A natural resource analysis system for outdoor recreation
by Paul Eric Nordstrom

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY in Crop and Soil Science
Montana State University

Abstract:
Increasing public demand for outdoor recreation, coupled with public concern for proper land use and land management, has strengthened the role of natural resource analysis in the outdoor recreation planning process. The natural resource analysis system, developed by this research, presents guidelines for establishing a relationship between natural resources and individual outdoor recreation activities. For each individual outdoor recreation activity: the natural resource factors critical to the activity are identified and weighted through literature review, the ranges of natural resource suitability (quality or quantity) for each resource factor are identified and weighted through litera- . ture review, these natural resource requirements are compared to inventoried site data, and from this comparison a suitability rating of the site's natural resources (for the individual outdoor recreation activity) is obtained and mapped.

An important characteristic of the system is that it allows for adaptability within its procedural framework.

Applicability of the proposed system was tested by analyzing the physical natural resource suitability of sites within the Gallatin Canyon of Montana for stream trout fishing and trail hiking. For stream trout fishing, a 40-mile section of the West Gallatin River in Gallatin County, Montana, was subdivided into 58 unit tracts for inventory and evaluation. For trail hiking, 4 1/2 sections in the West Gallatin River Drainage, Gallatin County, Montana, were subdivided into 72 unit tracts for inventory and evaluation.

This research presents a system that incorporates critical natural resource requirements, based on sound research findings, into the outdoor recreation and comprehensive planning process. Use of this system should minimize development and maintenance costs in outdoor recreation sites by identifying those tracts of land within a given site having the highest (or moderate, or lowest) natural resource suitability for a specific outdoor recreation activity; and the system provides a means of identifying those natural resource characteristics which should be protected or developed by proper land management practices to enhance outdoor recreation site suitability.

A NATURAL RESOURCE ANALYSIS SYSTEM FOR OUTDOOR RECREATION

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Although this section of the thesis is brief in relation to the overall content, it reflects the heart of my graduate work. It would be extremely difficult, if not impossible, to achieve a meaningful goal without the help of others. Throughout my graduate program, which is culminated by this thesis, I have been the recipient of innumerable instances of kindness and assistance.

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ABSTRACT

Increasing public demand for outdoor recreation, coupled with public concern for proper land use and land management, has strengthened the role of natural resource analysis in the outdoor recreation planning process. The natural resource analysis system, developed by this research, presents guidelines for establishing a relationship between natural resources and individual outdoor recreation activities. For each individual outdoor recreation activity: the natural resource factors critical to the activity are identified and weighted through literature review, the ranges of natural resource suitability (quality or quantity) for each resource factor are identified and weighted through literature review, these natural resource requirements are compared to inventoried site data, and from this comparison a suitability rating of the site's natural resources (for the individual outdoor recreation activity) is obtained and mapped. An important characteristic of the system is that it allows for adaptability within its procedural framework.

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This research presents a system that incorporates critical natural resource requirements, based on sound research findings, into the outdoor recreation and comprehensive planning process. Use of this system should minimize development and maintenance costs in outdoor recreation sites by identifying those tracts of land within a given site having the highest (or moderate, or lowest) natural resource suitability for a specific outdoor recreation activity; and the system provides a means of identifying those natural resource characteristics which should be protected or developed by proper land management practices to enhance outdoor recreation site suitability.

INTRODUCTION

If a single word were to typify this nation in the past decade, the word would very likely be "change". To some individuals, change may indicate growth and prosperity; while to others, it indicates decline and adversity. As with all elements of change, success or failure may be dependent upon human understanding and subsequent control exercised by the human element. Orville Freeman, U. S. Secretary of Agriculture, expressed the following opinion, "Man is but one element, but he is a dominant element. Emerging now is a special challenge of fitting man's activities and needs harmoniously into his total environment". (Freeman 1967.)

Regardless of the subject area being considered or the individual doing the considering, the following statement by Jack Hayes would be valid; "Change is always with us and yet sometimes we should take stock". (Hayes 1970.) Therefore, from this milieu of national change, let us precipitate the single area of outdoor recreation.

It is not the intent of this thesis to examine in any detail the word change, but rather to express a recognition that change constitutes a basic thread of the fabric of outdoor recreation. From a review of the changing field of

outdoor recreation, this thesis identifies a subject area that is deserving of: examination, revision of methodology, and incorporation into the planning process. This area is Recreation Natural Resource Analysis - a basis for outdoor recreation* planning.

PLANNING IN OUTDOOR RECREATION - The greatest impetus toward outdoor recreation planning came from the federal government when Congress passed the Outdoor Recreation Resource Review Act, which was signed by President Dwight D. Eisenhower on June 28, 1958, (Fitch 1970). The objectives of the Act were to appoint a Commission which would study and evaluate national outdoor recreation wants, needs, available resources, policies, and programs. The final product of this Commission was a summary document, Outdoor Recreation For America, which was submitted to the President on January 31, 1962. Fitch and Shanklin (1970) in a brief tribute to the Commission called their work a landmark in outdoor recreation history, which would have enduring influence on state and federal participation in outdoor recreation planning.

As a result of a proposal made by the Commission, the Bureau of Outdoor Recreation was created on April 2, 1962.

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*See Appendix I, page 134.

On September 2, 1964, the Bureau was given a means by which outdoor recreation could be advanced - the Land and Water Conservation Fund Act. It provided matching funds to state and local agencies for acquisition, development, and planning of outdoor recreation.

As a result of the encouragement provided by this federal funding assistance, numerous state and local planning efforts were initiated. Various planning processes have been used in guiding these efforts. By reviewing random planning publications, (Lynch 1962, Sargent 1967, Case 1969, Kerr 1967, VanMeter 1969, Hyppa 1970, Strong 1965), it is possible to abstract the basic steps found in most planning processes. These steps, a foundation for most outdoor recreation plans, are: 1. Inventory (of the site's physical resources and human objectives); 2. Analysis (of the inventories data); 3. Plan formulation and implementation (on the basis of the analysis determinations and budgeting considerations); and, 4. Updating the plan over time.

However, many agencies found that outdoor recreation was not an easy area to plan. Factors which needed to be considered in the planning process are generally classified as economic, social, political, man-made physical resources, and natural resources; but in recreation these areas have

presented numerous problems in value identification and analysis. Therefore, in outdoor recreation there is often an unavailability of criteria for evaluation. The lack of natural resource criteria presents a critical problem in the area of outdoor recreation, since by definition the field is natural resource based. If nature is to be accepted as a process that offers both opportunities and limitations to human use, the natural environment will provide one important set of considerations for outdoor recreation planning.

REVIEW OF EXISTING RESOURCE ANALYSIS SYSTEMS USED IN OUTDOOR RECREATION - Some recreation planners chose to deal with natural resource analysis problems by treating natural resources only superficially. For example, a publication explaining the process used by a state agency in recreation area planning stated: "... 2. Next, an informal inventory is taken of the resources of a proposed site. From this evaluation, it can be determined how the site may best satisfy a portion of the recreation demand in that vicinity. 3. After the ground is acquired ..." (Hyppa 1970.) In this case it would appear only an informal resource inventory is necessary prior to acquisition. Other recreation planners were alarmed by the minimal concern being given to the environmental aspects of planning. Attempts were made to

develop new techniques in identification, inventory, and classification of the natural resources. Three of the better known individuals who have made significant contributions to resource analysis and environmental planning are Ian McHarg, Philip Lewis, and G. Angus Hills.

In general, each of the approaches proposed by these individuals was: (1) designed to relate natural resources to land use suitability; (2) designed to consider recreation as one of the land uses, if not the only land use; and (3) designed for regional application.

