PROFESSIONAL PAPER

A DISCUSSION OF ECOLOGICAL MANAGEMENT IN THE NATIONAL PARK SYSTEM

Submitted by

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In partial fulfillment of the requirements

for the degree of Master of Science

Colorado State University

Fort Collins, Colorado

August, 1968

COLORADO STATE UNIVERSITY

August 1968

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ENTITLED A DISCUSSION OF ECOLOGICAL MANAGEMENT IN THE NATIONAL PARK SYSTEM

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science.

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Committee on Final Examination

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ABSTRACT

A DISCUSSION OF ECOLOGICAL MANAGEMENT
IN THE NATIONAL PARK SYSTEM

The basic theme of this paper is to discuss the management of the category known as "natural areas" within the National Park System. The natural areas are identified by their unique natural features and their management emphasis, which is to perpetuate the natural scene in an essentially unimpaired state.

Traditionally, the natural national park areas have been managed by a policy of strict protection. As the growing science of ecology developed concepts about the "land organism" it became apparent that a policy of strict protection was not sufficient to insure naturalness, and in certain instances actually impeded the natural processes.

As a result of the growing sophistication of land management practices and an added impetus provided by the scientific community, the National Park Service revised its administrative policies in 1967. The new policies emphasize active management of the national park resources. The ultimate goal is to manage the park resources in a way that will produce a "vignette of primitive America".

The ecological management of these natural areas presupposes an insight into the nature of biological naturalness

and this paper, in part, endeavors to explore that aspect. A significant divergence in viewpoint of the various "schools" of ecological thought concerning the nature of biological naturalness is apparent. Individuals responsible for the management of park resources should be aware of this controversy and its implications.

A major tenet in ecological park management is conceptualizing the park resources as ecosystems. An ecosystem is an energy oriented concept, involving the interaction of the biotic realm with its abiotic environment.

Change in the natural ecosystems of the park-scape is brought about both naturally (ecosystem-induced) and unnaturally (man-induced). The new focus of the National Park Service will be to manage that change in such a way as to achieve as natural a situation as possible.

A national park, in addition to being a repository for naturalness, is also a social institution. As the National Park Service departs from its traditional management policy of strict protection the socio-political aspects of new active management techniques must not be neglected. Techniques for innovating ecological management must remain within the limits of societal concensus. Experimentation, such as allowable wildfire burns, restriction of traditional uses, etc., must be accompanied by a program of public enlightenment.

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ACKNOWLEDGEMENTS

For the opportunity to participate in the graduate program of which this paper is a part, I am indebted to the National Park Service, and to that organization I wish to express my appreciation.

Particular thanks go to my adviser, Dr. Arthur T. Wilcox, and to the members of my committee: Dr. R.B. Held, Dr. Robert Hacker and Dr. Harold Hagen for their advice and assistance.

To my family for their patience and to my typist, Mrs. Marilyn Sitzman who deciphered the rough draft, I wish to extend my gratitude.

TABLE OF CONTENTS

CHAPTER I

THE PROBLEM AND APPROACH

Introduction

The National Park System embodies a social concept of land use which is a unique contribution to world culture. It has evolved from a modest beginning with the establishment of Yellowstone National Park in 1872 to a diversified system of parks, monuments, recreation areas, and other national shrines. It has served as a model for other countries throughout the world in their efforts to develop systems of national parks. Although the National Park System has expanded and grown in complexity to encompass a variety of areas with varying management goals, it remains a repository for many of the priceless natural environments on the continent.

To clarify the relationship of these diversified areas the National Park Service[1] has recognized three general categories of areas: natural, historic and recreation. There is an inherent amount of overlap, but every unit within the System may be placed within one of these three categories. Management objectives vary, to some degree, in each case (Administrative Policies 1967).

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[1]Hereafter referred to as Service.

The Service is operating under its 1916 mandate from Congress and their mission is well outlined in the following excerpt from that act (Ise, 1961):

> "The Service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

It is the "natural area" category with which this paper will deal and the spirit of natural area management has been well delineated in this legislation and in successive statements of policy.

Discussion of the Problem

Traditionally the Service has strived to fulfill its public trust. Management of park resources in the past has, in effect, centered around a "hands off" policy; that the best management is no management and that natural areas within the system should exist as self-regulatory ecological units (Robbins, et al., 1963). Safeguarding the parklands has centered around a policy of strict protection from both human and natural depredation. The very success of this course of action has, in part, led the Service to a dilemma which it is now having to face.

As the science of ecology develops and concepts about the "land organism" are developed, it is becoming apparent

that protection alone is not sufficient to insure the preservation of the "natural" parks and monuments. Speaking of the concern now being voiced about this dilemma, Frazer Darling (1967) said ". . . that unless a biologically informed policy is fully accepted and initiated immediately, the status of the national park heritage is going to deteriorate in all those qualities which inspired its designation."

It is now obvious that if biological naturalness is to be the acme of the Service's resources management objectives, then active manipulation of those resources will be a necessity. In a sense, through a "protection only" policy of resources management, the natural ecosystems have been manipulated. Natural processes have been retarded, even changed. This is especially true of the "frustrated" role of fire in perpetuating a natural and ecologically dynamic park-scape.

> "In nature, fire is a great regenerative force, one might even say rejuvenative force, without which plant and animal succession, in the absence of climatic upheaval or physiographic cataclysm (or at least of great climatic or physiographic change), would be retarded so that old, senescent, and decadent communities would cover the earth. I have been unable to find a single exception to the rule that fire always changes the succession to a younger stage. The intensity and the frequency of fire determines how youthful such a stage will be. Without fire, plant succession ultimately seems to lead to catastrophe, for increased hazard to fire apparently is in direct ratio to age. The older plant communities become more and more vulnerable to fire until finally, unless some violent upheaval occurs, fire rejuvenates the succession, sometimes even to the bare rock itself" (Komarek, 1962).

Fire, of course, is a dangerous tool and its use in perpetuating biological naturalness is both emotionally and

politically charged as well as being physically hazardous. It is singled out because of its importance and illustrative value, but it should not be inferred that it is the only natural process that is now being checked. The Service in their 1967 revised policy guidelines for natural areas succintly stated the new approach: "Passive protection is not enough. Active management of the natural environment, plus a sensitive application of discipline in park planning, use and development, are requirements for today."[2]

A second major influence affecting the objective of biological naturalness is the influence of man himself. The impact of man in many instances has ceased to be negligible and park visitation has increased explosively. Both this fact and the accommodations that must be made for the visitors have taken their toll.

At this juncture, it should be clearly pointed out that parks are for people and they exist only because of their contribution tc social welfare. There can be no other reason for their existence. They are, however, to be used in such a way that will not significantly alter the natural evolutionary processes that take place within them. This is in the nature of a paradox--preserve, but use.

"A national park exists in an intricate complex of political, social, legal, intellectual and sentimental factors" (Darling and Eichorn, 1967). Attention to biological

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[2]See Appendix A for the complete 1967 statement of the Service's resource management policy.

detail must reflect these realities. Policy devoid of these considerations will be more in the nature of a wish of the ecologically sensitive than within the context of effective policy.

What the Service is now seeking is a viable expression of its commitment to ecologically manage its trust. It should not be construed that this approach has been entirely lacking in the past. It has not. It is simply that expedience as a controlling factor in the Service's decisions relating to resources management will be subverted to ecological considerations. This, combined with a formal recognition that biological naturalness cannot be achieved through a policy of strict protection, will guide future planning and management practices.

Approach

It is the purpose of this paper to explore the one avenue through which an ecologically enlightened approach to park management may be taken. That approach is through the understanding and application of the ecosystem as a management concept.

This exploration will involve a survey of contemporary ecological thought concerning the ecosystem and the nature of biological naturalness. I shall then relate these views and their implications to the natural area management goals of the National Park Service.

An area within the National Park System is inseparably enmeshed within a socio-political matrix; therefore I shall

conclude with a brief discussion of the "biopolitical" aspects of this new approach to park management. Selected examples used to illustrate certain aspects of this paper will be taken from Rocky Mountain National Park.

CHAPTER II

CONTEMPORARY ECOLOGICAL THOUGHT

> "Every theory of the course of events in nature is necessarily based on some process of simplification of the phenomenon and is to some extent therefore a fairy tale."
>
> Sir Napier Shaw (1926)

The development of perspective concerning the nature of biological naturalness and the ecosystem is requisite to their application in park management. It is the endeavor of this chapter to seek that perspective, and to do so on a conceptual level.

Biological Naturalness and the Community Concept

A basic problem that must be faced by the Service is the determination of what in fact biological naturalness really is, and by what processes is it reached. This is best accomplished by examining that level of biological organization known as the community. It is at this level where biotic assembleges (populations) integrate to form a discernible part of the total landscape. Also, it will for the most part be the plant communities (with their resident and transient fauna) that will serve as a practical focal point in defining the Service's terrestrial management units.[3]

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[3]This paper will deal with the total park environment but the primary emphasis will necessarily focus on the terrestrial aspects of the "park-scape".

