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Alternatives for Ecosystem Classification and Their  
Use in Developing Rangeland Inventory and Management-Planning  
Approaches

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Key Words: ecosystem classification, rangeland inventory, land  
classification

Highlight

REARRANGE ORDER (SOMETIMES  
CONTENT) OF SENTENCES TO  
OUTLINE.

Many simultaneous choices present themselves to developers of ecosystem classifications. The approach may be arbitrary, pragmatic or natural. The degree of completeness of landscape coverage may be selective or comprehensive. The types of components used may be basic, integrated or interpreted. The classification system may be place-specific or place-independent. The number of variables used may vary from one to many. The methods of aggregation-disaggregation may be divisive or agglomerative and hierarchial or reticulate. Some major approaches to rangeland classification are discussed in relation to these variables and some strengths and shortcomings outlined. Exclusively-classificatory approach will probably yield to ordination, followed by classification, as more intensive management begins to demand greater predictive powers.

Even though livestock production might be a manager's primary concern, he doesn't deal with just forage and livestock. The unit of nature with which he must ultimately be concerned is the ecosystem (Lewis 1969). Ignoring this inevitability has created innumerable problems because it is the ecosystem that responds, as a whole, not just a few of its most visible and economically important parts. Realizing this and trying to deal with ecosystems is an extremely difficult task because of their complexity and the limited ability of the human mind to conceptualize them. Man has long recognized the need to sub-divide his problems into smaller pieces so that he can deal with the parts, one or a few at a time. This is why the process of classification evolved (Sokal ).

Classifications of rangelands have been used since the beginning of range management. The approaches have become more sophisticated as the intensity of management increased. Many different approaches are now being employed for classifying rangelands around the world. Many nations are just beginning to develop their rangeland inventory procedures. Some agencies are considering or testing new approaches in order to assist more intensive management. Therefore, I feel it is timely to review the approaches and attempt to summarize our current usage of rangeland classifications by using a classification of the classifications. Hopefully, this will reduce confusion by generalizing on the similarities and differences, strengths and shortcomings. I will begin with a listing and description of options we have for designing classification systems for rangelands and range inventory in general. I'll then illustrate how present classification systems fit within this alternative.

P. I. EXPLORE  
IT STANDS

TOPIC COVERED  
IN THIS SECTION OF  
THE DS OUTLINE.

Alternatives for Classification

I

I → III RECAP

2.1.1  
2.1 Selection of approaches to classification involve a great number of simultaneous choices. <sup>IN A ROUGHLY SEQUENTIAL ORDER</sup> These choices can be entirely arbitrary, pragmatic, <sup>2.1.2</sup> or can be used on perceived natural differences. <sup>2.1.3</sup> They can never be entirely natural because man has to choose attributes he can measure (Bianchi 1974). <sup>2.1.4</sup> Almost an infinity of potential attributes is conceivable.

APPLIES ONLY SELEC OF CHANA

2.2.1  
2.2 A major initial choice where lands are involved is between place-independent and place-specific approaches. <sup>2.2.2</sup> The latter is much more common because we have long delineated space--particularly ownership. <sup>2.2.3</sup> Maps are the concrete demonstration of the application of this approach. <sup>2.2.4</sup> Another descriptor of this approach is regionalization (Bailey 1976). <sup>2.2.5</sup> Place-independent classifications are those that can be utilized without reference to location. <sup>2.2.6</sup> An example would be the use of soil profile data to place a pedon at one of the higher level positions in the classification (U.S.D.A. 1975).

II

2.3.1  
2.3 Either place-specific or place-independent approaches may be selective or comprehensive in their coverage. <sup>2.3.2</sup> Selective classifications deal with only a portion of the total available variation. <sup>2.3.3</sup> Comprehensive classifications, however, deal with all the variation found. <sup>2.3.4</sup> Space-specific classifications are usually comprehensive, especially at the coarser grain of classification (e.g., political and legal boundaries). <sup>2.3.5</sup> Space-independent classifications are more commonly selective of what area and attributes are considered.