Ian McHarg believed that an area of land or water represented a number of interacting natural phenomena, (e.g. geology, soils, climate). He recognized that these phenomena create an intrinsic suitability for certain land uses. To determine a site's suitability, it was necessary to identify those ecological factors (e.g. Physiographic: land features, slope, etc; Pedology: drainage, erosion, etc.) and their values, which are important to the land uses being considered. Therefore, the system involved matching an inventory of site resource data to the value system based on the relationship of resource factors to land use. Areas possessing intrinsic suitability (and therefore low social cost) for a single or multiple land use are thus identified.

McHarg's approach is presented in some detail in his book, Design With Nature. (McHarg 1969.)

Philip Lewis based his analysis procedure upon identifying patterns of unique quality for recreation and conservation. Criteria were established by utilizing visual contrast and diversity. Various types of landscape resources (natural and man made) that met the use criteria were identified. (e.g. Natural Features: wetlands, topography, etc; Extrinsic Features: dams, camps, trails, etc.). Lewis found that many of the elements of the landscape could be combined into lineal patterns or "environmental corridors". By assigning values to the major features within the corridors, he was able to establish "nodes of interest". An example of Lewis' approach is presented in The Upper Mississippi River Comprehensive Basin Study. (Lewis 1969.)

G. Angus Hills developed a detailed land classification system. He identified site units according to land (or water) features and climate. Then use activities were related to physical requirements. The basic uses were subdivisions of the general use categories of Agriculture, Wildlife, Forestry, and Recreation. Then a capability rating was established for the site unit, which related the physical resources of the site to the intended use. The rating

indicated the natural capability of the land (or water) site to support the highest intensity and quality of any given use, under an assumed level of management. The final rating is adjusted by incorporating a consideration of: 1. Use suitability (the amount of labor and investment necessary to attain the use capability, e.g. installation of facilities and/or management) and, 2. Use feasibility (considering present and future social and economic factors, e.g. accessibility to populations). An adaptation of the Hills system is used in The Canada Land Inventory, a land capability classification, under the authority of the Agricultural Rehabilitation and Development Act. (Canada 1970.)

In review it may be stated that the approaches used by these three individuals would be representative of many of the approaches found in the spectrum of resource analysis. As Laurie (1971) noted, these individual approaches represented attempts to give emphasis to sorely neglected environmental factors and resources in the planning process.

Agencies, as well as individuals, have attempted to devise methods of incorporating natural resource data into the planning process. One of the earlier inventory and resource analysis systems to be applied on a national level, was the National Forest Outdoor Recreation Resources Review

of 1959, (U. S. Forest 1959) sometimes referred to as the National Forest Recreation Survey, (N.F.R.S.). This was to be a two year review of all outdoor recreation resources of the National Forests and other lands administered by the Forest Service. The objective of the survey was to evaluate the outdoor recreation resources and to formulate policies and plans needed to meet future recreation demands. The survey was to include an analysis of recreation demand, an inventory, and an analysis of the inventory findings. The inventory, a major part of the entire survey, consisted of selection, examination, and quality evaluation of the recreation land and water resources. As a key part of the inventory process, the quality evaluation was to systematically evaluate the quality of sites or areas (for certain types of recreation) on the basis of various sets of criteria. The evaluation would determine an outstanding, good, or fair quality rating for the site.

Although the work plan for the N.F.R.S. never achieved handbook status and detailed findings of the survey were never published, the survey was an imaginative and massive undertaking; and a positive step in the direction of resource analysis for recreation.

A more successfully implemented analysis system began

1966. The National Association of Soil and Water Conservation Districts (N.A.C.D.), in cooperation with the Soil Conservation Service of the Department of Agriculture, developed a system to appraise the potentials of county areas for outdoor recreation developments (U. S. Soil 1966). The ARDA system provided, for counties, a systematic approach to appraising its potentials for future outdoor recreation developments. Basically, twelve general kinds of recreation developments (e.g. vacation, cabins, winter sports areas, golf courses) were related to ten resource conditions or "key elements" (e.g. climate, scenery, soils, population, ownership). These key elements were weighted in relation to the influence they exerted on the proposed recreation development or enterprise. The key elements were also weighted in relation to the quality of the element in the county area. The final result was a scored rating for each activity considered. The system is adaptable to local development interests and resource factors. It may be stated that the NACD system has been widely implemented and appears to have provided many county areas with some measure of outdoor recreation development potential.

The preceding review exemplifies the more representative resource analysis systems being applied in many outdoor

recreation planning processes. However, as thorough as many resource analysis systems appear, they unfortunately possess inherent characteristics which prevent their practical application in many outdoor recreation situations.

THE PROBLEM

LIMITATIONS OF EXISTING OUTDOOR RECREATION RESOURCE ANALYSIS SYSTEMS - Planners today, for the most part, are willing to accept the fact that natural resources are a relevant factor in outdoor recreation planning. As a result, natural resource data is generally accepted as a desirable input into the decision making process. This improvement in natural resource awareness, however, does not simplify value identification and evaluation of natural resources critical to specific types of outdoor recreation.

At the present time; individuals, agencies, or governments wishing to identify natural resource suitability of a given area for a specific type of recreation activity, usually attempt to adapt existing regional multi-use analysis systems to the local situation. Most existing resource analysis systems when applied to outdoor recreation possess some, if not all, of the following limitations:

1. In many resource analysis systems, recreation is broadly defined and is assumed to include numerous, often undefined, recreation activities. In other words, all types of recreation activities are encompassed by the one land-use title - "Recreation". In some cases, Recreation is divided

into subunits. However, these too are often general categories, such as Active Recreation or Passive Recreation as proposed by McHarg (1969) and Lewis (Harvard 1967). Also the NACD Study (U. S. Soil 1966), had such divisions as Water Sports (skin diving, boating, etc.), and Winter Sports Areas (snow skiing, ice skating, etc.). Conventional wisdom indicates that different types of recreational activity (e.g. river rafting, lake swimming, snowmobiling) will possess different natural resource requirements. Obviously, snow skiing and lake swimming relate to different types and ranges of natural resource factors. An active-passive subdivision of Recreation does not solve the disparity found in recreation natural resource requirements. For within most general subtitles, such as "passive recreation" or "active recreation", there remains a variety of activities, each having somewhat different natural resource requirements for maximum suitability. Therefore, resource analysis systems that liberally identify and analyze many, if not all, recreation activities under one title are grossly oversimplifying the recreation-natural resource relationship.

2. Even in resource analysis systems where recreation activities are more specifically identified, generalization often remains a weakening factor. Generalization in the

wording of rating criteria is extremely common. For example, the National Forest Recreation Survey (U. S. Forest 1959) included rating criteria such as "excellent hunting - 3 points, good hunting - 2 points, fair hunting - 1 point". Other NFRS rating terms included, "easy walking... low cost... some recreation potential". Interpretation of terms such as easy, low, some, excellent, are extremely susceptible to differences of opinion. "Low" or "easy" to one individual may be "high" or "difficult" to another. Instructions explaining the meanings of such ambiguous terms (such as low, difficult, etc.) are lacking. Therefore, many resource criteria have no specific ranges or limits to guide interpretation.

3. The susceptability to variation in interpretation due to generalized criteria is compounded by the fact that local, often untrained personnel were used in relating the resource criteria to the site. Many evaluation systems (such as the NFRS (U. S. Forest 1959), the NACD (U. S. Soil 1966), and the Lewis system (Harvard 1967), are dependent upon local personnel to apply the inventory and analysis. Therefore, the validity of the resource evaluation often depended upon the competences (and biases) of a wide variety

of evaluators; evaluations often lacking any special interpretive training or interpretive instructions.