Although many variations exist, a good representative definition of community is offered by Odum (1959).

> "A biotic community is any assemblage of populations living in a prescribed area or physical habitat; it is a loosely organized unit to the extent that is has characteristics additional to its individual and population components. It is the living part of the ecosystem."

The literature offers a bewildering array of terminology and theory as to what constitutes the processes by which a community is formed and in fact the question even arises as to whether an individual community can truly be defined. This is particularly relevant in the manipulation of the "park-scape" to represent and maintain biological naturalness since there must be some standard as to what is natural and what is not.

Man has very likely always been at least cognizant of the spatial relationships of organisms. Prehistory man may not have "intellectualized" these relationships but he had to take advantage of them for his existence.

One of the earliest recorded observations concerning the spatial relationship of plants was made by Theophrastus (teacher of Aristotle) about 300 B.C.: "Now all grow fairer and are more vigorous in their proper positions . . ." (Theophrastus--circa 300 B.C.).

Pioneering studies concerning the community would have to include those done by Forbes (1844) and Mobius (1877). Both studied animal communities in the sea; Forbes describing the spatially distributed communities ("provinces of depth") and Mobius who perceived community interaction as well as

between its nonliving environment. What proved to be the really pertinent studies of community ecology began about the turn of the century and were largely directed toward plants.

The phenomenon of succession is particularly important as a characteristic of the community and as this paper develops, it will become apparent that the nature of succession has great implications in realizing the Service's goal of perpetuating biological naturalness.

Outstanding among the early studies of succession is Henry Cowles (1899) classic paper concerning succession of the vegetation on Lake Michigan sand dunes. In his paper, an effort was made to analytically describe and translate the static scene into a continuously changing and dynamic process.

From Cowles' studies there emerged a formal recognition of the directional, and orderly replacement (succession) of one "formation" by another--this being dependent on the changing "life conditions". He also emphasized as one of the "fundamental principles of ecological plant groupings," that it is "comparatively seldom that any single species can be regarded as perfectly characteristic of a formation, while a group of five or ten species can be so selected as to enable one to detect that formation almost anywhere within a large area" (Cowles was using the word "formation" in the sense that plant community is used today).

Also early on the scene and worthy of mention was the Danish botanist, Eugene Warming. In addition to recognizing the descriptive aspects of community development, he became concerned with processes, e.g., why species have certain habitat preferences and why they congregate to form definite communities (Warming, 1909).

A controversial landmark in the philosophical development of the community concept was the work of Frederic Clements (1916) who published a monograph on the nature of plant succession. Clements based his theory on the premise that the developmental study of vegetation rested on the assumption that all succession leads to one climax type which is ultimately determined by climate. This monoclimax theory takes into consideration intermediate stages of succession ("seres") that may appear static, such as those due to soil, fires and other factors that appear to stabilize the community in a kind of equilibrium. However, the overriding aspect of climate will be the final determinant of climax.

Clements also equated the plant community with an organism that "arises, grows, matures and dies". Further inferences would be that the maturation process and the structure of the community offer a record of its development with function acting as a clue to that development. Once the ultimate stage (climatic climax) has been reached the stabilization will be achieved through the dominance of the species possessing the life form to control the community. That assemblage will remain dominant until the climate

changes or unless a more suitable dominant chances in from another region.

Contemporary with Clements and on the European scene was Josius Braun-Blanquet whose viewpoints gave rise to the Zurich-Montpellier "School" of phytosociology. Braun-Blanquet, like Clements, held to the "organismic" concept of a community and also put great emphasis on a "perfect knowledge of the floristic composition of the association" (community), and especially on "characteristic species". This implies that the plant community is a discrete, identifiable unit of the landscape, delimited by species showing a kind of exclusive fidelity to the community (Braun-Blanquet and Ernst Furrer, 1913).

Although the viewpoints of Clements and Braun-Blanquet had a profound influence on ecological thought they have received considerable criticism.

H. A. Gleason (1926) believed that plant communities resulted from utter randomness and he questioned their objective reality. It was his idea that the process of community establishment is the result of a combination of seed (and spore) availability and varying degrees of environmental hospitality towards the potential residents. The species that were destined to be dominant would have to have an abundant (and presumably nearby) stock source; would have to be available for colonization; and finally would have to be greeted by a receptive environment. In other words, any given plant community is a kind of "happening" and there is

no reason to expect consistency from one area to the next, nor to believe in the definiteness and distinctiveness of plant communities.

Contemporary with Gleason in a similar approach, yet working independently, was the Russian, L. G. Ramensky (1926). He too believed in a vegetation continuum and the non-discreteness of the community. Ramensky debunked the idea that large areas could be understood through the analysis of small parts and spoke decidedly against a classification of inflexible units. He concluded that "plant cover mcdifies itself continuously in space" and that "each species reacts to the other unique factors and occurs as an independent member of the (community). . . ."

These viewpoints (that community uniqueness is a result of random establishment made by environmental selection) gave rise to the concept of the "continuum" which was formalized by Curtis (1951) and Whittaker (1951). The continuum concept recognizes a pattern of overlapping populations distributed along a gradient. The extent of a given population's distribution would be a function of its particular tolerance range to conditions along the gradient.

Stanley Cain (1947) also takes a critical look at the tenets of the phytosociologists and attempts to show their conceptual error. His viewpoint is similar to Gleason's. According to Cain, "The drawing of a parallel between

associations (communities)[4] and species is not tenable. The members of a species are related by descent and reproduce their kind; the members of an association have no such genetic connection".

Fortifying Cain's viewpoint, Billings (1952) states that:

> "Every plant species is distributed according to the tolerance ranges of its own ecotypes and biotypes. It is independent of other species except where individuals of other species constitute an integral part of its environment. It grows where it does because the whole environment in space and time fits its genetic requirements and time and the environment have allowed its seeds or propagules to reach that place. Communities result from such independent distribution and vary gradually or sharply as the environment varies."

I interpret these statements as implying that the community per se does not depend on genetic antecedents for its existence. It would follow, therefore, that the idea of viewing community development as the result of processes operating from an imperative is not valid.

Elaborating further, Cain (1947) focuses on entities which are themselves facts as opposed to abstractions which are treated by the phytosociologists as facts. As facts, Cain includes species, the areas of the species, environments, habitats (best described for small areas), life forms of a species, and the physiognomy of an aggregation of a species. An <u>individual community</u> is a fact, i.e., the individuals that compose the community, their boundary (indefinite as it

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[4]The words association and community should be interpreted <u>here</u> as meaning the same thing. Unless otherwise indicated the word community will refer to the "plant community".

may be), and the circumstances under which they grow are real, therefore they are facts. The concept of community is abstract and artificial, therefore one must not expect consistency as an imperative from one community to the next. Similar communities over a large area would be explained as being a product of similar circumstances, not a homology but again a kind of sophisticated "happening". This would be true, even if one might be able to successfully predict their composition.

One aspect of the controversy worthy of further mention in this discussion is the question of what finally determines a climax. The "Clementsian" viewpoint conceives the climax situation as being ultimately controlled by climate, i.e., in any given situation, over time, the vegetation will approach a dynamic equilibrium as a function of climate. This has become to be known as the monoclimax theory. An opposing viewpoint (the polyclimax theory), recognizes the importance of climate; at times its controlling importance, but maintains as unrealistic the hypothetical "over time" controlling aspect of climate. The polyclimax adherents hasten to point out that all "local factors" would never be neutralized by climate, therefore equal status should be given to those "terminal communities that develop in habitats whose usually local features have a controlling influencing . . ." (Oosting, 1956). In polyclimax terminology, special adjectives are used as prefixes, e.g., edaphic climax, fire climax, salt spray climax, etc.

Whittaker (1953) proposes that "there is no absolute climax for any area and climax composition has meaning only relative to position along environmental gradients and to other factors." Following this line of reasoning, Whittaker said that:

> "In general, climax status should be determined not by abstract or generalized conceptions of what should be ultimate, but by what populations actually replace other populations and then maintain themselves."

The previous discussion does not represent a thorough review of all contemporary viewpoints concerning the nature of the community concept. It does, however, represent at least a thread of continuity as to its development and divergence of viewpoint. No viewpoint was presented that does not have contemporary advocates. Also, to anticipate questions concerning the relevance of what appears to be mostly an academic inquiry, I would offer the following two reasons: First, it is fundamental that at least an appreciation be developed for the biological basis of what the Service will be using to develop a management concept; and secondly, the divergent viewpoints concerning the very nature of the biological concept itself. The basic dilemma that the Service faces (or at least must be aware of) is who will be the definitive authority as to what ultimately represents biological naturalness? This point will be developed further at the conclusion of the chapter.