III

2.4 The types of attributes a classification may deal with could be basic components, integrated or interpreted information. Basic components of wildland ecosystems can be divided into stable attributes such as bedrock, regolith, soil, climate, topography, potential vegetation,

IV

and temporal attributes, such as current vegetation, animals, physical developments, legal ownership, etc. These basic components can be fractionated into as many further subdivisions as we can and/or care to measure, e.g., climate into precipitation, temperature and wind. It is really then quite arbitrary where we begin to differentiate integrated or interpreted information from basic components. Soil-vegetation classifications are a common way we deal with two major basic components on rangelands (an integrated approach).

III

3.1 Classifications involving interpreted information involve further synthesis, usually organized by usefulness to man. The range site concept of the SCS is a major example used in the U.S. (Shiflet 1975). However, the earliest pastoralist probably had some, perhaps un verbalized, recognition of poor, good, better or best range. This utilitarian classification must change as vegetation and/or class of animals change. They are also greatly influenced by the culture of the people using the land. Reindeer range for Laplanders was not range for Eskimos until the recent introduction of these animals to North America.

I

3.2 In any of these approaches we may attempt to classify on the basis of single attributes, "monothetic" or on the basis of several "polythetic" (Lambert ). Because of the simplicity of dealing with one thing at a time, monothetic approaches have been very popular. Need to consider many renewable and nonrenewable uses and values has forced managers in the more developed portions of the world to inventory and classify lands on a broader base. The increasing intensity of management has also made it too expensive to send different parties to the field to inventory just one resource at a coarse-grain (Poulton 1962).

4.1.1 Managers and policy makers need information at differing levels

of generality or specificity, depending on the scope of their responsibilities.

4.1.2 A district manager needs fairly detailed inventory data to make particular

on the ground decisions. 4.1.3 The Regional Forester or Congressman needs much

more general information. 4.1.4 The choice of one level of classification will

not simultaneously allow both maximum generality and maximum specificity.

4.1.5 We therefore need means for relating information and one level with that

of another. 4.1.6 We need specific information for the district ranger that

can be aggregated into summaries of value to the regional forester and

congressman. 4.1.7 Two alternatives for accomplishing this are available,

4.1.8 hierarchial or reticulate classification schemes. The hierarchial

approach is usually employed because of the ease of aggregating or

4.1.9 disaggregating information. All of the information can be aggregated or

4.1.10 divided equivalently by each branch. Unfortunately, all of the empirical

data point to nature being more correctly modelled on the reticulate

4.1.11 scheme with variable stems. Man, however, prefers bifurcated trees,

probably related to his possession of 2 lobes the brain, 2 hands, 2

eyes, 2 ears, etc.

4.2 A choice of how to aggregate or disaggregate the classification

presents itself. A divisive classification is from the whole to the

parts, or from the top to the bottom. An agglomerative classification

scheme starts at the bottom and works toward the top. Although there

are theoretical reasons for favoring the agglomerative approach

(Fiebleman 1954), we can rarely comprehensively classify rangelands so.

We can't attain enough individual experience to reach the middle and

higher levels, even though we know they must exist. Committee approaches

produce camels. ? WHAT'S A CAMEL?

IV A, B, C

IV D

IV A?

5.1 The combinations of the above approaches possible present a great many alternatives to classifying rangelands. No one approach ever leads to conceptually ideal classifications. The important thing is to realize that you have these choices when you are developing a classification scheme and recognize the strengths and shortcomings of a system you may have inherited. Whether your classification scheme is good or bad can only be answered in the light of your needs. Cost effective classifications must be designed and implemented for specified purposes. If generality is specified because of multiple use purposes, a necessary tradeoff with better specificity of just one resource will have to unavoidably be made. <sup>5.1.7</sup> Generality of classification can be aided by using a common conceptual framework to develop user, goal and place specific systems for application (Davis and Henderson 1977). Most historic, and many current efforts at classification generally fail to specify client, purpose and conceptual foundation in sufficient detail. We should probably spend as much time identifying exactly who is going to use a classification and for what as we do in developing the classification proper.

GOOD  
IN TO III?