4. Another limitation of existing resource analysis systems is that of "purpose". Many systems are designed for a purpose or purposes which limit their use in other situations. If one of the purposes of the analysis system is to evaluate large (county or state areas) quickly, then the generalizations mentioned previously become quite common if not necessary. For example, Lewis (Harvard 1967), had to analyze the environmental resources of the state of Wisconsin in one year, a feat which does not lend itself to specificity. It seems logical to assume that criteria used for evaluation as well as format to be followed would tend to be shaped by the purpose of the study. For example, the Hills system (Harvard 1967), and The Canada Land Inventory (Canada 1970), base their rating classification on intensity of use the land will withstand or the quantity of recreation sustained per unit area. In other words, "quality" of a site is dependent upon high concentrations of use. Another example of survey purposes affecting a system's adaptability would be the NACD Study (U. S. Soil 1966). This system, primarily concerned with private recreation development, selected only those

recreation activities of primary interest to developers. In addition, although the system does relate resources to activities, this relationship is highly simplified and the reasoning for the weight given the "resource-activity" relationships is never explained in any detail. This presents interpretation problems to anyone wishing to expand the system's use - not only to other activities but also to change any of the "resource-activity" rating relationships.

In summary it might be stated that most existing resource analysis systems do possess certain weaknesses or limitations. The same will undoubtedly be true of future systems. Yet this should not dampen the researcher's enthusiasm for attempting to develop "The Ideal System" which would correct limitations of existing systems and also hopefully be adaptable to future change.

PROCEDURE - THE PROPOSED RECREATION NATURAL RESOURCE ANALYSIS SYSTEM

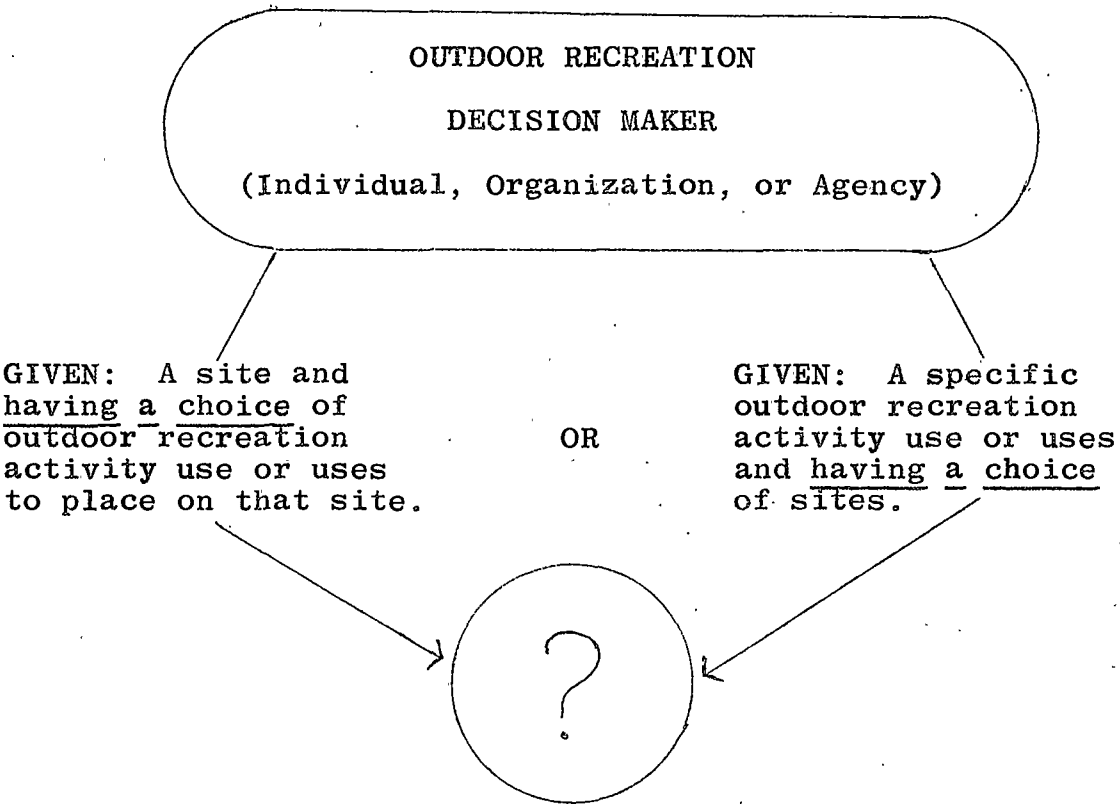
OBJECTIVES OF THE PROPOSED SYSTEM - It is the intent of this research project to relate only to the physical natural resource aspect of the resource analysis process. Although physical natural resources are but one of the resource factors in a total analysis system, they represent a basic consideration. The use of natural resource criteria as a foundation for consideration is based upon the relative permanence of natural resources. To base a classification system upon the permanent physical land characteristics (upon which economic and social classification may be later superimposed) is in agreement with principles expressed by Jacks (1946), Marbut (n.d.), and Davis (1971).

Application of this natural resource analysis procedure will identify those tracts of land within a given site, which have the highest (or moderate, or lowest) natural resource potential (suitability) for a specific recreation activity. Rating of potential sites and/or tracts within a site is accomplished by placing a number value on ranges or qualities of resource factors. The rating will establish a qualitative measure of the suitability (or potential) of a site (or tract) for one type of outdoor recreation activity.

City, county, and state funds for outdoor recreation are often limited, and it appears this will remain so for some time. Therefore; inventory, acquisition, and development of outdoor recreation areas will tend to be selective. This proposed analysis system would be a method for identifying "best" sites for outdoor recreation endeavors.

In addition, this proposed analysis system, by identifying those natural resources and their ranges of quantity or quality most beneficial to specific outdoor recreation activities, will identify those natural resource characteristics which should be protected or developed by proper land management practices. Also, man-made improvements my be created in order to provide the critical natural resource requirements for a particular outdoor recreation activity, once those requirements are known. If the procedure is applied to a number of outdoor recreation activities, it will ultimately allow for identification of sites or tracts of land which possess complimentary or competitive natural resource capabilities for those various recreation activities.

In summary, the fundamental guidelines establishing general relationships between: (1) an individual outdoor recreation activity, (2) natural resource requirements for that activity, (3) inventoried site data, and (4) analysis rating conclusions; are illustrated in Figures 1 through 8.



1. Is this site suitable for ____*____?

2. What tracts within this site are best suited for ____*____?

*A specific outdoor recreation activity or combination of activities.

1. and/or 2. =

WHAT IS THE SITE SUITABILITY FOR A SPECIFIC OUTDOOR RECREATION ACTIVITY?.