The discussion up to this point has largely ignored the mention of animals, i.e., fauna, inclusively. The fact that

the fauna is an inseparable part of the community is implicit in any discussion concerning community dynamics:

> "In the functioning system the balances among plant populations exist in relation to, and are partially determined by, animals acting directly on the plants through consumption and trampling, indirectly through soil, etc." (Whittaker, 1953).

It is because the plant community generally stays put that it serves as a convenient frame of reference. The plant community forms a framework upon which the animals depend either directly or indirectly. In a sense, as the plants "go" (realizing that the animals may be helping them "go"), so "go" the animals. Manipulation of the park biota to achieve the goal of biological naturalness will be directed largely towards perpetuating vegetative naturalness. For example, when control of excessive ungulate populations becomes necessary it is primarily due to intolerable pressures brought to bear on the vegetation; hence the particular emphasis on the vegetative aspects of the community.

The Ecosystem Concept

Although the concept of the ecosystem has always been inherent in dynamic ecology, the use of the term and formalization of the concept is relatively recent. Professor A. G. Tansley (1935) coined the term and wrote an exposition on the concept:

> ". . . the . . . fundamental conception is as it seems to me, the whole system, including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome--the habitat factors in the widest sense. In an ecosystem the organisms and

> the inorganic factors alike are components which are in relatively stable equilibrium. Succession and development are instances of the universal processes tending towards the creation of such equilibrated systems."

Tansley's elucidation of the concept remains basically unchanged. A number of ecologists have advanced similar definitions.

> "The ecosystem may be formally defined as the system composed of physical-chemical-biological processes active within a space-time unit of any magnitude, i.e., the biotic community plus its a-biotic environment" (Lindeman, 1942).

> "In its fundamental aspects, an ecosystem involves the circulation, transformation and accumulation of energy, and matter through the medium of living things and their activities" (Evans, 1956).

> "An ecosystem is an ecological unit, a subdivision of the landscape, a geographic area that is relatively homogeneous and reasonably distinct from adjacent areas.[5] It is made up of three groups of components--organisms, environment factors and ecological processes" (Marr, 1961).

There are many other definitions which are for the most part variations of the same theme; that the biotic realm is inextricably bound to the abiotic realm.

There is some divergence of opinion as to how an ecosystem should be viewed in relation to the space dimension. Some ecologists tend to view an ecosystem as an entity with boundaries of varying degrees of distinctness (Tansley, 1935; Oosting, 1956; Marr, 1961). This viewpoint is also succinctly expressed by Van Dyne (1966):

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[5]Although the concept is basically the same, note the strong influence of the phytosociological viewpoint in Marr's definition.

> "We delineate boundaries of ecosystems chiefly for convenience of study, although some natural boundries may occur (e.g., shore lines and air-water or soil-water interfaces for aquatic systems), and man often introduces distinct boundaries, such as fences and field edges. Most ecosystems are bounded in nature by gradual and indistinct boundaries."

A broader view is taken by Odum (1959):

> "The concept of ecosystem . . . is . . . a broad one, its main function in ecological thought being to emphasize obligatory relationships. Ecosystems may be conceived and studied in various sizes."

Evans (1956) takes a similar but somehwat more inclusive view of the concept:

> ". . . regardless of the level, the ecosystem concept can appropriately be applied. In any given case, the particular level (of organization) on which the ecosystem is being studied can be specified with a qualifying adjective--for example, community ecosystem, population ecosystem, and so forth."

To carry this one step further, it would follow that the term ecosystem implies a concept and <u>not</u> a unit of the landscape, terrestrial or aquatic (Van Dyne, 1966).[6] It is the concept[7] that may be applied to a specified unit of the landscape regardless of its size and complexity of organization, be it an entire mountain range, a plant community, population of rabbits, or for that matter, a rabbit pellet.

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[6]Van Dyne, in a sense, contradicts himself by first recognizing the existence of boundaries to ecosystems and then suggesting that the ecosystem is a concept and cannot be thought of in terms of a biological entity.

[7]The concept encompassing the fundamental aspects of an ecosystem which is the flow, accumulation and transformation of energy (both solar and biogeochemical) through the medium of living things and their activities (Evans, 1956) and (Margalet, 1963).

"A single cell and its microenvironment, whether free-living or part of a tissue system, may be conceptualized as an ecosystem" (Ripley and Buechner, 1967). Although this is true, the ecosystem concept is generally applied to situations where at least several organisms are being considered (Van Dyne, 1966). Evans (1956) expands this even farther: "The ecosystem concept may indeed be more useful when it is employed in relation to the community than to the population or individual. . . ."

The implicit danger in using this concept is that one could inadvertantly view an open circuit concept in a closed circuit way. All would agree that an ecosystem in the simplest terms is the biotic world interacting with the abiotic world. This broad and vague definition may be clarified to a high degree of sophistication. All goes well until a biological-physical entity such as a pond or a grassland is given specific volumetric identity and is referred to as an ecosystem. The danger lies in a tendency to exaggerate the discreteness of the entity. A pond has fixed boundaries (although these may not be clear) but an ecosystem does not. A pond and everything that lives in it is constantly receiving (importing) energy from its surrounding environment and by the same token, is constantly discharging (exporting) energy into the surrounding environment. It then becomes clear that the ecosystem in the strict sense has no boundary. To clarify this farther, a pond has limits while a pond ecosystem does not.

The important point is that when the term ecosystem is used to identify any unit of the landscape, the unit then becomes more than a pond or a rabbit or what have you. It becomes part of a continuous system, and is both affecting and is being affected by its surrounding environment. Unless an ecosystem is thought of in these terms, it simply is "jargonism" and has no real meaning. Aldo Leopold (1941) nicely sums up this endless link by posing the following rhetorical question: "Does the wild goose, reconnoitering the farmer's cornfield, bring something more than wild music from the lake, and take something more than waste corn from his field?"

Perspective--Clarified

Schultz (1967) makes a clear distinction between the community and the ecosystem:

> "The difference between the community and the ecosystem is that in the former the observer chcoses to relegate to the environment those spatially interwoven objects (soil, air, water) which in the ecosystem the observer uses as vehicles to carry energy and matter from one object to the next."

The concept of ecosystem is clear but the problem of clarifying the nature of biological naturalness is not. The crucial question in the quest to achieve perspective is not "what is" but "what should be" and by what processes is that condition reached? That is the question the Service will have to answer first. This answer is requisite to the perpetuation of naturalness within the National Park System. I submit that it cannot be answered definitively. When the

question "what should a given community[8] be composed of" is asked, there is implicit in the question the idea that if all the data could be assembled, one could anticipate a certain community structure. This structure would be in the nature of a "given" that was "destined" to be, and would result from some sort of imperative, rather than being a function of randomness. On the other hand, if one accepts the viewpoint (and I do) that natural communities are, at least in part, a function of "randomness", then there is no imperative per se and the only "givens" are ex post facto. Therefore, predicting what should be the composition of a certain community will not be derived from an imperative but from statistical probability. This is admittedly an academic question and perhaps in the final analysis a philosophical point of view. Yet, I believe that as one gropes with these highly abstract and theoretical viewpoints he must realistically face ambiguity if that is what is presented. Lucid explanations are not always in the offing and to operate from as near a realistic frame of reference as possible will hopefully bring Sir Napier Shaw's "fairy tale" a little closer to reality.

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[8]I have assumed that although the community as a concept is an abstraction, a given community is real and it is from that level of organization which biological naturalness is best analyzed.

CHAPTER III

THE ECOSYSTEM AS AN APPROACH TO PARK RESOURCE MANAGEMENT

Resource Management Defined

The word resource has connotations which generally imply some sort of harvest. A natural resource is often thought of in terms of "extraction", e.g., timber resource, mineral resource, etc. It also implies something less than the whole, i.e., a part of the environment that is eventually to be consumed. It should therefore be made perfectly clear that these consumptive connotations do not apply to the park resource. The park resource *is* the park, and it should generally imply a non-consumptive use.

A sound working definition of park resource management was advanced during the First World Conference on National Parks in 1962.

> "[Resource] Management is defined as any activity directed toward achieving or maintaining a given condition in plant and/or animal populations and/or habitats in accordance with the conservation plan for the area. A prior definition of the purposes and objectives of each park is assumed. Management can involve active manipulation of the ecosystem or protection from modification of external influences" (Leopold, *et al.*, 1963).

Historic and Legal Basis

The current Service resource management policy[9] has been generated by changing demands on the park resources and advances in ecological thought.

