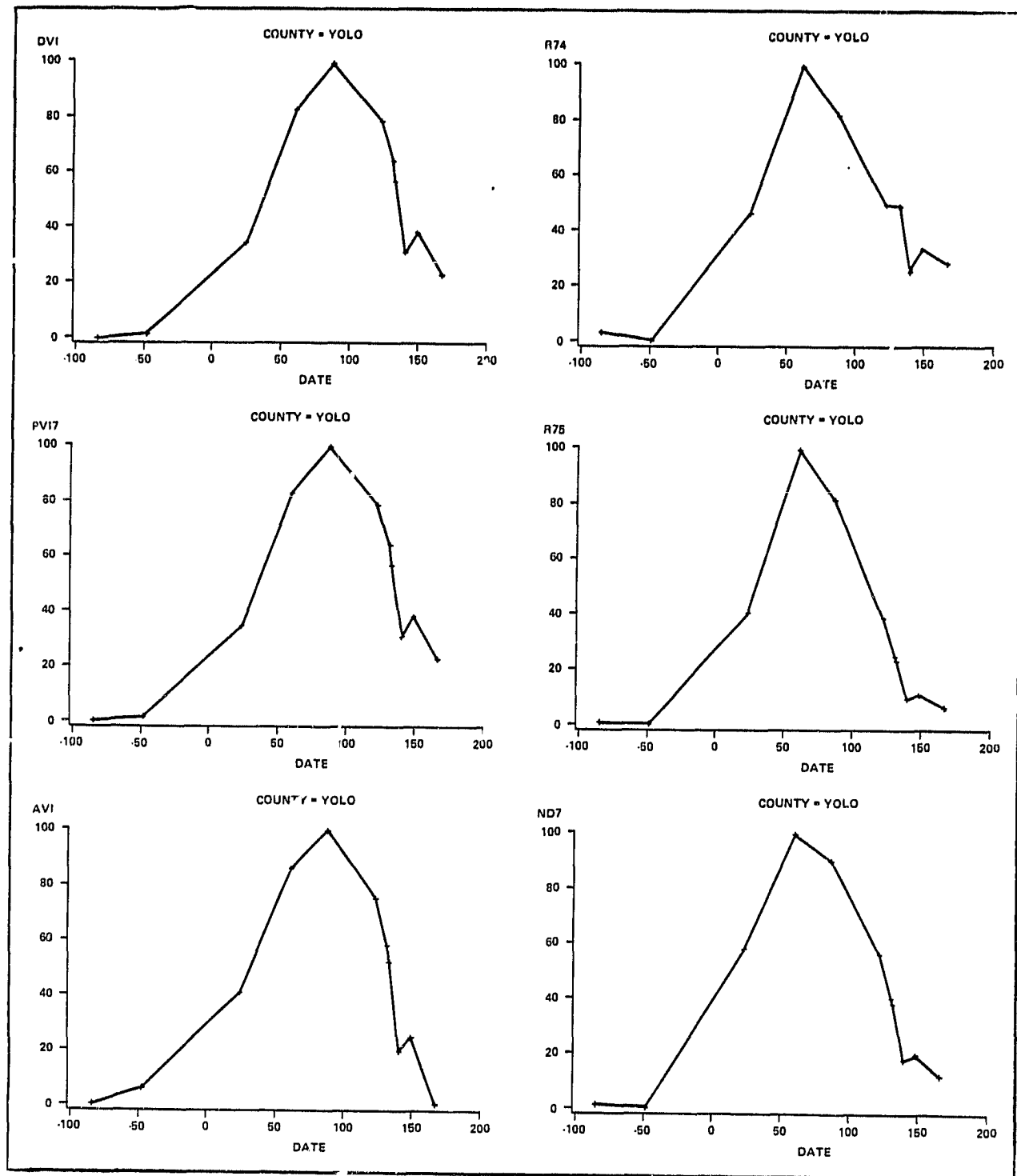


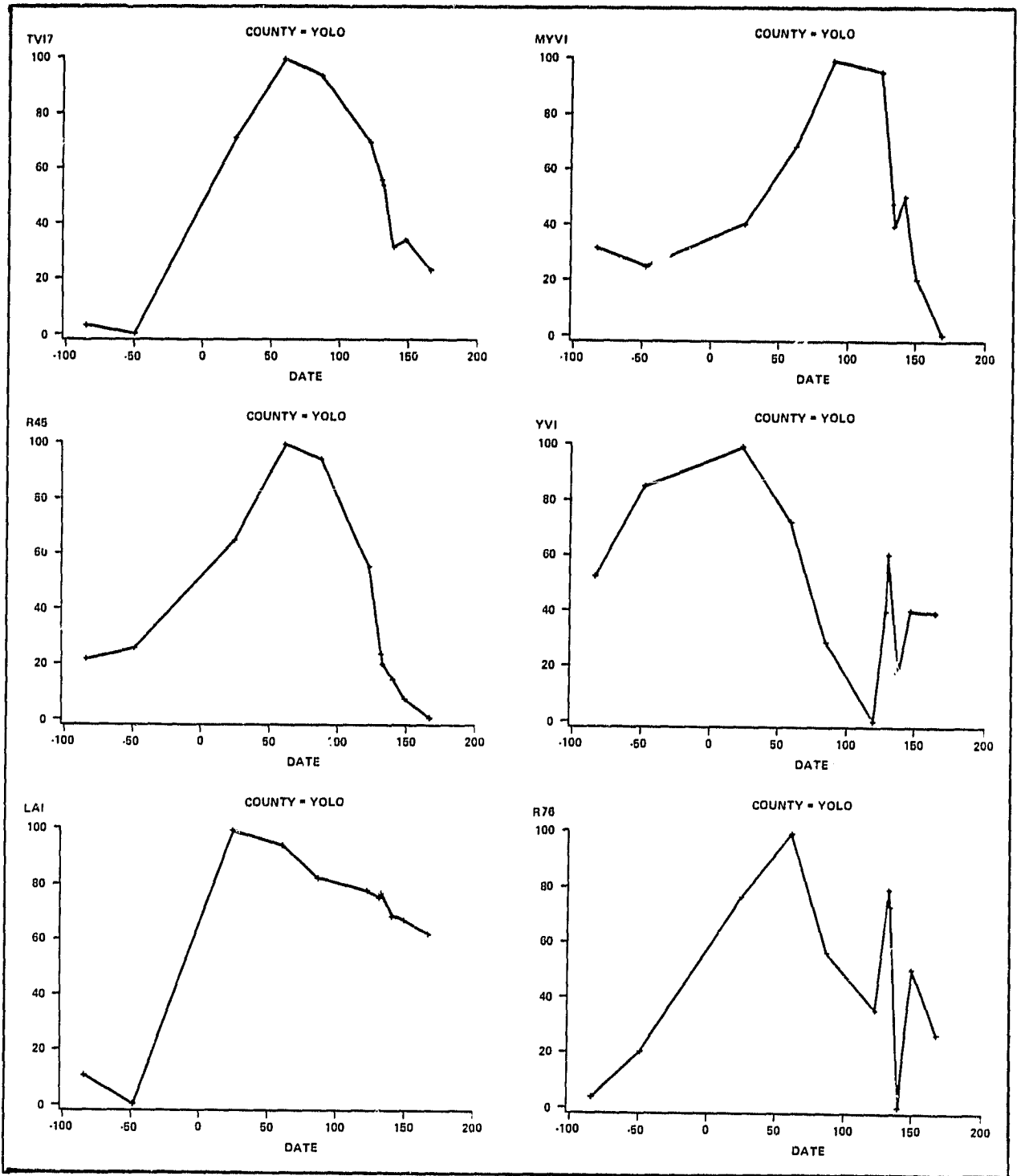