Figure 1. THE BASIC QUESTION

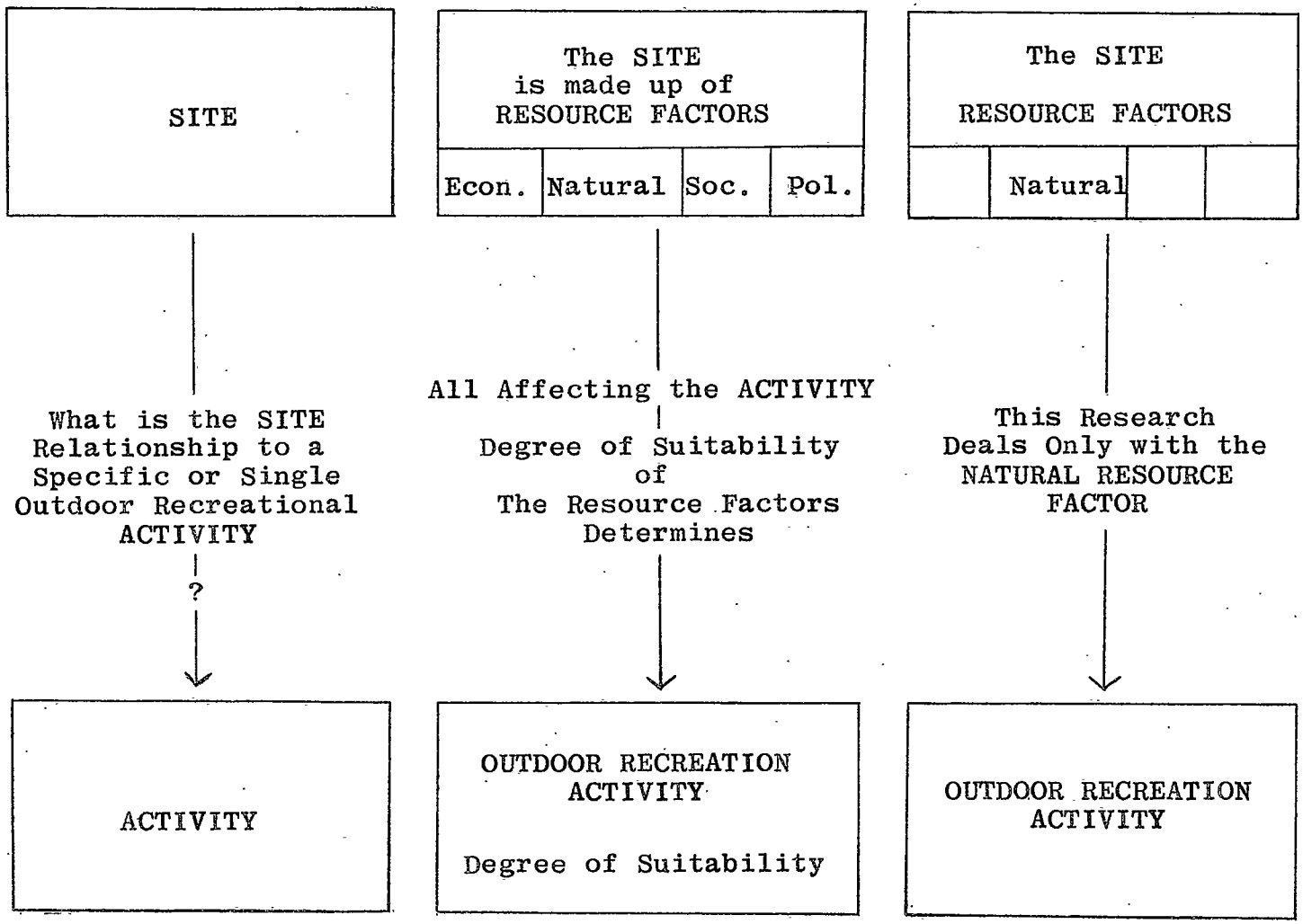


Figure 2. THE SITE-ACTIVITY RELATIONSHIP

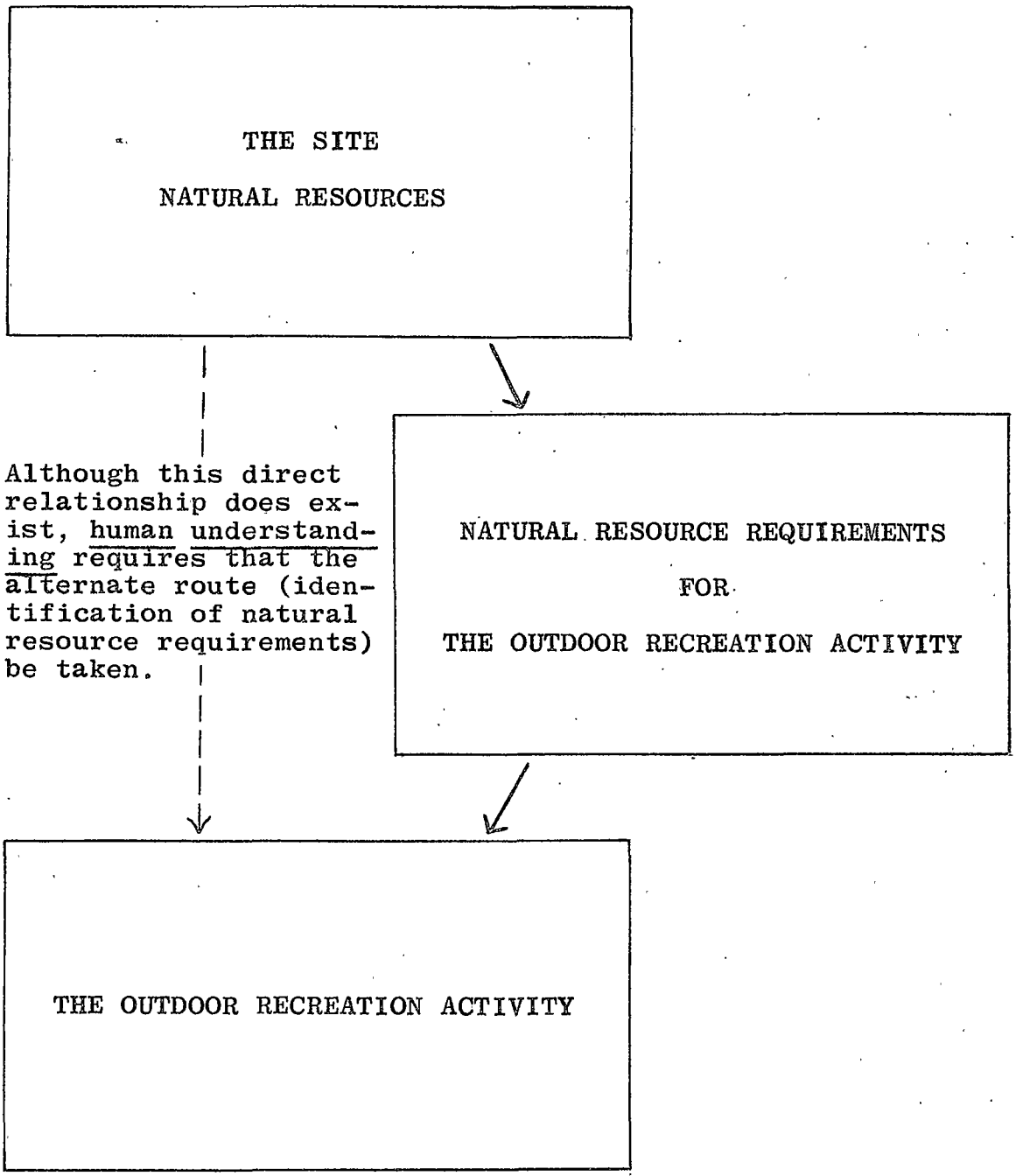


Figure 3. THE SITE - NATURAL RESOURCE - ACTIVITY RELATIONSHIP

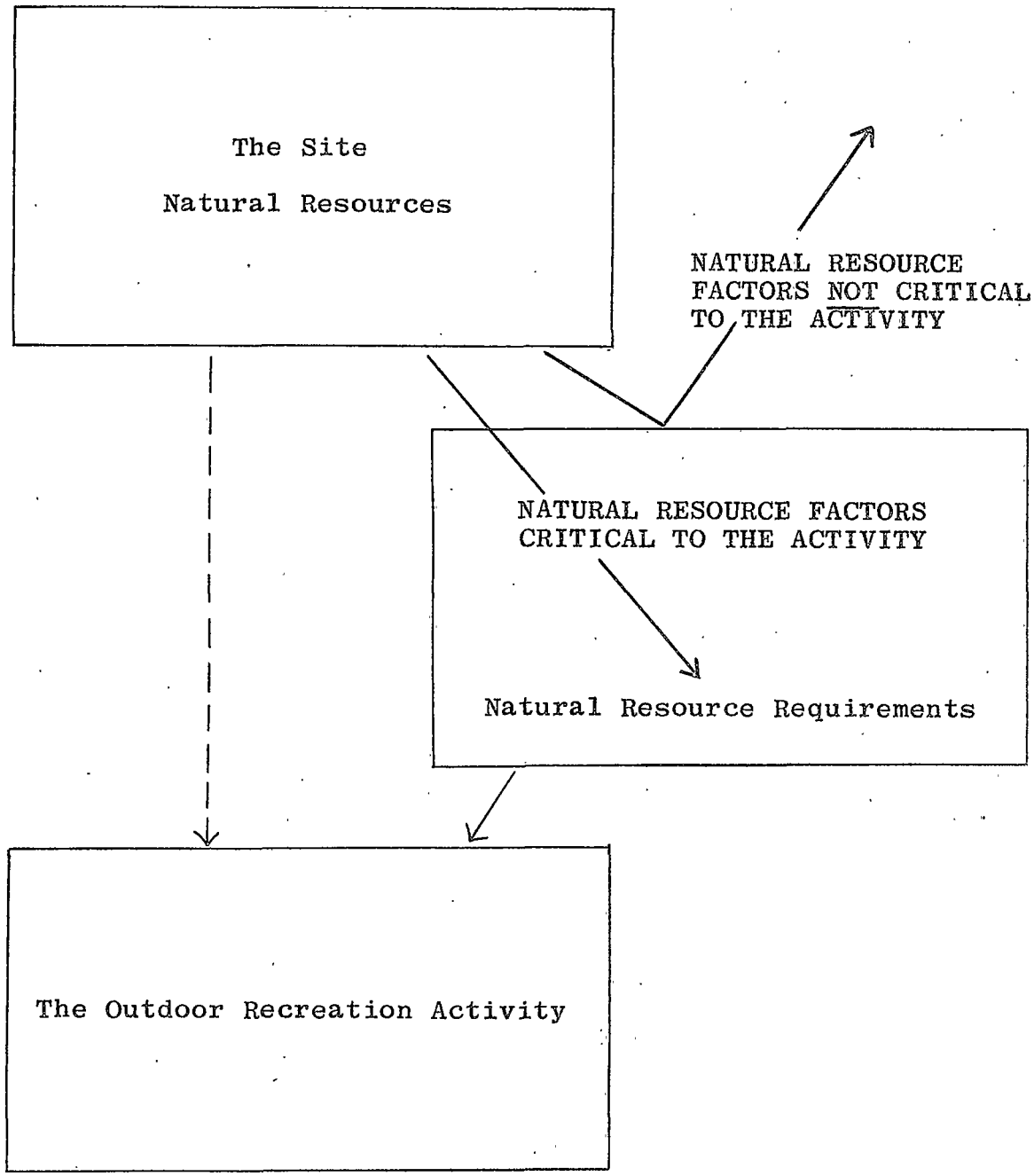


Figure 4. CRITICAL NATURAL RESOURCE FACTORS (A PART OF THE SITE - NATURAL RESOURCES - ACTIVITY RELATIONSHIP)