5.2 Another common failing is not describing the methods in enough detail so that others can understand what has been done to make the classification. This is a common problem with integrated and interpreted information. Objectivity in classification is essential if one wants others to be able to repeat the process and use the results with consistency.



## Present Classification Systems

6.1 Let's now consider how some classification systems in use fit the alternatives available. <sup>6.1.2</sup> The choices are not in neat, nested, hierarchial sets as might be implied by the order of presentation. <sup>SEE NOTES</sup> For simplicity, I will show the relative position of the system on two variate axes. Any combination of axes could have been chosen (Figures 1-4). The approaches vary <sup>OVER ALL AXES OF CHOICE,</sup> in multivariate ways.

## Future Trends

6.2 Finally, I must warn you that the whole classification approach runs counter to empirical data concerning the structural and distributional variation in rangeland ecosystems. In the first place ecosystems are multivariate phenomena. Ideally, we should consider near infinite numbers of variables. In practice we assume that vegetation, vegetation and soils, vegetation, soils and landform, and other combinations of a few variables describe the bulk of the ecosystem. Even though computers can handle summarization and retrieval problems for many variables, man still has to tell the computer how to think and use the output. The user is likely to be attuned to the one, two or at most three simultaneous variable limitations we have with mind, media, and culture.

6.3 Variation in rangeland characteristics are more often continuous than discrete. Multiple variables are involved in nonlinear, interdependent ways. This means that the ideal way to show rangeland variation would be by ordination rather than classification. Ordination would prevent the over-generalizations, erection of categories forces, and allow conservation of more detailed information (Kessell 1976). <sup>AT THE CORE OF HANDLING MORE DATA.</sup>

Classification, however, is likely to continue as the major way renewable resources managers stratify wildlands in the near future, because of his need to make discrete discussions (e.g., to build a fence or not) (Heady 1975). As management gets more intensive and greater predictability of the response of management action is required, however, the costs of taking resource survey data and organizing it into comprehensible ways will eventually allow ordination-based and computer retrieval approaches to prevail.

7.1 This will allow avoidance of the circularity of reasoning so common with classification activity (Williams 1973). Ordination will not be a panacea, however. We will never be able to physically take the point samples theoretically required if ordination is pushed to the ultimate. We will still need to aggregate data for certain purposes. Rules for doing this will need to be specified. A combination of ordination and various classifications within the ordinations seems to be the logical way to best preserve the details needed for on the ground decisions.

Good.

1 COAST UNDEVELOPED  
 THIS AXIS. WHY IS  
 H. TYPE MORE PLACE INDEPENDENT  
 THAN SCS. IS 9% LANDSCAPE  
 77 THAN 7% LANDSCAPE RANGE?

Geographic Specificity

Place Independent

Place Specific

Higher levels of American soil classification system (USDA 1975)

ECOSYM (Davis and Henderson 1977)

Walter (1976)

Habitat-type (Pfister 1975)

SCS (Shiflet 1975)

Australian CSIRO (Perry 1962)

Selective

Comprehensive

Coverage of Landscape

Figure 1. Position of selected classifications of wildlands and their major features in relation to completeness of coverage of landscape and geographic specificity.

YOU USE 14 CLASSIFICATION SYSTEMS FOR COMPARISON - BUT ONLY SHOW 4-9 PER PLANE. IF I COULD SEE ALL POINTS ON EACH PLANE (EVEN IF THIS MEANS  $n < 14$ ) THE COMPARISON WOULD BE COMPLETE (ALL COMBINATIONS VISIBLE FOR COMPARING ANY 2 CLASSIFS ON ANY/ALL AXES). THIS WOULD MORE CLEARLY SHOW RELATIONSHIPS BETWEEN THE AXES, AND HELP SPEED THE READER ON HIS WAY TO 8-SPACE. A 1-PAGE, COMMON LEGEND COULD SHORTEN