The initial "management through protection" was an obvious reaction to such threats as market hunters, loggers, grazing interests, miners, vandals, etc. This concept of park management has deep roots in Service philosophy, extending back to the Yellowstone Act of 1872 (Ise, 1961). It is threaded through all park legislation, either implicitly or explicitly, including the 1916 Act creating the National Park Service.[10] An historic and legal document that serves as a basic guideline from which the Service develops resource management policy is the often quoted Lane Letter of 1918. This historic letter was written by Interior Secretary Franklin K. Lane and sent to Stephen T. Mather, Director of the newly created National Park Service. Lane's purpose was to outline the administrative policy to which the new bureau would adhere. Particularly pertinent was Lane's directive that "the national parks[11] must be maintained in absolutely

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[9]See Appendix A.

[10]See page 2 for excerpt of the 1916 National Park Service Act.

[11]The words "parks" or "national parks" in this paper refer to all "natural areas" whether they are officially designated as National Parks or National Monuments. To a certain degree this would also hold true for areas that are in the Historic or Recreation category with sizable acreages (in addition to their primary historic or recreation features) that are to be managed as if they were in the Natural Area category, e.g., Mesa Verde National Park (Historic) or Point Reyes National Seashore (Recreation).

unimpaired form for the use of future generations as well as those of our own time. . . ." Lane was not aware of the complexities such a mandate would entail, yet this goal set forth in 1918 remains viable (although not attainable) to this day. In 1964 Stewart L. Udall, Secretary of the Interior, included the following reaffirmation of the Lane Letter in a memorandum to the Director of the National Park Service.

> "The principles enunciated in this letter have been fully supported over the years by my predecessors. They are still applicable for us today, and I reaffirm them."

In a sense the phrase "unimpaired for future generations" has become an institution, even a kind of ideology, for the preservation oriented conservationists.

The best way to fulfill this change was envisioned by the Service as letting nature take its course. This goal was to be achieved through a policy of protection. Unfortunately this is not what happened. Summarizing the contradiction, Lyle H. McDowell (1968), the Service's resource management chief, made the following remarks:

> "Protection as a management concept was steeped in emotionalism and sentiment and coated with the best of intentions but unfortunately it was misdirected."

> "Nature did not run its natural course. Nature was 'aided' by 'selective protection'. 'Good' resources were protected from 'bad' resources. Ungulates were good--predators were bad; trees were good but nature (sic) insects and diseases were bad; fire was all bad; reptiles were generally bad; flowers were good but poison ivy was bad; etc., etc."

The purpose of this paper is not to lament and dwell upon past mistakes. Suffice to say, that over the years,

the Service has become considerably more sophisticated in its approach to park management.

The newly published Administrative Policies (1967) are a combination of the best of the old and an expression of the collective thinking and research of ecologically sensitive people and competent scientists both in and out of the Service.

In order to synthesize this thinking and research, and give direction to the goal of ecological park management, the Secretary of the Interior requested two studies. The first to be released was the report by his Advisory Board on Wildlife Management with A. Starker Leopold serving as chairman.[12] Their report has received much acclaim and is known as the Leopold Report (Leopold, et al., 1963).

Although the Leopold Report's specified purpose was to offer recommendations concerning wildlife management (which it did), it encompassed a much wider spectrum of park management philosophy. Following are excerpts from the report that aided in dispelling the "protection only" policy and gave scientific sanction to new policies:

> "As a primary goal, we would recommend that the biotic associations within each park be maintained, or where necessary recreated, as nearly as possible in the condition that prevailed when the area was first visited by the white man. A National park should represent a vignette of primitive America."

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[12]The members of the Secretary's Advisory Board were composed of an astute body of well-known scientists.

> "Restoring the primitive scene is not done easily nor can it be done completely." [Yet], "A reasonable illusion of primitive America could be recreated using the utmost in skill, judgement, and ecologic sensitivity. This in our opinion should be the objective of every national park and monument."
>
> ". . . observable artificiality in any form must be minimized and obscured in every possible way." "Above all other policies, the maintenance of naturalness should prevail."

The recommendations of the Advisory Board have been embraced by the Secretary and have been incorporated into the Service's revised Administrative Policies (1967).

The second report requested by the Secretary was from the National Academy of Sciences. An "Advisory Committee to the National Park Service on Research" was appointed, and instructed "to submit to the Secretary . . . a report on the natural history needs and opportunities in the National Park System" (Robbins, et al., 1963).

This Report[13] clearly focused on the need for the Service to become more research oriented, especially with "problems directly relatable to park management questions. . . ." According to the report, the Service's research program "had lacked continuity, coordination and depth." Also, it was "inconceivable" that the national parks, regarded as "one of the finest examples of our national spirit, should not be provided with sufficient competent research scientists in natural history as elementary insurance for the preservation and best use of the parks." In 1962, funds allotted for

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[13]Known as the Robbins Report.

research amounted to one cent per visitor and six-tenths of a cent per acre.

Following are several excerpts from the Robbins Report that augment the Leopold Report and help to further crystallize the principle of ecological management as a replacement for the strict protection policy.

> "The committee believes that the purpose of the national parks should be the preservation of nature, the maintenance of natural conditions, the avoidance of artificiality, with such provisions for the accommodation of visitors as will neither destroy nor deteriorate the natural features which should be preserved for the enjoyment of future visitors who may come to the parks."
>
> ". . . no national park is large enough or adequately isolated to be, in fact, a self-regulatory ecological unit. . . ." "This Committee believes that management of our national parks is unavoidable."
>
> "It is not enough, however, to urge that the purposes of the national parks should be the preservation of nature, the maintenance of natural conditions. Any administrator . . . is immediately faced with the questions--What state of nature? What natural conditions?[14] The biological nature, the condition of a national park when first established, with rare exceptions, has not persisted; factors within and without the limits of a park have modified it, sometimes profoundly. Should the management of a national park endeavor to restore a park to its primitive condition, maintain it as it is now, or aim for some state in between?"

The Robbins Report was sympathetic to the "vignette of primitive America" mentioned in the Leopold Report and it also appreciated the difficulties in attaining this state while so much human influence and so many environmental changes have taken place.

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[14]Refer to the discussion on the nature of biological naturalness in the chapter on "Contemporary Ecological Thought."

Apparently realizing that the "as first viewed by the white man" and "a vignette of primitive America" concept might be interpreted as maintaining parks in a fixed ecological condition, the Robbins Report stressed the following point.

> "To attempt to maintain them [the parks] in any fixed condition, past, present or future, would not only be futile but contrary to nature. Each park should be regarded as a system of interrelated plants, animals and habitat (an ecosystem) in which evolutionary processes will occur under such human control and guidance as seems necessary to preserve its unique features. Naturalness, the avoidance of artificiality, should be the rule."

These points (especially the naturalness of change), have been clarified by Heinselman (1965): Natural "catastrophes", e.g., "windstorms, insect and disease outbreaks, landslides, avalanches" have decimated natural vegetation since "time immemorial". Over time there are many possible natural landscapes for any given park area. This is a most important point.

The basic mission of the Service regarding park resources remains essentially unchanged. The new focus rests primarily in the approach to accomplishing that goal which distinguishes itself by concern for the "total [park] environment, as compared with the protection of an individual feature or species . . ." (Administrative Policies, 1967).[15]

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[15]See Appendix A, first paragraph.

The Ecosystem as a Management Concept

The nature of an ecosystem has been discussed in Chapter II. An exploration of this concept and how it relates to the primary goal of park resource management is now in order. To reiterate: That goal is to manage the park resources in such a way as to first achieve, and then to perpetuate an essentially "natural" order of events to the greatest extent possible.

> "The term 'natural' implies that there is no effective disturbance by man. Man excludes himself from nature as he chooses, or at least participates on tiptoes" (Schultz, 1967).

The following discussion will for the most part continue to remain on the conceptual level. The approach is not to list priorities or models for a resource management plan per se, but more to provide a frame of reference. Specific examples are used primarily to augment an understanding of the concept of the ecosystem and its relation to park management.

What is Ecosystem Management?

Man has been practicing ecosystem management since he began to husband the land. The field of agriculture probably offers the best known example of man's effort to utilize the concept in a practical and functional way. Here the effort is to gain maximum productivity from the available energy, and to do this on a sustained yield basis. This has been refined to a high degree of sophistication. The element of manipulating the ecosystem for some sort of tangible harvest

(food, fiber, etc.) is what distinguishes other natural resources from the park resource.[16] Hence, the basic goal of manipulating the ecosystem in park resource management activities is to "produce" an essential "purity" of the total park environment. In a sense, it is that "purity" or naturalness which is the harvest whether it be as an increment of aesthetic enjoyment by the park visitor or utilized as a primeval reference point for basic scientific research. As Heinselman (1965) points out, this goal implies management of the most precise kind.

It might well be appropriate to reemphasize that the ecosystem is an energy oriented concept and that an ecosystem may be conceptualized in any magnitude that serves the pragmatic goals of management.

There are two distinct factors that will influence the basic management goal of achieving naturalness.