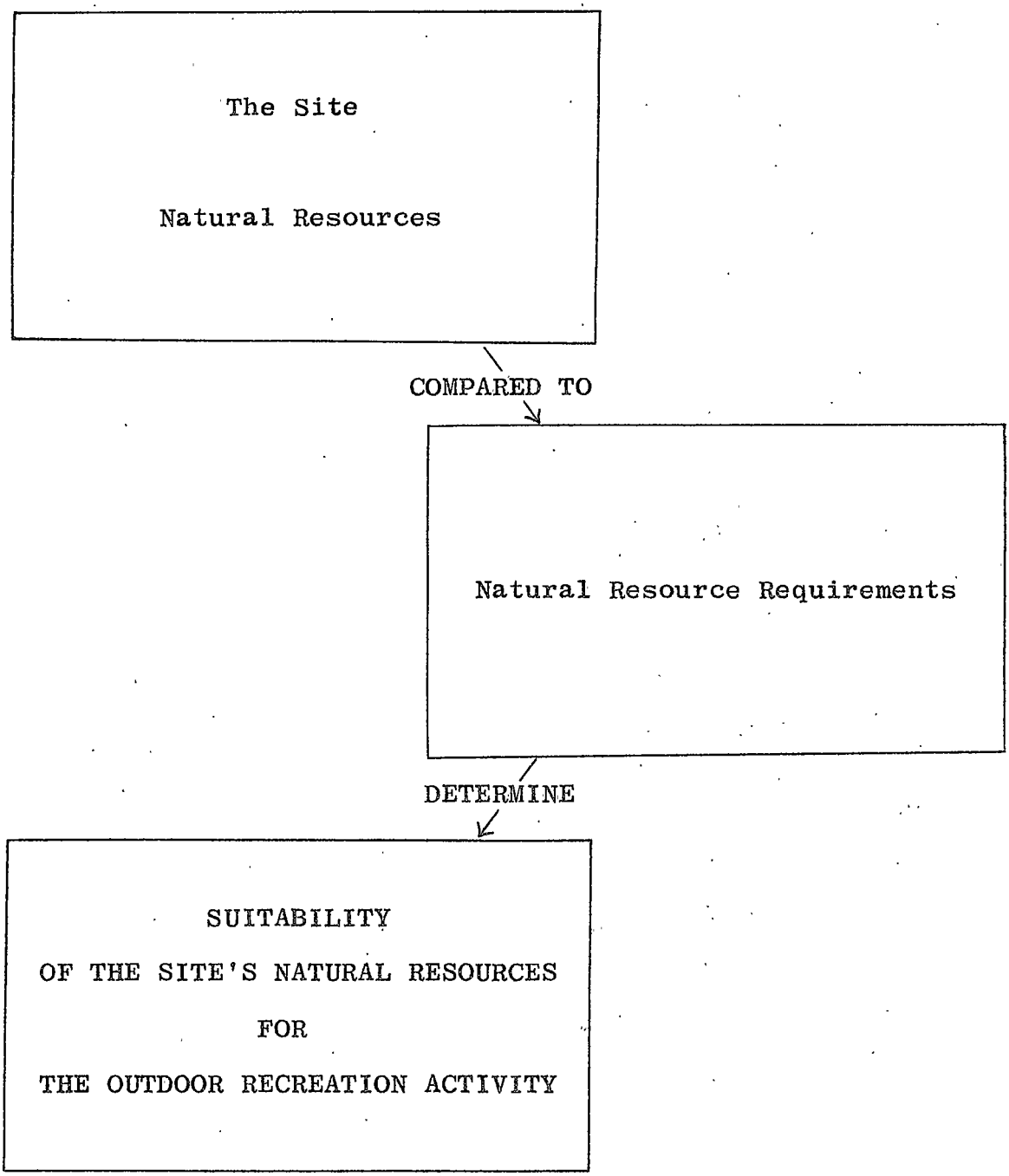


Figure 5. THE SUITABILITY RELATIONSHIP

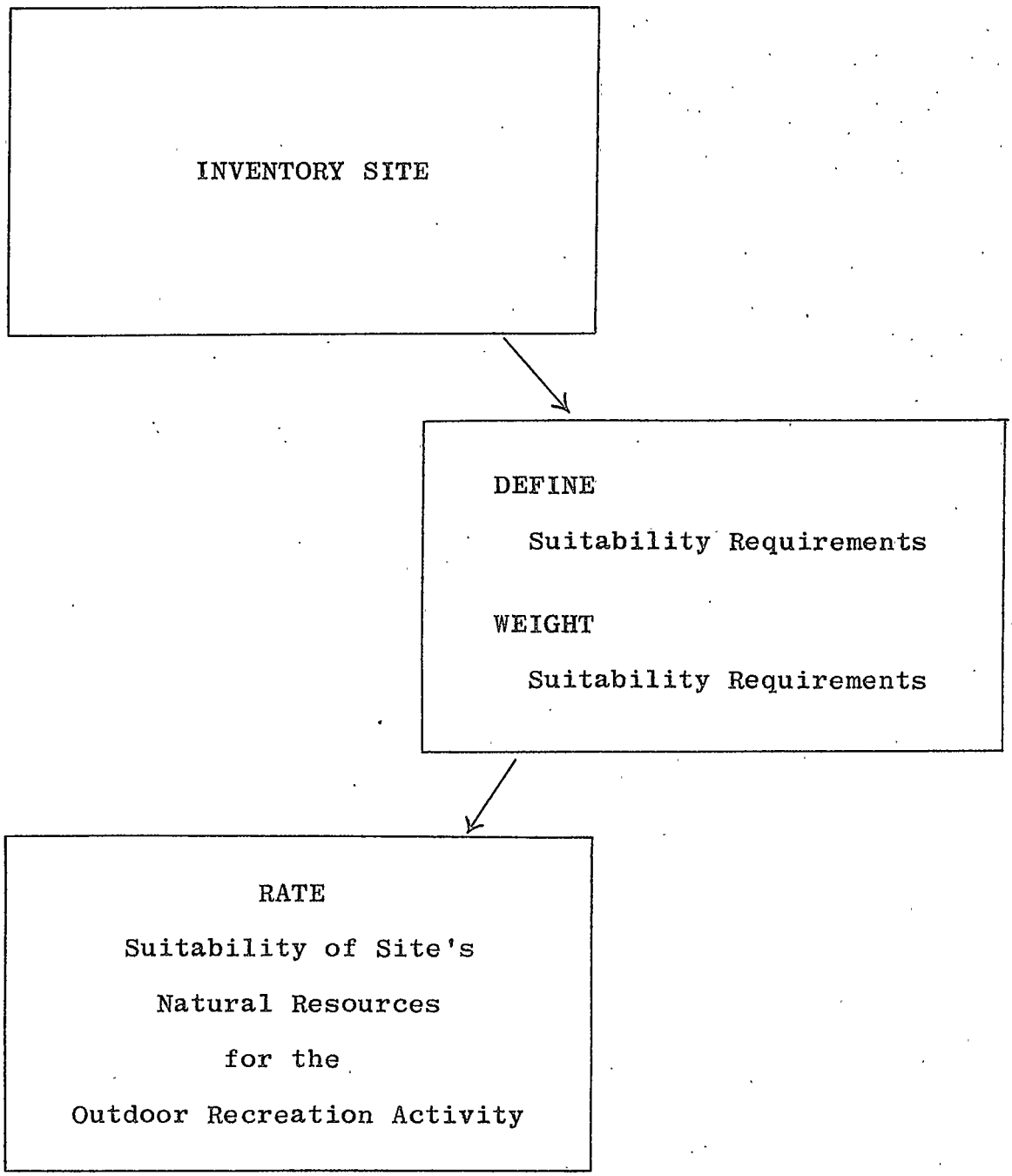


Figure 6. THE FUNDAMENTAL ACTION RELATIONSHIPS OF THE PROPOSED RECREATION NATURAL RESOURCE ANALYSIS SYSTEM

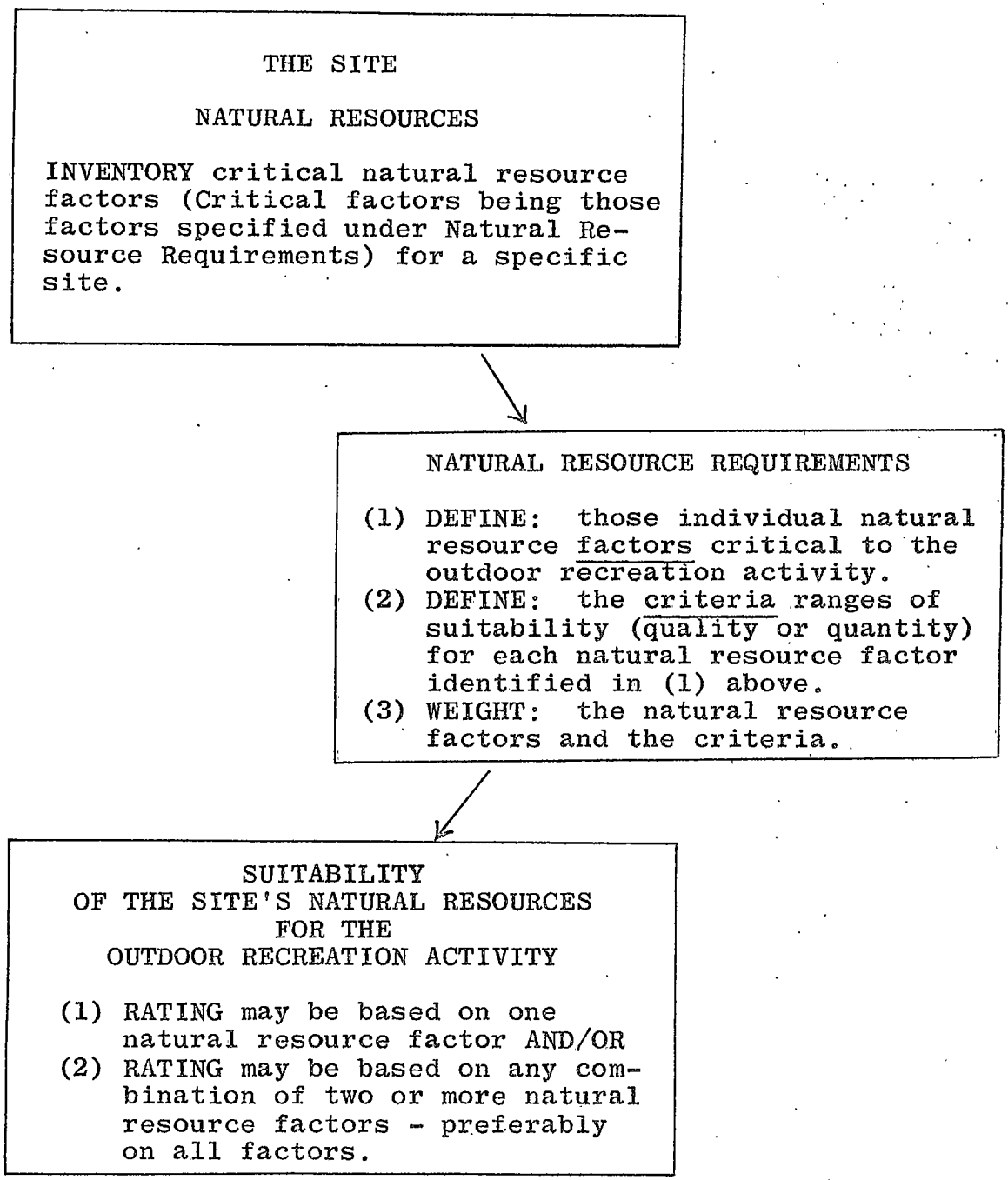


Figure 7. AN EXPLANATION OF THE PROPOSED SYSTEM'S FUNDAMENTAL ACTION RELATIONSHIPS

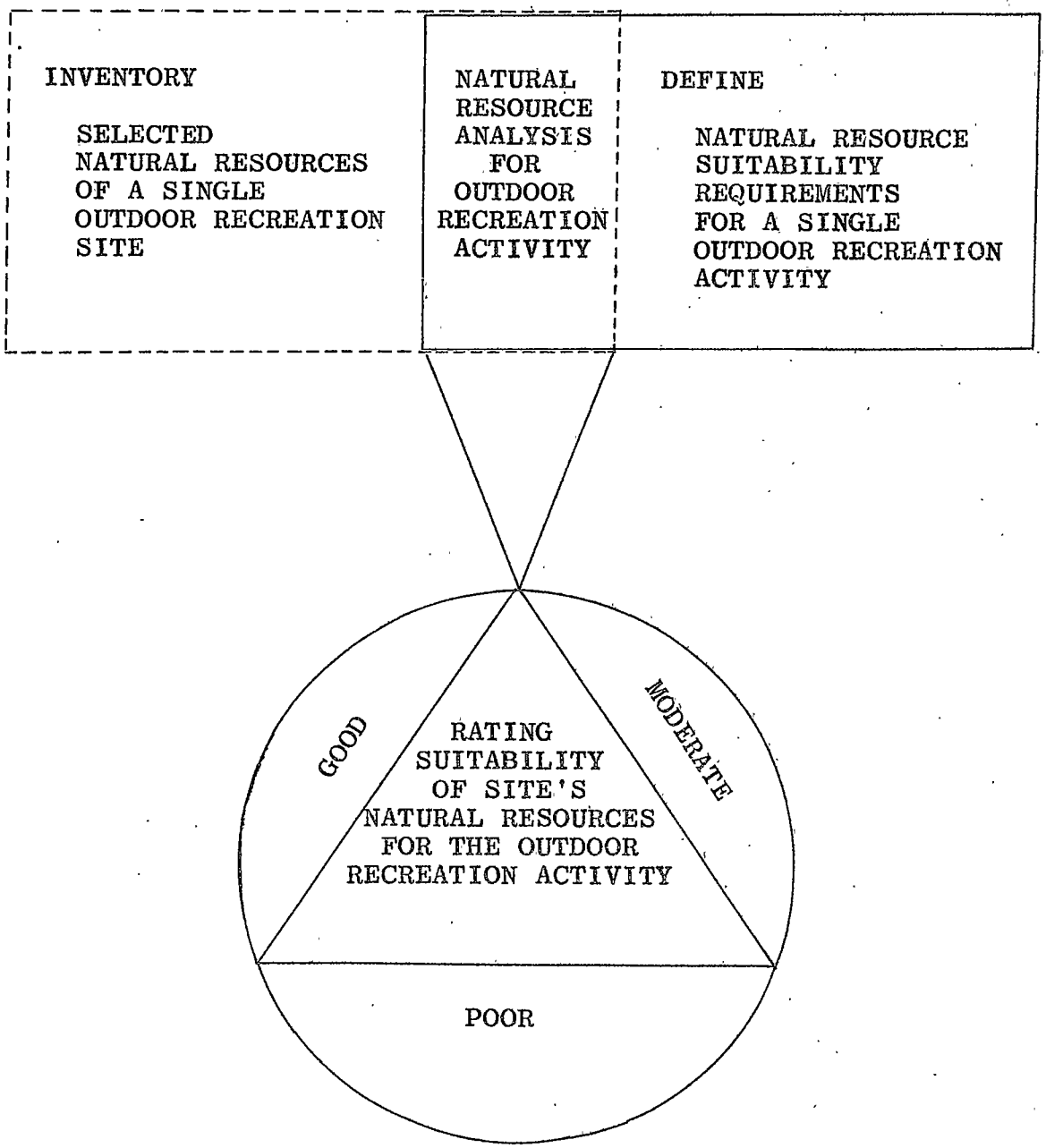


Figure 8. THE PROPOSED RECREATION NATURAL RESOURCE ANALYSIS SYSTEM

PROCEDURAL GUIDELINES FOR THE PROPOSED SYSTEM - The fundamental relationships introduced in Figures 1-8 may now be expanded upon. A diagramatic explanation of the principles involved in the