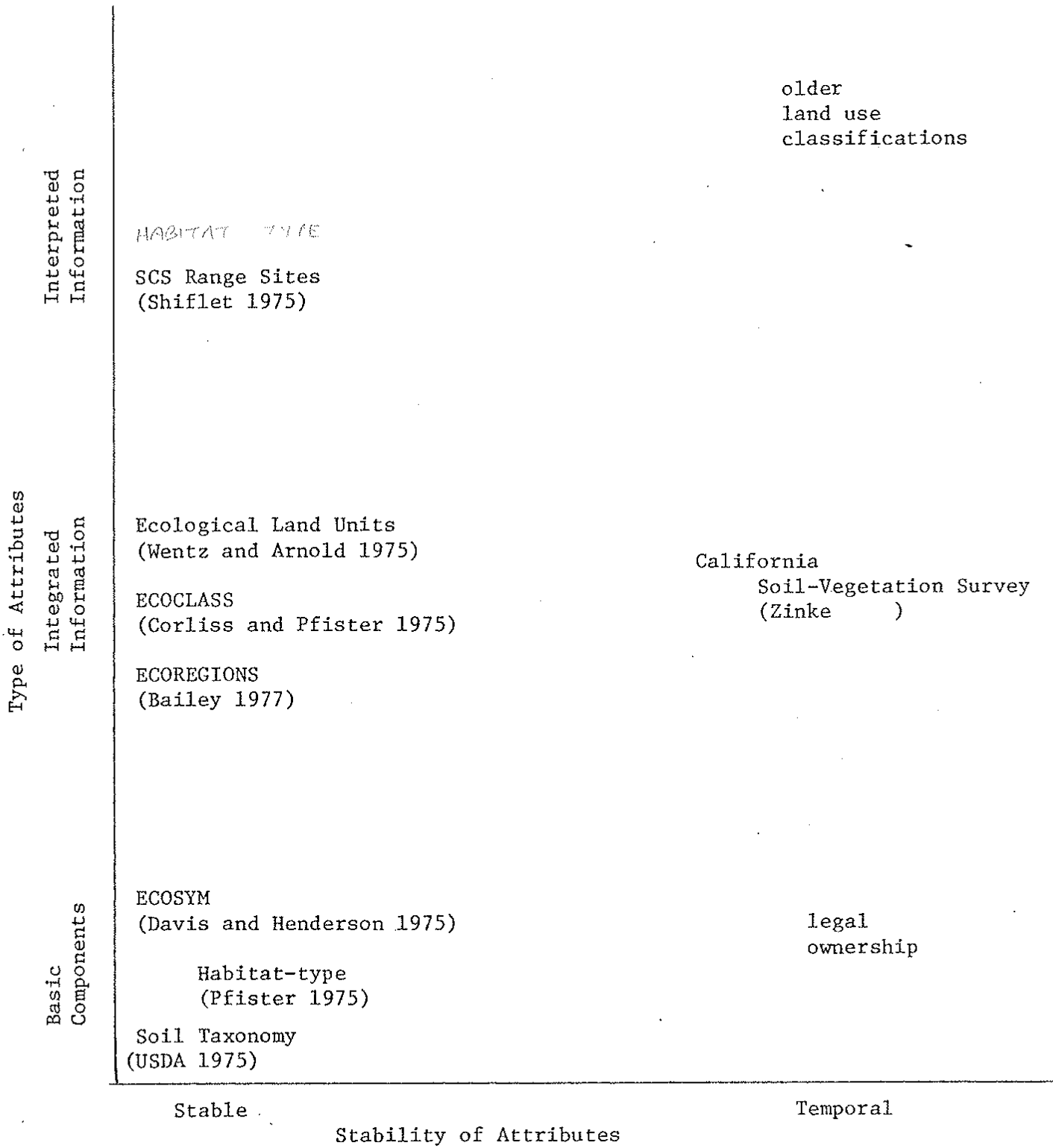


Figure 2. Position of selected classifications of wildlands and their major features in relation to type and stability of attributes