First is the operative factor of the ecosystem itself, i.e., the inherent interacting influences of the ecosystem(s) producing change within itself, independent of man's activities. This constant change is an imperative but at times it (the energy) must be directed or manipulated in order to insure a dynamic natural mosaic.

The second operative factor that must be considered is the encompassing activity of man's presence, whether it be

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[16]The one exception to this is recreational fishing, a traditional use of the parks. In many parks lakes and streams that were originally barren are now being stocked and managed to produce a sustained fishery. This is a questionable practice, but it is likely to continue.

direct use by the visitor or the facilities attendant to that use. This factor of course must be accommodated, but in such a way as to maintain its influence on the ecosystem at an "acceptable" minimum. It is this latter realm that will bring about the greatest degree of compromise in the achievement of the basic goal.

> "National parks . . . are managed to minimize the impact of man and to maintain as far as possible, complete, functioning ecosystems with all their natural variety" (Eichhorn, 1966).

Although in reality, they (ecosystem induced and man-induced change) are inseparable, it will be helpful to consider these two factors separately in the following discussion.

Ecosystem-Induced Change as a Factor in Park Resource Management

This realm of biotic activity is probably the most difficult to perceive and to manage. The manipulation of this factor involves the utmost of ecologic sensitivity. Although Darling and Eichhorn (1967) imply a sense of urgency in their "reflections on policy", it does not follow that a panic-oriented action program should follow. That could be as disastrous as no action.

General ground rules may have universal application, but the areas within the system represent great diversity in ecosystem structure and function. Therefore each area will present a unique set of problems and must be treated individually. Most efforts will be virtually pioneering with little or no precedent.

Keeping in mind that this paper is primarily concerned with the terrestrial aspect of park resource management, I would again stress the importance of vegetation as a pragmatic indicator of naturalness, and a major focal point for management activity. This should in no way convey the impression that the Service is not concerned with aquatic (both fresh and salt water) as well as subterranean (caves) and hydrothermal ecosystems.

Billings (1964) views vegetation as having several main roles in an ecosystem. First, "vegetation is the great modifier of environment" by influencing solar radiation, temperature, soil moisture, soil composition, erosion rate, etc. "Thus, it indirectly determines the kinds of organisms that can live in the ecosystem."

Second, vegetation fixes energy for the entire ecosystem by capturing solar radiation and converting it into chemical energy upon which all organisms can draw. Third, vegetation furnishes the medium through which the essential elements are made available to the ecosystem's fauna and in addition acts as a synthesizer of these inorganic elements into amino acids, the building blocks of protein. And finally, "vegetation, by photosynthesis and respiration, plays a fundamental role in the cycling of oxygen and carbon."

Any endeavor to preserve (perpetuate) a park ecosystem must be an endeavor to manage and direct change. The primeval condition must first be conceived, then recreated (achieved) and finally perpetuated. This will primarily be

accomplished through the medium of the vegetation, either directly (e.g., by fire) or indirectly (e.g., removal of excess ungulates).

In order to pursue the goal of achieving naturalness an inventory of the most thorough nature must be accomplished. It should consist of the present resource (ecosystem) structure and a concerted effort to determine the primeval conditions. Neither condition, and especially the latter, lends itself to being defined with immaculate precision. The inventory would involve considerable basic research, both ecological and historical. Probably, it could never be totally completed.

When the inventory is as complete as possible, a resource management plan must be conceived that will have as its long range objective, at least a "reasonable illusion of primitive America". Or to put it perhaps in a less stilted way, a reasonable approximation of the primeval conditions that would naturally be present in the absence of influences of modern man. This will be potentially achievable inversely to the presence of man and his activities. What the approximation "should be" is a matter demanding considerable acumen. The relative accuracy of such enlightened guesswork will depend on the thoroughness of the inventory and the good judgement of the decision maker. It will also depend on a resource audit or automatic review of the status of the park resources as gauged by the objectives in the plan.

For the purposes of this paper, we can assume that all are "reasonably" accurate and thorough.[17]

> ". . . diverse analytic data cannot at present be synthesized back into anything like the whole nature of the ecosystem" (Cain, 1966).

The major problem confronting the Service is that after a primeval mosaic has been decided upon for any given area, how will it be achieved--funds, manpower, and other practical considerations not withstanding.

Once a resource management plan has been adopted as to what a given park area will try to perpetuate, the resource manager must view the park in the ecosystem context. He will not be concerned with actually implementing the plan--to manipulate and guide change in the total system. Somewhere in the process he must identify controllable management units (at least loosely). They will often take the form of the natural boundaries of the conceived primeval mosaic that is to be achieved. These will very likely be plant community boundaries since it is at that level of organization which most often lends itself to manipulation and predictability of naturalness. The management unit might, however, include something less than a community or a number of communities. Regardless of the size of the unit it will be conceptualized as an ecosystem and it is thinking in those terms that we are concerned with in this paper.

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[17]Refer to the discussion on discerning the nature of biological naturalness, pp. 20-21: Also recall Sir Napier Shaw's "fairy tale", p. 7.

According to Stone (1965) efforts to preserve natural vegetation "have largely been unsuccessful because of a failure to appreciate fully that vegetation is a living, dynamic complex and cannot be preserved in the sense in which a building or an archeological site can be preserved."

The following comments by Stone will help set the stage for a conceptual discussion of managing and directing change within the ecosystem ("ecosystem factor") without at this time considering the influence of man and his activities:

> "Even the most uniform vegetation is a mosaic created by local variations in the environment and by prior events such as fire, drought, and insect infestation."
>
> "Vegetation can only be preserved by controlling the complicated successional forces that have created it and that, if unchecked will in turn destroy it."

The Service has traditionally had a penchant for preserving dominate species. This goal, "achieved" through a policy of strict protection, is leading to "the fact that successional stages may be fast disappearing. . . ." (Sone, 1965).

The "vignette of primitive America" as proposed by the Leopold Report[18] did not mean setting the ecologic clock back and then trying to keep it there. It means the Service should manipulate the park resources [ecosystem(s)] to a point where the operative factors of the environment and the system-induced (autogenic) change would be the primary controlling factors.

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[18]Also, refer to p. 28.

The environmental factors would include a wide range of natural catastrophes which would in nature constantly be disrupting the energy flow and producing in effect a continuous parade of successional stages. These catastrophes would include: fire, epizootics, landslides, blowdown, antural erosion, etc.

This disruption of the energy flow is based on the assumption that the ecosystem (with its vegetation as visable evidence) is constantly tending towards the condition that fosters the most efficient utilization of energy for a given area; or, to put it in more popular terminology, working towards the "climax" for a given area. The impedence of these natural catastrophes has resulted in a most unnatural condition. According to the Service's new policies, they will now be guided so that the park ecosystem(s) will present a manifestation of naturalness represented by all the natural rhythms. It would be unrealistic, both from the ecological as well as the political standpoint, to let all catastrophes go completely unchecked.

It is important to clarify that the processes causing succession do not come from the environment surrounding a given community, but are generated from within. The role of the catastrophe may be to disrupt the climax condition thus creating an opportunity for succession to begin again--ultimately to reach a new climax state. Once it has started, however, succeeding successional stages ("change") will be caused by factors within the community.

> "Ecological succession is one of the most important processes which result from the community modifying the environment" (Odum, 1962).

It would appear then that the "guidance" given to a management unit ecosystem would be essentially to permit, or in the case of an "overdue" system, to initiate the circumstances which would start succession. For a given park, there will likely be areas that have achieved a "climax" and are in a state of dynamic equilibrium. There will also be areas that for some reason (hopefully because of some natural catastrophe) have not reached this stage, i.e., they are in a successional trend. This is a perfectly "natural" state of affairs, and the degree of this aspect of naturalness will oftentimes be a function of how successful or unsuccessful the protection effort has been.

Through a policy of strict protection from the controllable catastrophes such as fire, insect and/or disease there has not been the naturally induced initial point from which succession will naturally proceed. This does not make for a primeval (natural) condition, and it is this aspect of management of the resource itself which, according to the new Service policies, will be changed.

Estella Leopold (1968) succinctly sums up these ideas with the following remarks:

> "Management of natural areas must be based on continuing research, should be intimately related to the purposes for which the area was set aside, and should allow for the dynamic factors that are discovered to be intrinsic to the particular plant communities. Climax communities are subject to constant change, but changes are within the fabric

> of the community and are not progressive or antithetic to the climax types. Successional communities, however, will not long remain in a state of dynamic equilibrium. Shifts in population density and composition will bring the diminution or disappearance of some species. New species will arrive responding to the changed conditions. While the latter kind of dynamic change is natural, it is subject in nature to catastrophic, physiographic and other natural influences. Perpetuation of these kinds of communities will only be achieved through controlled burning and other techniques of active management, or else by permitting the natural catastrophic forces to work. Complete fire protection for federal lands and absence of controlled burning does not provide a natural physical environment for fire climax or successional communities."