proposed analysis system is presented in Figure 9. Using this diagramatic format, an applied example is given in Figure 10. It may be observed that again three basic general areas are involved: (1) Inventory of the Site, (2) Establishment of the Natural Resource Requirements, and (3) A Numerical Evaluation.

To determine the quantity and/or quality of natural resources present on the site constitutes the inventory portion of the analysis procedure. The site data may be acquired by reviewing existing inventories done of the site and extracting the data needed. However, since the inventoried data must relate to the ranges established in the natural resource requirements, many of the existing surveys may not contain the data needed. Therefore, it will be the responsibility of the individual or agency (interested in rating the site's natural resource suitability) to perform the natural resource inventory. The method of inventory is left to the discretion of the inventorying agency. If the total project were to involve a relatively small area or if unlimited personnel were to be available to assist in the analysis, then perhaps a

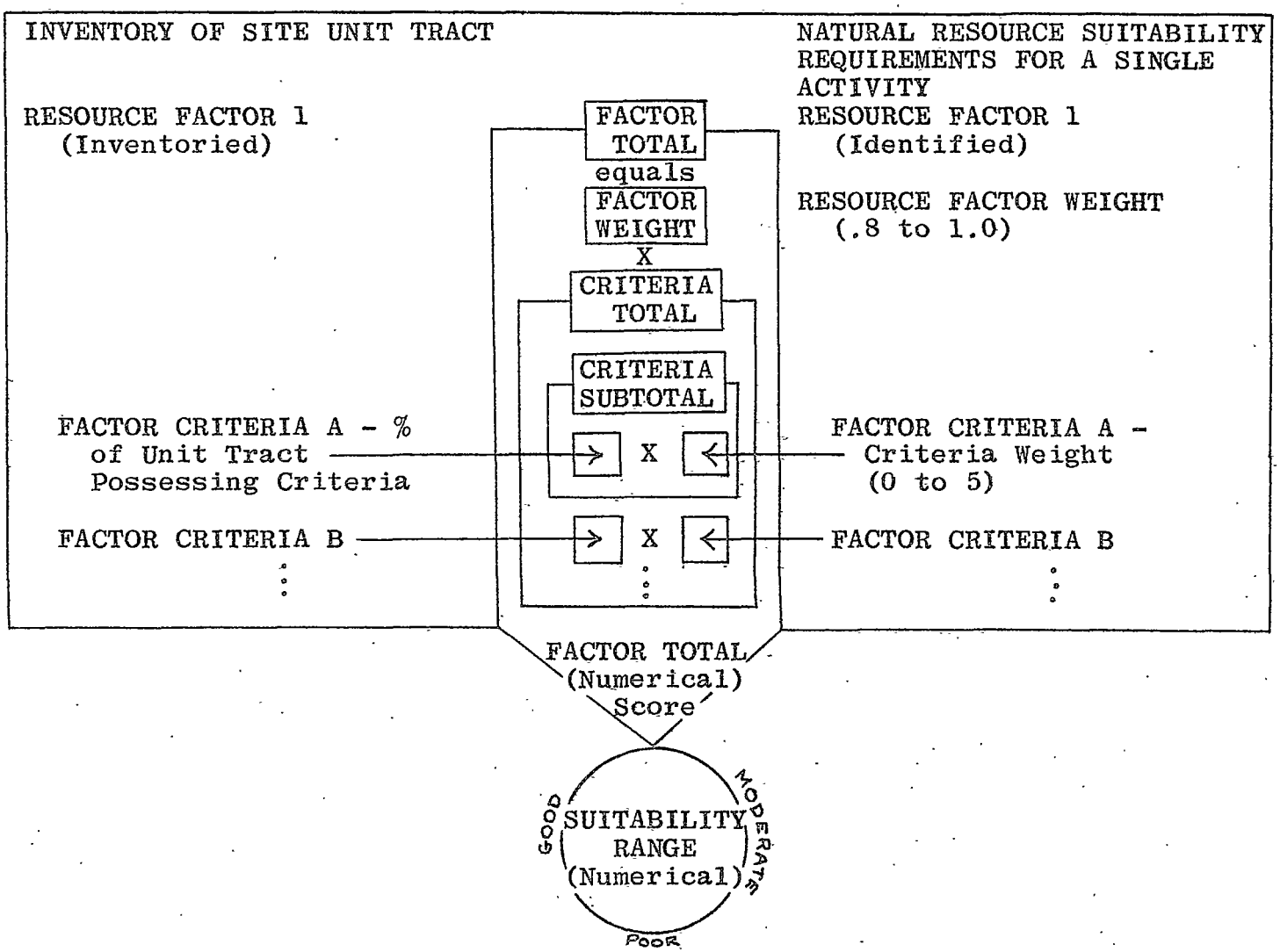


Figure 9. APPLICATION DIAGRAM OF THE PROPOSED RECREATION NATURAL RESOURCE ANALYSIS SYSTEM NOTE: Using Only One Natural Resource Factor