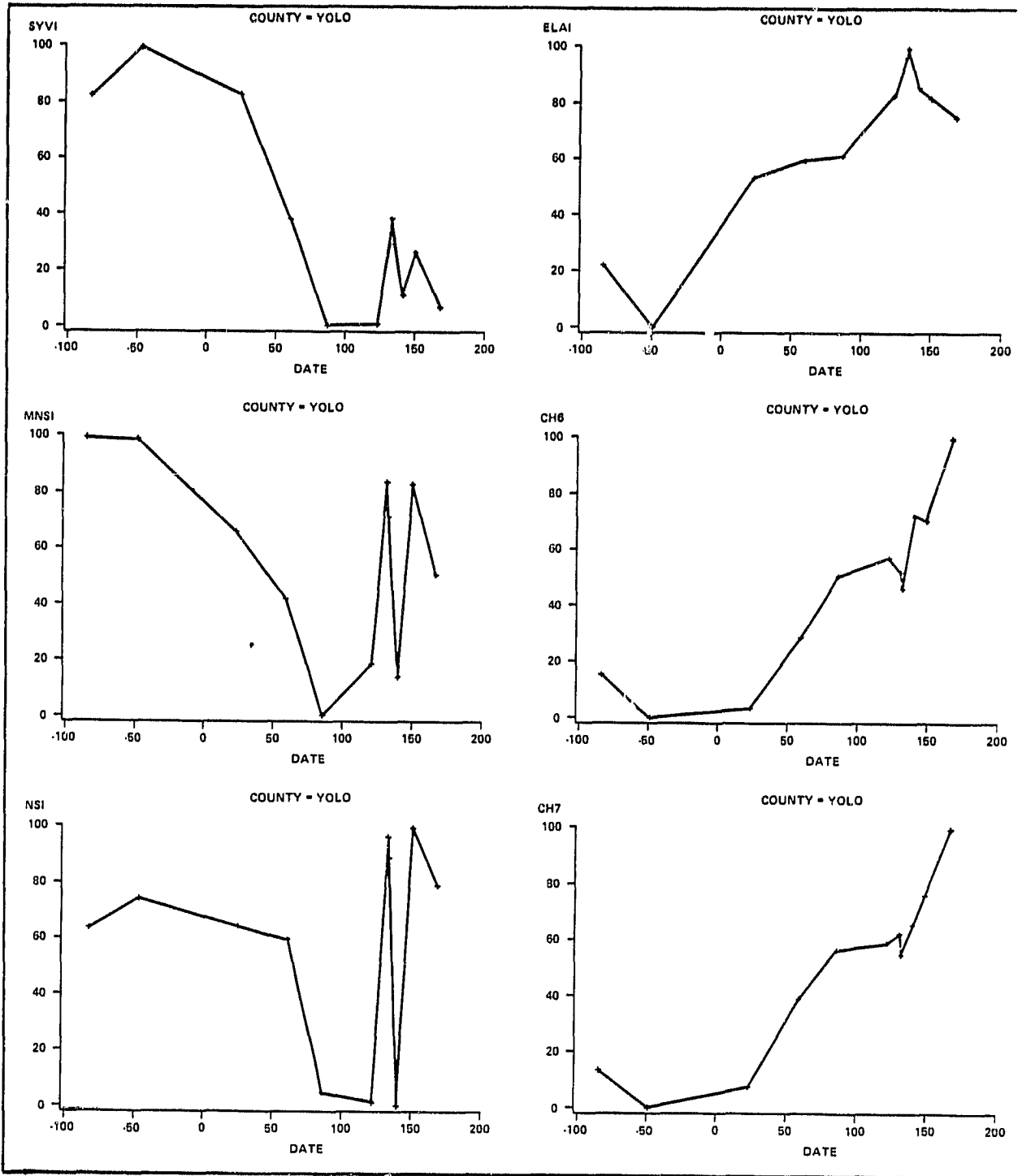


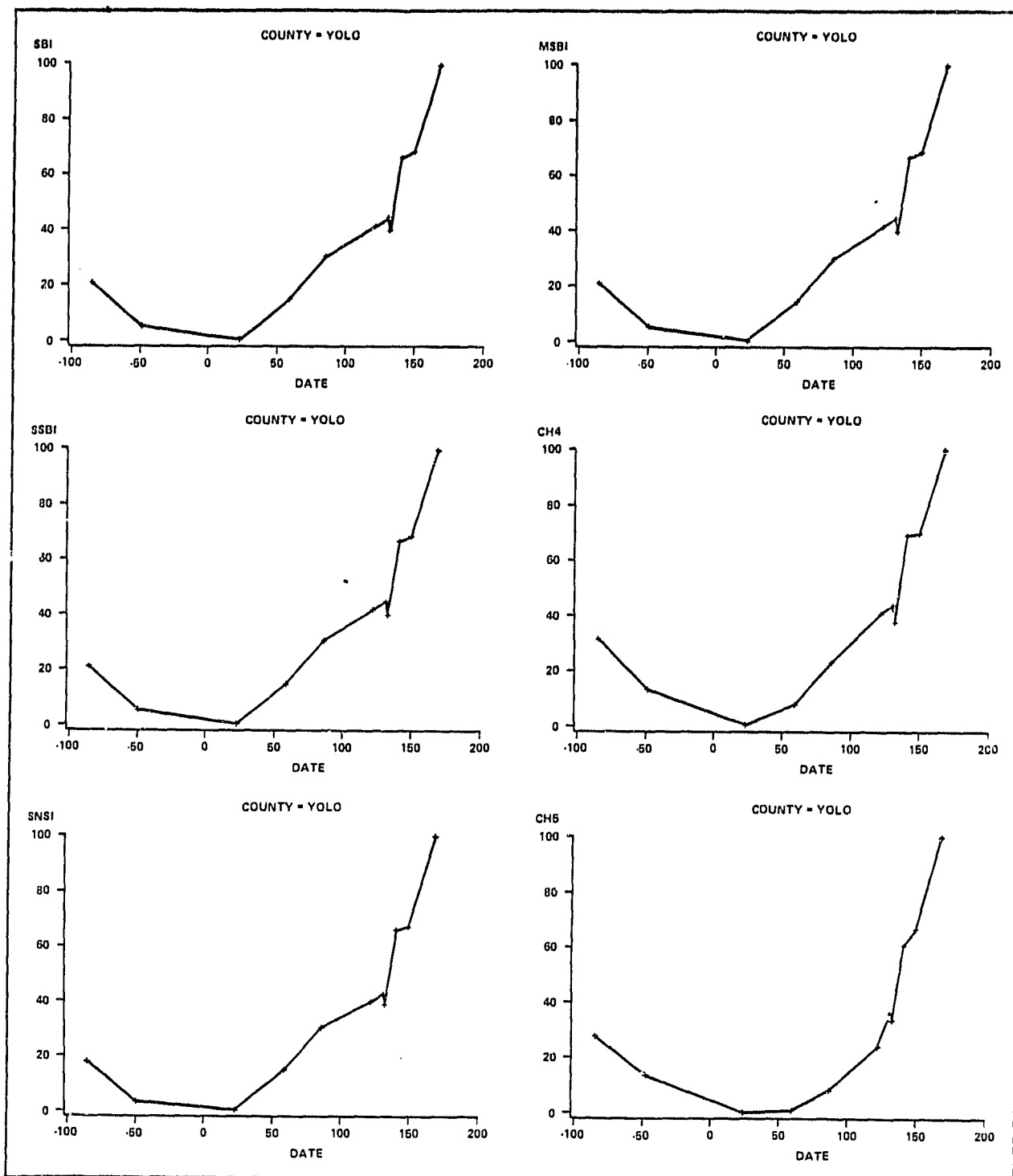






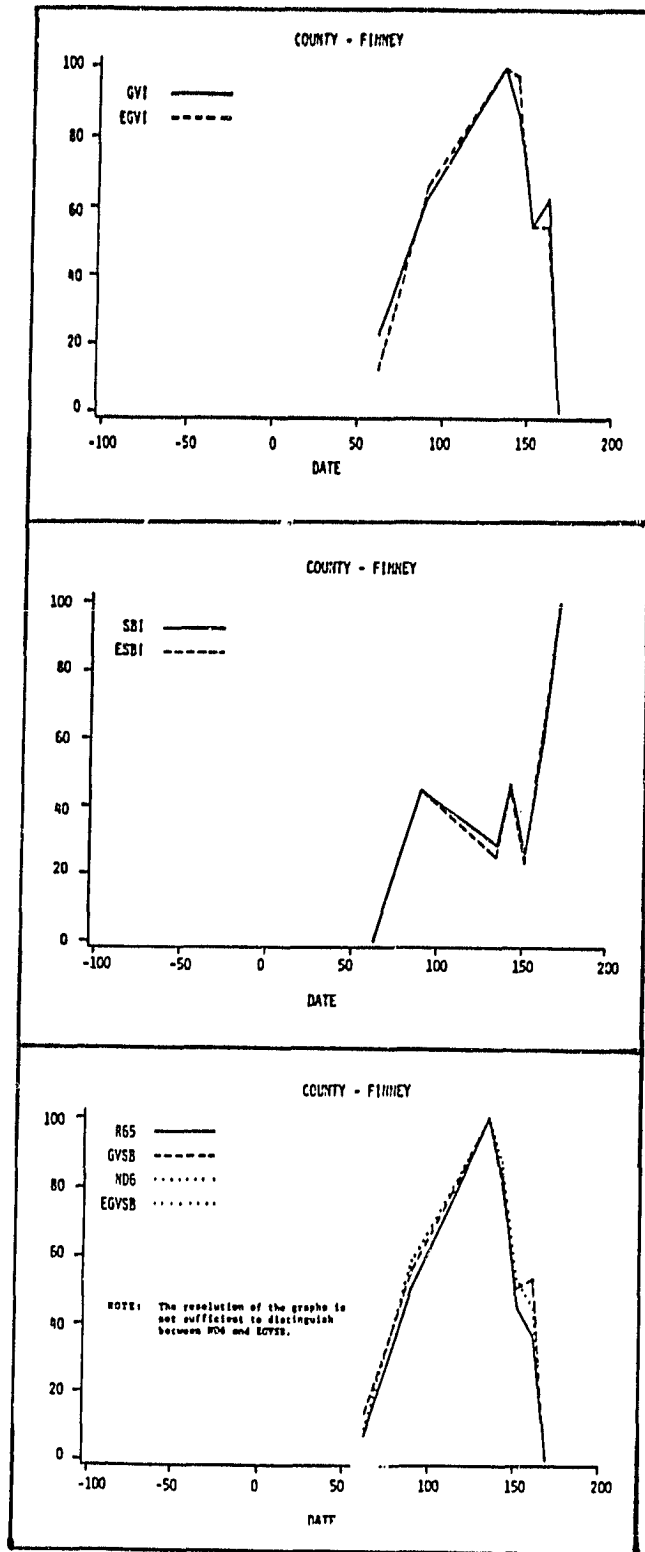