Another example of "guidance" or giving "direction to" natural processes within a given ecosystem is illustrated by the following hypothetical case. Take, for example, a climax area that has burned severely and the ecosystem is prepared to be "exploited" by a successional trend. Now, consider that in the area there is a well established and prospering exotic plant that finds recent burns very hospitable. It then might very well behoove the resource manager to investigate the possibility of attempting to eliminate that stage of succession by planting native flora. In this way he would be introducing a native plant that "belongs" to the natural successional trend and would give it an "edge" that would hopefully cause it to successfully compete with the exotic and permit succession to continue in a natural way.

There are a number of natural catastrophes that could be explored in depth as to their effect on the primeval mosaic. However, by far the most important and controversial is fire. I believe that it would significantly add to

this conceptual discussion to include several quotations from learned sources concerning the importance of wild fire to natural processes.[19]

> "In thinking of land in a natural state, we must recognize, that at this latitude, natural fires have always swept over the vegetation and on this continent the American Indians used fire extensively to manage forests for their hunting and agricultural benefit. The stability of the biotic community has been dependent upon fire" (Boardman, 1967).
>
> ". . . where fire is excluded over a period of several years the land ceases to be a living museum of the past" (Boardman, 1967).

Boardman also makes an appeal for a less emotional approach to fire and its place in nature:

> "The fact that vegetation protected from fire may change completely in a relatively short period has rarely been considered, because administrators and the public have not appreciated that this can happen" (Stone, 1965).
>
> "There is no question that man has changed the natural 'fire mosaic' and the natural fire environments by his activities, including his use or non-use of fire" (Komarek, E.V., 1967).
>
> "The wildlife landscape like the architects landscape is fundamentally a disturbed landscape. It depends on disturbance for survival. In its absence in most cases it deteriorates. In general, the basic condition of the wildlife landscape is variety: forest, brush, grass, weeds, lakes, ponds, creeks. Abundant historical records indicate that during primitive times, it was largely a fire landscape. It depended upon this agent as a source of disturbance to rejuvenate the quality, quantity and distribution of its vegetative composition to which wildlife increase responded, sometimes spectacularly" (Komarek, R., 1966).

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[19]See Komarek's remark on p. 3. Also refer to the Service's policy on fire in Appendix A.

> "Lightning is an inherent component of the earth's atmosphere and is ecologically fully as important as such better known factors as temperature, rainfall, soils, etc." (Komarek, E.V., 1964).
>
> "Plant and animal communities have evolved largely as the effect of summer fires" (Komarek, E.V., 1964).

Other ramifications of ecosystem induced change could be discussed but due to the nature of this paper, i.e., to "provide a frame of reference", I do not believe that significant gains would be made by lenghthening this aspect of the discussion.

Man-Induced Change as a Factor in Park Resource Management

With the discussion of ecosystem-induced change providing a framework of what "naturally" takes place (or should take place) it is timely to interject the inseparable socio-ecologic or man-induced influences on the park resources. Thus enters the proverbial "fly in the honey". Yet, if man did not benefit from parks in some way there would be none. The most obvious way to benefit from, and enjoy the parks is to put oneself into the scene. Contrary to what some would say, national parks are not "locked up" land; they embody a special concept of land use. It is that use that imposes the necessity for compromise in achieving the goal of perpetuating naturalness.[20] It is that compromise that the Service must keep to a minimum. To use and yet preserve is in the nature of a paradox. It is, I believe, philosophically

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[20]Refer to the excerpt from the 1916 Act creating the National Park Service on p. 2.

sound to advance the proposition that since the "use" of the parks is resource based then it becomes imperative that concern for the resource be considered first in priority over providing facilities, etc., for the visitor. Darling and Eichhorn (1967) offered the following comment concerning this question:

> "Our own definition of legitimate enjoyment of the national parks would be that it should be of that order which places first the ecological well being of those areas in relation to their perpetuation as natural biological communities and expanses of natural scenery."

One assumption that would find universal agreement is that man is very much on the scene in the parks, and from all indications he will remain there in ever-increasing numbers. It is also a truism that he is having a significant effect on the park resources and hence on the objective of perpetuating a primeval park-scape.

Dr. Beatrice Willard (1960), after considerable study of visitor impact on Rocky Mountain National Park stated that: "Areas altered by visitor impact occupy a small fraction of the park's total landscape". This is very likely true when one views the <u>total</u> park acreage. In most parks there are many square miles of roadless, trailless terrain. Yet, where man is having his most significant effect is often on the choicest and most fragile ecosystems, e.g., along stream banks, and lake sides, in meadows, directly around and in major unique features of high scenic and scientific value.

Some of the more important sources of man-induced "shock" to the ecosystem would be generated from the following activity:

Direct Impact through visitor use, mostly taking the form of trampling and general atrition. This would also include collecting fuel for campfires; fire, unplanned and man caused; garbage and refuse disposal--mostly a problem in the backcountry; taking of fish, berries, mushrooms and the picking of wild flowers; grazing pack stock or saddle horses, etc.

Indirect Impact through the provision of facilities and services for visitors. This aspect of impact covers a wide spectrum and would of course be linked closely to direct impact. Examples would include a variety of buildings and all of the "disruptions" that go with them, e.g., concessionnaire lodging and stores, employee residences, visitor centers, comfort stations, horse stables, ski lodges, etc. Also to be included would be such things as roads, trails, sewage (both treated and untreated) cycling into the ecosystem, campgrounds, clearing park slopes for winter sports developments, swimming beaches, marinas, etc.

Non-Visitor Related Impact, both direct and indirect. This includes such sources as private inholdings, watershed manipulation arising from private water rights retained within the park; the "carry-over" effects from the area surrounding the park (involving such things as trespass livestock grazing, introduction of exotic plants and (some) animals;

pollution of various kinds; and fires started out of the park. No doubt there are others.

This is not intended to be a complete list and all parks would vary as to the relative impact from these sources. However, the important point illustrated here is that each item does, to some degree, induce change that involves energy input or withdraw from the system.

This aspect of change is a reality, a paradox, and the source of compromise. Many of the items mentioned are an indispensable aspect of park operations. The job the Service now has is well outlined in the following guideline taken from the new resource management policy:

> "The application of ecological management techniques to neutralize the unnatural influences of man, thus permitting the natural environment to be maintained essentially by natural agents" (Administrative Policies, 1967).

The management units that will form the functional aspect of the resource management plan (depicting the desired primeval mosaic) must reflect these enclaves of use and development, as well as other disturbances. In order to develop this aspect in greater depth I shall temporarily stray from the conceptual tenor of discussion and become specific.

In order to "reflect these enclaves", I would suggest the use of an "overlay" of man-induced impact that would be superimposed on a base map depicting the desired primeval mosaic. In this way special "objectives of compromise" could be developed for these areas. The obvious areas of

development and human use have already been outlined in a land classification system which is a part of all park master plans.[21] This system, briefly outlines below, resembles that prescribed by the Bureau of Outdoor Recreation for Federal lands:

Class I - high density recreation areas.

Class II - general outdoor recreation areas.

Both Class I and II identify lands that are in some way reserved for visitor accommodations, administrative facilities, formal campgrounds, two-way roads, etc. They would normally occupy a small percentage of the total park acreage.

Class III - natural environment areas.

These are important lands that often provide the "transition" or "setting" or "environment" or "buffer" between the intensively developed areas and the ones described in the following two classes. This would also include the so-called "wilderness threshold".

Class IV - outstanding areas.

These lands include the outstanding or unique natural features, e.g., the geyser basin in Yellowstone National Park.

Class V - primitive areas.

This category is reserved for essentially pristine and undisturbed lands. The above classification follows that described in Administrative Policies (1967).

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[21] "A Master Plan will be prepared for each area to cover specifically all Resource Management, Resource Use and Physical Development programs" (Administrative Policies, 1967).

Although this classification scheme is a gross treatment, it does depict areas that have been, or are proposed to be intensively developed, e.g., Class I and II lands. It is an excellent starting point for the resource manager's "overlay". However, there will still remain innumerable enclaves of man-induced impact will be found in Class III, IV and V lands. These enclaves then will become part of the overlay. Also included would be sources of impact or "shock" that are not always clearly obvious, e.g., treated effluent which is abnormally rich in nutrient elements being discharged into natural bodies of water. At any rate, from this point the park resource manager will be able to develop an action program designed to minimize or neutralize the compromise.

Concept of the Trigger Factor - An Approach to Discovering the Source of Change

The Service's resource management goal of naturalness is deceptively straight forward, including the qualification of "as near as possible". Attaining that goal could be incredibly difficult.

There are thousands upon thousands of facts about any given ecosystem and they are all an inseparable part of the whole. The park resource manager must limit himself to the crucial facts, i.e., those that have a controlling degree of relevance. Otherwise he will become hopelessly bogged down. In developing this approach the resource manager may advantageously employ a concept elucidated by Billings (1952 and

1964), known as the "principle of the trigger factor". In order to eliminate confusion with two similar and related concepts they will also be included in the following discussion.