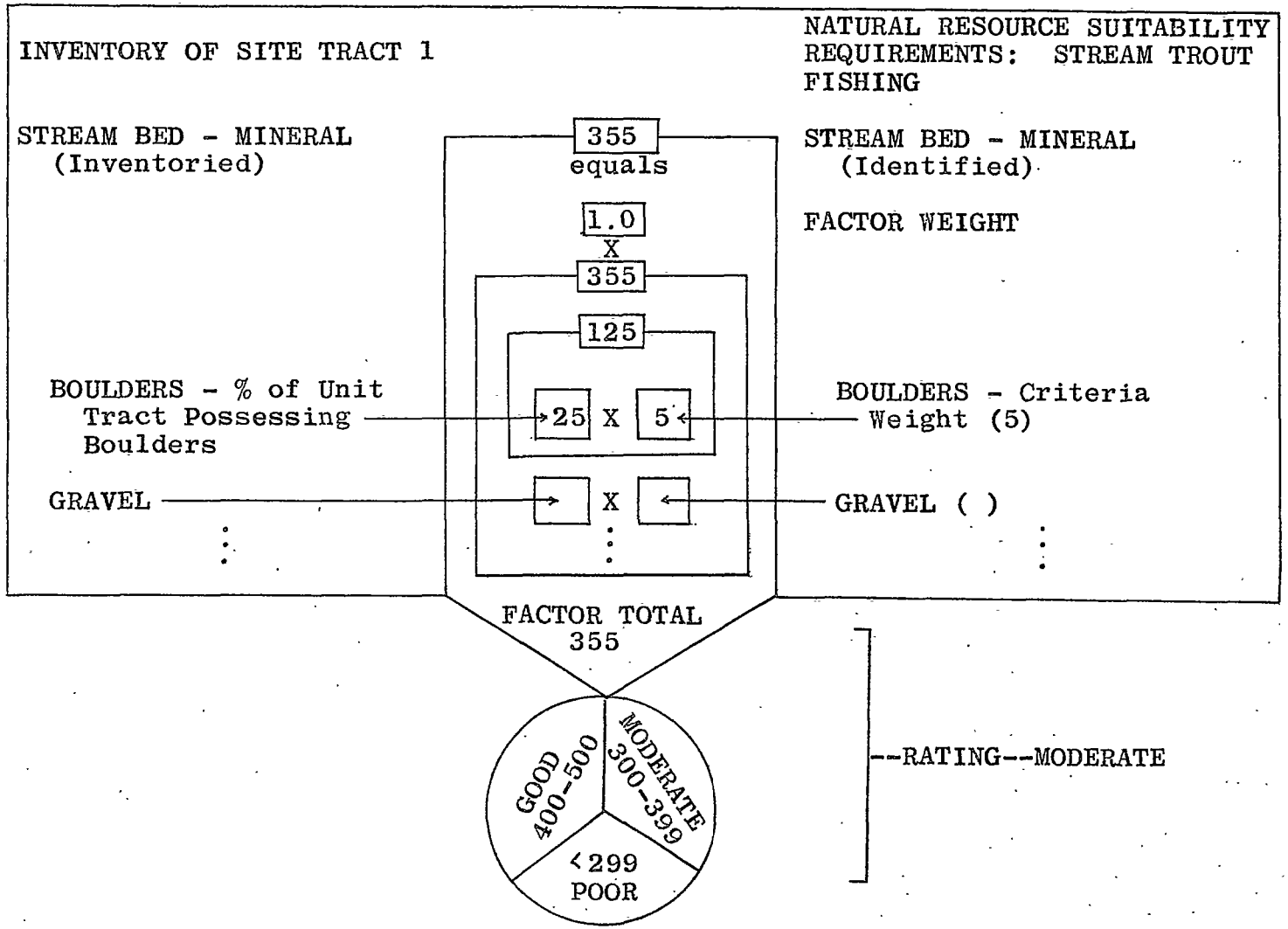


Figure 10. APPLICATION DIAGRAM (Example)

detailed on site analysis would be possible and desirable. This unfortunately, is not often the case. Rather, the areas to be analyzed are often large and the personnel available are limited. Therefore, inventory procedures that supplement a personal on-site inventory are often desirable. For example, the use of aerial photographs is an excellent means of supplementing on-site surveys (see the methods applied in the fishing analysis). For some recreation activities, the site inventory may be of the total area as a single unit; while for other activities, the site inventory may involve the separate inventory of unit tracts (a unit tract is defined as that land area that is individually and independently inventoried). The inventory procedure involved in the proposed system requires that percentages be determined, each representing that part of the unit tract which possesses a particular natural resource criteria. A visual aid which may be used in determining on-site percentages is the illustrated Chart for Estimating Proportions of Mottles and Coarse Fragments (Appendix II).

The size of areas to be individually evaluated (rated) is also flexible, depending upon the intent of the evaluator. The size of the tract to be evaluated may be the same size as the total area, or it may be the size of an inventoried

unit tract, or it may be an average of two or more inventoried unit tracts. In Figures 9&10, pages 27&28, it is assumed the area being evaluated is the same size as the area inventoried. The size of area being evaluated (and/or graphically presented) depends in part upon: (1) the intent of analysis (for example, whether the analysis is to determine one overall suitability rating such as for an entire river; or to determine suitability ratings for smaller units, within a larger area, for comparative purposes such as selecting best access sites along a river), and (2) the method of data output (for example, perhaps a computer program or project unity dictates that ratings be made in designated sized unit tracts).

In any case, it is important to note in both inventory and evaluation that analysis is possible of small unit tracts, of large areas, or of combined unit tracts.

The proposed recreation natural resource analysis system is designed to incorporate numerical weighting of the natural resource requirements. This weighting will ultimately determine the suitability rating of the site for the specific outdoor recreation activity. Two general natural resource items may be weighted: (1) the resource factor criteria (subdivisions of the resource factor, and

(2) the resource factor.

In weighting the natural resource factor criteria (subdivisions of the resource factor), the criteria are established from review of existing research literature. The weighting values range from 0 (a criteria which in excessive quantity has the potential to destroy the site's suitability for that activity) to 5 (a criteria that has excellent suitability for the activity). The criteria weighting is a judgement made by the individual or agency who initially establishes the guidelines for that activity. It is based on the "best knowledge" available at that time. A "spread" of criteria is established for each resource factor. The spread is intended to encompass best (weight 5) to worst (weight 0 or 1). These limits are determined by interpretation of research data. In some cases, it may be possible from review of research data to establish only one of the limits. In any case, any values (2, 3 or 4) assigned to criteria between limits represent further interpretations of the research data, and an attempt to establish a range of values between limits. Once the weights are established, they should remain constant (for anyone using the system for that activity) until better knowledge becomes available (see the Section, "Adaptability", page 127. To apply the

criteria weighting, the criteria weight (0 to 5) which is established for each resource factor criteria is multiplied by the percentage of the "unit tract" (the tract of the site being inventoried at one time) which possesses that factor criteria (refer to Figures 9 & 10).

The other item to be weighted was the resource factor. The weighting range for resource factors was from .8 to 1.0. The purpose of this weighting is to allow the individual or agency using the system, some flexibility when grading the relative importance between resource factors; as well as a means of indicating the strength of the research basis used for criteria identification. For example, if the resource factor and its relationship to the outdoor recreation activity is well established by research, then a weighting of 1.0 should be given that factor. On the other hand, if the resource factor's relationship to the outdoor recreation activity is not well documented or if this factor is of less importance than other factors, then a .8 or .9 weighting may be used. Therefore, a .8 or .9 weighting of the resource factor will indicate either a relatively less important factor in the activity rating and/or a lack of resource criteria documentation based on research findings. See Figure 11, page 33, for a detailed explanation of this