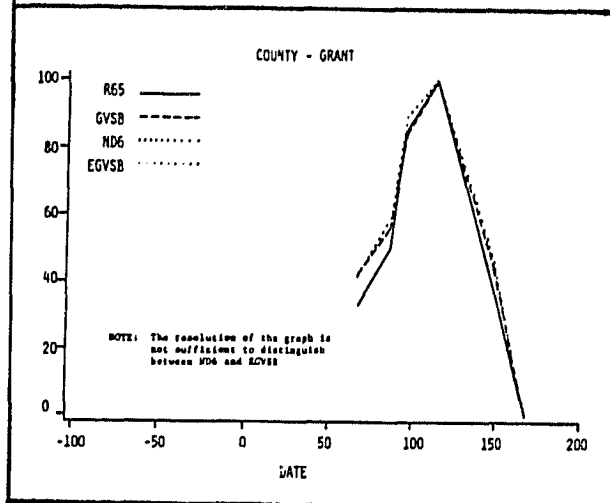
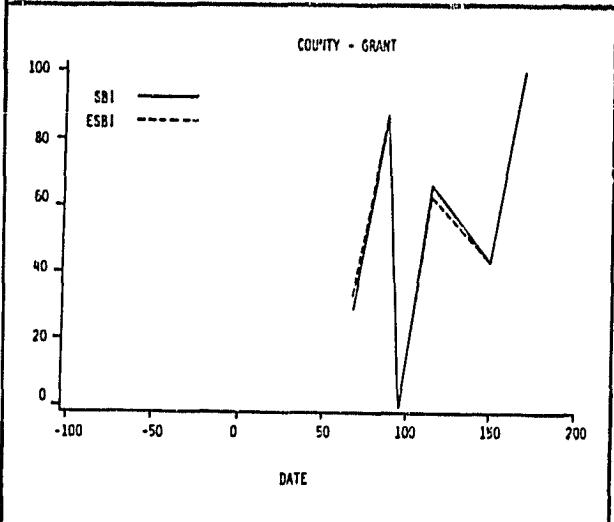
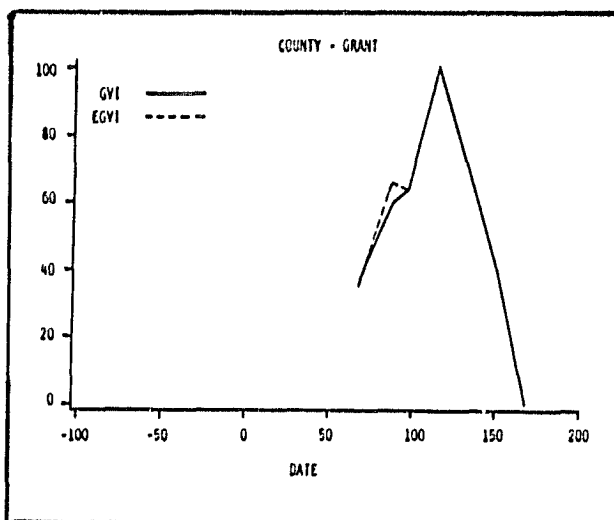


APPENDIX E

VEGETATION INDICES EQUIVALENTS
AND APPROXIMATIONS ILLUSTRATED
WITH TRAJECTORY PLOTS



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