In ecological parlance the "principle of limiting factors" is well known and refers to those environmental factors that limit the growth of the individual organism or populations and communities of individuals. When a crucial environmental factor becomes in short or excessive supply for an organism it grows poorly, or if a critical stage is reached may even die. This would then be a limiting factor for that organism.

The limiting factor principle can be extended to include the environment. Here, "if one factor in the environment is changed, this change may cause shifts in other environmental components." Billings sums up this "Principle of the holocenotic environment" with the following statement:

> "The ecosystem reacts as a whole; it is practically impossible to wall off a single factor or organism in nature and control it at will without affecting the rest of the ecosystem."

Since Billings' primary concern is with the ecosystem, he draws a corollary with the holocenotic "environment centered" principle to develop the "principle of the trigger factor", which "is a factor that sets off a chain of events in an environment or ecosystem and effects change." A "trigger factor" would be a good example of a crucial fact.

This principle has great implications in park resource (ecosystem) management, especially in the realm of discovering

the source of change (desired or not desired) and in both predicting and anticipating future change. I believe it is to this type of thinking that the park resource manager must commit himself.

An Example of Direct Impact Research

An in-depth discussion of the methodology of determining change due to human impact would be a study in itself. Nevertheless, the determination of the extent of change taking place and a continuing record of it would be an integral part of any operative resource management plan. For most terrestrial ecosystems, vegetation can be used as a visible and measurable manifestation of change. I believe that a short discussion of one actual approach would be pertinent to the discussion.

An excellent example of descriptive research directed at determining the effects of man-induced (visitor) impact on natural terrestrial ecosystems was conducted in Rocky Mountain National Park. Dr. Beatrice Willard (with the assistance of Dr. John Marr) from the University of Colorado began a five year study in 1958 on a contractual basis with the National Park Service.

Much of Dr. Willard's research was concerned with areas that received heavy use, i.e., on Class I and II lands. She did, however, survey the effects of use on Class III, IV and V lands.

Of particular interest was her methodology which was both quantitative and qualitative. Impact areas selected

for study were enclosed, and a qualitative analysis of the vegetation was made by using the abundance-cover scale of the Zurich-Montpellier School of Phytosociology.[22] This provided a record of what was there at the time of the study, and provided a datum point from which to determine recovery rates, further impact, etc. Keeping a photographic record of the area also has value, not only to serve as a comparative visual record of current events, but also to compare with any available historic photographs of the area.

A qualitative scale of "visitor use impact" was developed on the basis of the quantitative study. Dr. Willard Developed six "degrees" of visitor impact on the vegetation that ranged from negligible impact and effect to a denuded condition with bare mineral soil.[23] This system was found to be applicable to most herbaceous layers of the Park's ecosystems.

The "trigger factor" in the case of Dr. Willard's study was the impact itself and the relationship of impact to change was probably linear. The question the resource manager will have to answer is, how can the impact (in this case. obviously, the "trigger factor") be contained within "tolerable" limits and what are those tolerable limits? In the case of this alpine ecosystem those limits would be affected by a number of factors. Several which were determined by the study are:

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[22]Regardless of whether one agrees or disagrees with the conceptual basis of a certain "school" of ecological thought, their analytical methodology may be employed as a pragmatic approach to problem solving.

[23]Dr. Willard's "scale of visitor use impact" is included in Appendix B.

1. It is probable that visitor use effects "depend somewhat on the character of the regional environment during the particular year of use."
2. The type of original vegetation in the area.
3. Condition of soil moisture at the time of use.
4. The intensity and duration of the impact by the visitors.

The point to be made clear is simply that there are methods already developed that can be employed to determine the magnitude of change taking place in natural ecosystems. Certainly others could be developed to meet the needs of the various areas.

The overriding implication of this chapter is that the Service must actively manage the park ecosystem(s) in order to achieve naturalness, and that a compromise of this goal (naturalness) is inevitable because of the presence of man and his activities. It is the "compromise" that the Service is most concerned with minimizing, and with as little artifice as possible in the process.

> "In all cases, the distinguishing facet of a natural resource ecosystem is that man has a direct involvement in the complex set of ecological products (Spurr, 1968).

A National Park is a "natural resource ecosystem" in a very real sense. It is the "product" of naturalness which sets it apart.

CHAPTER IV

SOCIO-POLITICAL ASPECTS OF ECOLOGICAL PARK MANAGEMENT

This paper would not be complete without at least touching on the socio-political aspect of implementing a new ecologically oriented approach to park preservation. There has been implied that the "old" discarded policy of strict protection is "bad" and that the "new" and scientifically enlightened" policy is "good". Hopefully this is true, and since the subject of this paper has been generated by a change in policy I feel compelled to briefly discuss first, the nature of policy itself and secondly some of the realities that must be a companion to a new policy.

The Nature of Policy

Definitions of policy are legion, and most are generally vague and broad, e.g., "policy is a path to administrative action". Something like this is generally "decanted" almost as a kind of automatic slogan. Dr. Phillip Foss (unpublished) suggests a definition with a more precise meaning: "A policy is an enforceable decision. . . ." In anticipation of an expected retort that such a definition is not applicable to "Service" resource policy, Foss had the following to say:

> "Policies are formed by people <u>for</u> <u>people</u>. There is really no such thing as natural resources policy--there is only <u>people</u> <u>policy</u>. The effect of the policy on the resource is important only

> through its effect on people. Natural resources in themselves have no intrinsic value. They have value only as they can be utilized by people" (even though this may be through their preservation as is the case of the Parks).

If one accepts the definition that "A policy is an enforceable decision," then it is implied that until a "policy" is activated and succeeds, it is only a wish or an objective. I submit then, that at this point much of the new Service "policy" is still a "wish". Again, this may be an academic point, but it is one worthy of raising since reducing the "wish" is precisely what the Service is endeavoring to do.

Basically, most Service policy <u>is</u> enforceable and has been well grounded in the prevailing ideology of the park preservation movement. Or perhaps one might argue that the ideology and the policy forming process evolved together. At any rate, the important point is that the "national park idea" has become an institution and the basic policy of "preservation" for the "continued use and enjoyment" in an "unimpaired" state, remains basically unchanged (Administrative Policies, 1967). What has happened is that there has been a shift in emphasis as to how to accomplish the original policy (through the application of ecological management techniques instead of strict protection), and this has resulted in a change of "lesser" or "substantiating" policies.

In the case of Service resource management policy, the shift or change is directly related to the growing sophistication of the technology ("science") of ecological land management. Also applicable to the recent "shifts" is a

remark by Ordway (1966) about promulgating policy that results from new and relevant knowledge:

> "So it should be with habitat protection: timely, knowledgeable, and institutionally feasible."

Remarks Concerning the Socio-Political Feasibility of Service Resource Policy

Techniques for innovating ecological management, e.g., allowable wildfire burns, restriction of traditional uses, or actual closure of ecological "stretcher cases", all may be scientifically grounded, but they must not pioneer beyond the "periphery of the area of societal concensus" (Strong, 1966). Speaking in a broader context, but still relevant, Darling (1967) remarked that: "Politics,[24] let us admit, is an immensely important ecological factor on this planet."

When we speak of park "resource policy" we are speaking of a culture derived concept that has transcended purely ecological considerations. It includes a social institution with all of its myriad implications. In a sense, we have simply added another ecological factor--that of the socio-political matrix, popularly known as "public opinion".

It is this latter factor that must be "manipulated" to a state of "receptivity" or at least tolerance for new programs. This may be in the nature of a truism, but all too often "truisms" have a way of getting lost in the shuffle. The Service is fortunate in having a ready-made vehicle for

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[24]Politics can be briefly defined as "the process of forming public policy" (Foss, 1960).

selling new approaches. Every park area has in its organizational structure an "interpretative" (educational) division that can imaginatively compliment a new program involving ecological management techniques.

The principle point of this aspect of the discussion is to focus on the fact that the Service must not remain in intellectual isolation from the political realities that a new (at times appearing as a radical departure from the traditional) management approach may entail. In the words of Lynton Caldwell (1966):

> "The public official responsible for some particular aspect of public action affecting the biophysical environment . . . is therefore concerned not only with the internal operations of his agency, but equally he must be concerned with what the phychosocial environmental matrix within which his program must be administered will permit him to do."

CHAPTER V

SUMMARY

The National Park Service in 1967 released a revised statement of administrative policies for natural areas within the National Park System. Although the original goals were unchanged, a new approach to their realization was adopted. This approach is the preservation of the parkscape through ecological management instead of a strictly protection oriented philosophy.