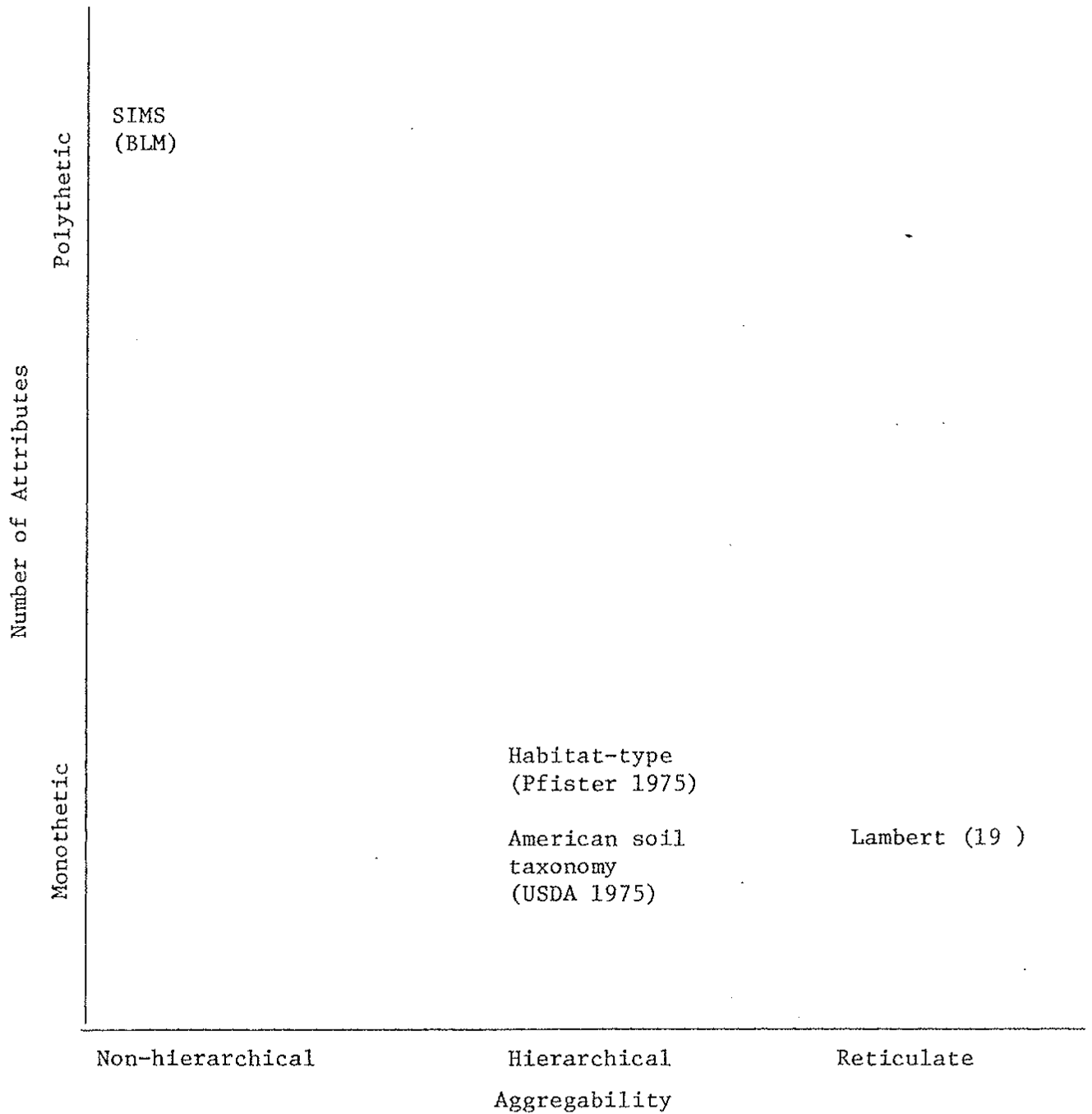
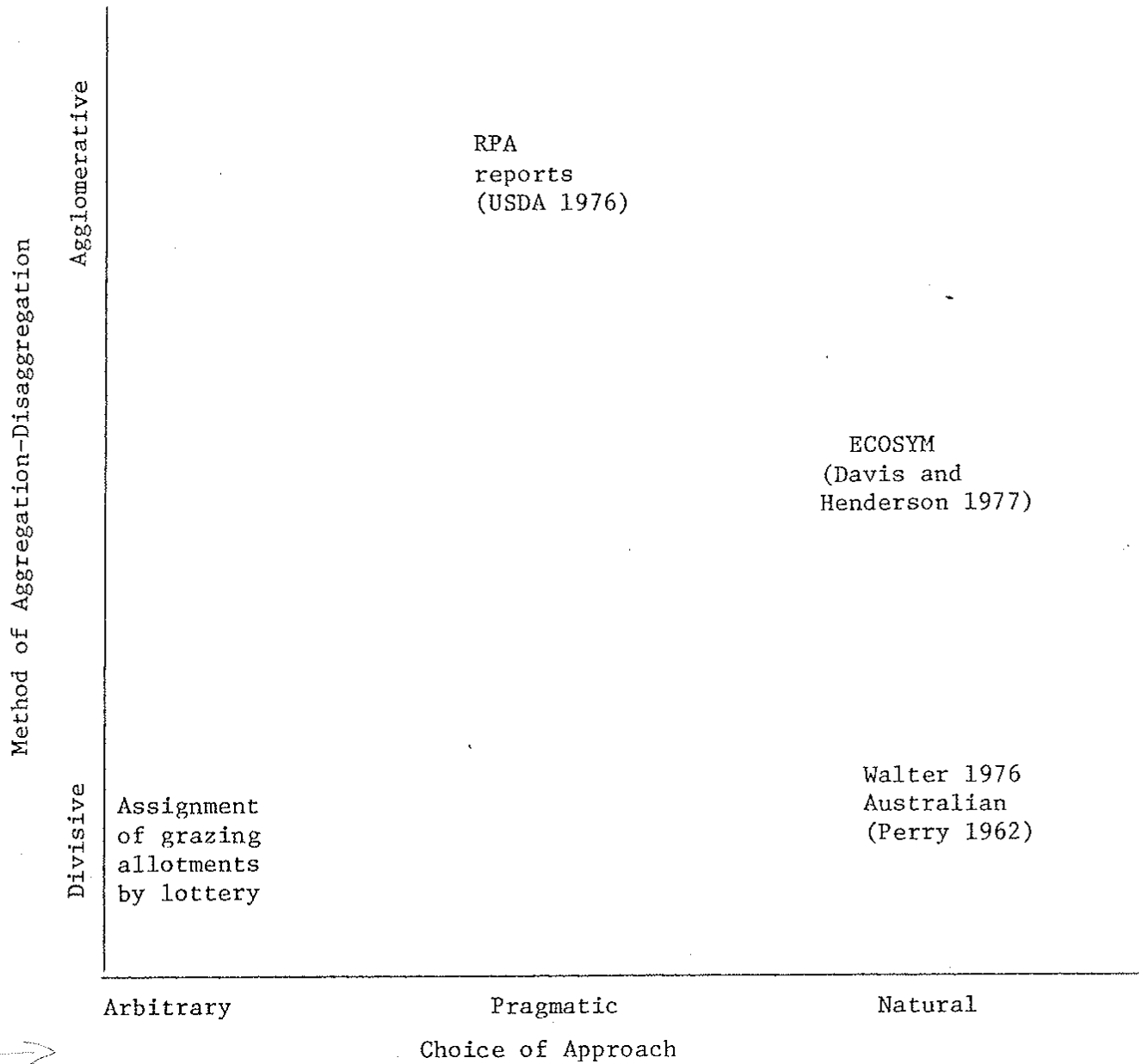


Figure 3. Position of selected classifications of wildlands and their main features in relation to number of attributes studied and aggregability of units.



APPROACH IS  
 RELATIVE TO  
 SCALE OF TYPE  
 & INFO  
 HANDLED. I  
 DON'T UNDERSTAND  
 HOW YOU USE THIS  
 AXIS.

Figure 4. Position of selected classifications of wildlands, their major attributes, and activities concerned with them in relation to choice of approach and methods of aggregation-disaggregation.