Implications of such an endeavor are far reaching and in this paper I have undertaken a broad and primarily conceptual discussion of these implications as they apply to managing the terrestrial resources of the national parks. I have purposely refrained from interjecting personal values of an ethical nature as to what the Service should, or should not do in order to fulfill its legal and ideological obligations of preservation.

An exploration of the ecological literature revealed a divergence of expert opinion on the very nature of biological naturalness. Since it is primarily to this end that the Service will be aiming its program of ecological management, there is an aspect of ambiguity to contend with. Much of the diversity of opinion is of a theoretical nature and an ecologically oriented resource manager should be aware of it,

but a preoccupation with its meanings can be pushed to a point of absurdity. The Service has neither the personnel nor the time for an endlessly detailed analysis and synthesis of all of its natural ecosystems. Perhaps what is needed is a common sense balance between expedience and perfectionist efforts that are backed up by extensive research, both basic and applied.

The ecosystem, I submit, does not yet crystallize into a solid management concept (tool) where precise measurements and analyses of the biotic and abiotic factors are undertaken. When a park resource manager conceptualizes a management unit as an ecosystem he is using the concept in a conceptual way, not as a management tool per se. In visualizing the management unit as an ecosystem he is "thinking" in terms of total environment and corresponding "trigger factors" instead of individual species and "limiting factors". The resource manager will be more concerned with predictability than with precise measurement. He will be "thinking" in terms of energy flow and how that energy might be manipulated in a gross way to achieve a dynamic state of naturalness.

The word ecosystem is much in vogue these days. It is a prestigious word and as such could become over used and misused. It could also take on the aspect of a kind of slogan. The concept of ecosystem is excellent as a frame of reference but it must not become victimized by closed circuit thinking. Its operational antithesis of "strict protection" has received considerable wrath, and has itself

become victimized by over reaction. The Service is still very much "protecting" the parks; it simply has changed the context from static to dynamic protection.

Specialization of personnel on the park level will be a requisite to implementing an ecologically oriented management regime. Major decisions will presumably be coordinated at a higher level, but in effect a kind of autonomy (incident to the specialization) may develop. This could have a potential for greater operating efficiency and ecological effectiveness on the one hand, but also a potential for a lack of Service-wide consistency on the other. This possibility does not present itself as a dilemma, but simply an element for the Service to watch closely.

Each park within itself is considered a resource, yet in another sense the park resource consists of naturalness and the "harvesters" have a vested, and at times patronizing interest, in "their" parks. They must be accommodated and any newly effectuated resource management plan must be gauged to the prevailing socio-political realities. The parks are not only "vignettes of primitive America", but are also social institutions, and that fact must be kept foremost in the minds of those individuals responsible for promulagating shifts in administrative policy.

As the new manifesto of naturalness through ecological management takes shape and begins to permeate the thinking and action of park managers on all levels, the Service will then begin to see progress in realizing its new apprcach.

In conclusion, I submit that "ecosystem-induced" change can be directed to achieve naturalness; that "man-induced" change can be minimized to lessen the compromise of artificiality; and finally, that this can be accomplished through an ecologically enlightened effort of "dynamic protection".

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APPENDIX A

NATIONAL PARK SERVICE 1967 ADMINISTRATIVE POLICY GOVERNING RESOURCE MANAGEMENT IN NATURAL AREAS

The preservation of natural areas is a fundamental requirement for their continued use and enjoyment as unimparied natural areas. Park management, therefore, looks first to the care and management of the natural resources of a park. The concept of preservation of a total environment, as compared with the protection of an individual feature or species, is a distinguishing feature of national park management.

In earlier times, the establishment of a park and the protection of its forests and wildlife from careless disturbances were sufficient to insure its preservation as a natural area. The impact of man on the natural scene was negligible since the parks were surrounded by vast undeveloped lands, and there were comparatively few visitors. This condition prevails no more, for the parks are fast becoming islands of primitive America, increasingly influenced by resource use practices around their borders, and by the impact of increasing millions of visitors.

Passive protection is not enough. Active management of the natural environment, plus a sensitive application of discipline in park planning, use, and development, are requirements for today.

The resource management thus embraces:

1. Safeguarding forests, wildlife, and natural features against impairment or destruction.
2. The application of ecological management techniques to neutralize the unnatural influences of man, thus permitting the natural environment to be maintained essentially by natural agents.
3. Master Planning for the appropriate allocation of lands to various purposes in a park, and in the character and location of use areas as needed for developments.

The administrative policies which guide park resource management are as follows:

Plant and Animal Resources

Natural areas shall be managed so as to conserve, perpetuate and portray as a composite whole the indigenous fauna, flora and scenic landscape.

Management will minimize, give direction to, or control those changes in the native environment and scenic landscape resulting from human influences on natural processes of

APPENDIX A (cont.)

ecological succession. Missing native life forms may be re-established, where practicable. Native environmental complexes will be restored, protected, and maintained, where practicable, at levels determined through historical and ecological research of plant-animal relationships. Non-native species may not be introduced into natural areas. Where they have become established or threaten invasion of a natural area, an appropriate management plan should be developed to control them, where feasible.

Fire

The presence or absence of natural fire within a given habitat is recognized as one of the ecological factors contributing to the perpetuation of plants and animals native to that habitat.

Fires, in vegetation, resulting from natural causes are recognized as natural phenomena and may be allowed to run their course when such burning can be contained within predetermined fire management units and when such burning will contribute to the accomplishment of approved vegetation and/or wildlife management objectives.

Prescribed burning to achieve approved vegetation and/or wildlife management objectives may be employed as a substitute for natural fire.

Fire Control

Any fire threatening cultural resources or physical facilities of a natural area or any fire burning within a natural area and posing a threat to any resources or physical facilities outside that area will be controlled and extinguished.

The Service will cooperate in programs to control or extinguish any fire originating on lands adjacent ot a natural area and posing a threat to natural or cultural resources or physical facilities of that area.

Any fire in a natural area other than one employed in the management of vegetation and/or wildlife of that area will be controlled and extinguished.

Grazing

Domestic livestock grazing competes with native wildlife and impedes the effort in natural areas to achieve an ecological balance. Accordingly, grazing of domestic livestock in natural areas is permitted only where it is sanctioned by law, is incidental to visitor use, or is desirable to preserve and interpret significant historical resources of the area. Where grazing has been permitted and its continuation is not specifically covered by the aforestated conditions, it should be eliminated through orderly and cooperative procedures with the individuals concerned. Support of Service or concessioner pack and saddle stock by the use of forage in a natural area shall be limited to locations where dry feeding is clearly impractical (see Agricultural Uses).

APPENDIX A (cont.)

Agricultural Uses

Agricultural uses, including domestic livestock raising, may be permitted in natural areas only where they are desirable to perpetuate and interpret significant historical resources, are permitted by law, or are required pursuant to acquisition agreements or similar documents (see grazing).

Refuse Disposal

Refuse generated from operations within a natural area shall be disposed of by approved methods outside the area, where practicable and feasible. Refuse disposal within the area, where necessary, shall be accomplished by incineration, sanitary landfill, or modification of these methods as appropriate.

Off-Road Use of Motorized Equipment

Public use of motor vehicles shall be confined to designated park roads or other designated overland routes exclusive of foot trails and bridle trails. Public use of portable power equipment, such as generators, power saws, and the like, may be permitted in specifically designated areas.

The off-road use of motorized equipment for official purposes shall be carefully planned and controlled to meet the requirements of area management with due regard for the protection of human life and park resources.

Cultural Resources

Where significant cultural resources are present in a natural area, and are worthy of preservation for their historical value, they shall be protected and presented for public understanding, appreciation, and enjoyment to the extent compatible with the primary purpose of the area. In such cases, the management and use of the cultural resources will be patterned after the management and use of similar resources in historical areas.

Cooperation with Soil Conservation Districts

A natural area may participate in the program of a Soil Conservation District when the purposes, plans, programs, and operation of the District are consistent with the purposes of the natural area and the policies for its management and use.

APPENDIX B

SCALE OF VISITOR USE IMPACT DEVELOPED BY DR. BEATRICE WILLARD

Degree 0 -- receiving no impact; total vegetation cover--75-100%.

Degree 1 -- receiving visitor impact but not showing any measurable alteration; total vegetation cover--50-100%.

Degree 2 -- ecosystem obviously affected by visitor impact but the vegetation not severely damaged; total vegetation cover--50-90%.

Degree 3 -- ecosystem definitely altered by visitor impact; plants showed reduced vitality; attrition affects to normal growth great; normal growth persists only in small protected places; soil exposed and eroding; total vegetation cover--25-75%.

Degree 4 -- ecosystem drastically altered by visitor impact; vegetation gone except in protected places; humus layer of soil exposed over most of area and eroding; total vegetation cover--5-40%.

Degree 5 -- ecosystem virtually destroyed by visitor impact; plants existing only in very protected places if at all; mineral soil exposed by erosion; total vegetation cover--1-25%.