

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Washington, D. C. 20240

Budget Justification FY 1967-1970

Natural Science - Resource Studies

Research

The owner of a new automobile enjoys a period of grace. He can drive it coast-to-coast with no knowledge whatsoever of how the complicated parts of that machine work. Sooner or later, however, the car must come under the eye and hand of a mechanic, thoroughly familiar with every interrelated part and function, who can diagnose its condition, and make the necessary adjustments and repairs. Otherwise, the car may be driven to ruination.

For most of their years, the National Parks have enjoyed a period of grace. Comparatively isolated, and under moderate use, they have been almost self-maintaining. Even today, the beauty of the National Parks can be intensely enjoyed in the absence of any factual knowledge about them. For a while, they can be managed passively, by drawing boundaries around them, and by controlling fires and other things that destroy.

Without man and his civilization, the natural scene, unlike the automobile, would continue to perpetuate itself -- changing only in response to natural climatic and evolutionary changes. But, the parks are being used by man, and his civilization directly and indirectly effects unnatural changes upon the natural scene.

These changes occur in a system infinitely more complex than the most sophisticated machine devised by man; yet, like the machine, parts of the system begin to wear and to malfunction. The system, like the machine, comes

Prepared by Division of Natural Sciences, April 15, 1965

to need a kind of care that can diagnose what has gone wrong, prescribe and administer repairs, perform maintenance checks and continuous appraisal to back up adjustments in use and management. Otherwise, like the car driven ever-harder without maintenance and repair, the system can develop serious difficulty before we are scarcely aware that anything is the matter.

The National Parks as they have been handed down to us, are the product of many interacting phenomena over periods of thousands of years. In more and more instances, however, they are requiring the application of techniques designed to neutralize and correct for man-caused departures from the natural state. Unless these management measures are based upon exact knowledge, there is a serious danger that they may compound the problem that they were conceived to cure.

The National Park Service has the competence and the capacity to perform every service required to serve its many visitors, and to apply protective management techniques in the care of the natural community. Development and construction, public service, fire suppression, forest insect and disease control, maintenance, public health and safety programs, for example, are models of excellence. But research, the key activity so vital to all of them, has not kept pace.

This is not to deny that excellent and practical research has been accomplished. In earlier days this was done predominantly by other agencies, universities, and independent scientists. Today, such research, as is within the capability of this Service, is sharply focused upon only the most critical problems. As pointed out by the National Academy of Sciences--National Research Council, however, there is just too little to meet the need. In some instances, this need for research based knowledge has been recognized very late in the

deterioration of park resources. As a result, in these instances, we are perilously close to a position where research has been too little and too late.

Responding to this situation, the Congress has begun to increase the funds available to the Service for investigations of this nature. The increases have been quite modest and far too little to meet the needs as now recognized in the parks. It is generally recognized among those scientists across the country who are familiar with the parks that this limited effort has been too thinly spread to influence, in any fundamental way, the destiny of the National Park System. The gap between research needs and accomplishment is already so great that it cannot be closed for many years. On the other hand, the funding allowed, thus far, has not been out of line with the state of development of organization within the Service to make most effective use of the money.

Within the past year and a half the Service has taken a hard look at its research needs and has reorganized parts of its internal structure to provide for an expanded, more effective and tightly controlled research effort. The most critical problems for investigation have been identified and are receiving maximum attention consistent with funds and personnel available. Currently less urgent but potentially equally serious research needs have also been identified and the groundwork laid for initiating appropriate remedial studies when adequate funds are provided.

A program now underway will lead to the development of Master Research Plans especially tailored to the individual needs and research requirements

of each unit in the Park System. These Plans are being developed by teams of Service and university scientists after careful analyses of the natural resources, the use objectives, the resource management objectives, the current condition of resources, and the information already available relative to the identity, distribution, welfare and ecological relationships of these resources. As the result, the Plans are to contain authoritative evaluations of the "state of the park resources." In addition, they will provide identification of the research needed to facilitate the solution of existing management and interpretation problems and to produce the additional information required to permit intelligent approaches to the restoration and/or maintenance of resources in the natural conditions which obtained when the park was established. Eight such comprehensive park Master Research Plans are expected to be completed prior to FY '67 if the necessary funding and personnel are available.

Although the park Master Research Plans will permit more exact and complete elaboration of research needs in each unit of the Park System, the compilation of research needs already identified is very substantial, the longstanding urgency for the studies has been pointed up repeatedly by committees of non-Service scientists advisory to the Service and to the Department, and the Service is now geared to administer a much larger research effort. Results from a meaningful assault on the natural science research needs of the Service at this time should, within two or three years, begin to contribute importantly to overall park operations, and be manifest in more careful planning and development with respect to natural values, circumventing

embarrassing and sometimes costly errors. The results should be manifested, as well, in improved management techniques, in enhanced content of interpretative programs, and in other practical ways.

In carrying out such a program, the first consideration must be to secure the highest level of competence for the studies. The five Park Service individuals whose regular full-time assignments are oriented to field research in the natural sciences, constitute a staff quite obviously much too small to undertake even a significant fraction of the investigations needed in the more than 200 areas administered by the Service. Thus, for the first year or two, the greatest share of the studies must be accomplished by contract with university scientists, and a lesser share by agencies such as the Fish and Wildlife Service, the Geological Survey and the Forest Service. The sister agencies are quite cooperative in conducting research for the Park Service provided the work is somewhat oriented to the participating agencies' mission, and NPS funds are available to underwrite the costs of investigation. Sometimes, however, trained individuals of the type needed are more readily available from universities than from sister Federal agencies and, very often, the cost of conducting a particular research project is more costly if done by a Government agency team than if conducted by a university team of investigators.

As the program progresses, it would be to the advantage of the Service to do a larger proportion of the work with its own personnel. Within three to four years, it is estimated that the Program should be about evenly divided between intramural and extramural research. In order for such plans to materialize, however, the Service staff actively engaged in field research must

be enlarged materially through retraining and reassignment of suitable individuals presently in the Service and through recruitment from non-Service sources.

The following material consolidates and identifies some of the management and interpretation problems being faced in Service administered areas. Identified as well are the kinds of information required to contribute to the solution of these problems. The research vehicles for obtaining this information constitute the investigative program which we hope to initiate in FY '67 and for which funds are being sought in this and following years:

1. Wildlife

- a. The Problems

Under the protection efforts of the Service, populations of elk, deer, moose and certain other wild ungulates have increased to levels which have resulted in severe range deterioration and soil erosion, a decline in bighorn sheep, antelopes and other wildlife, and disturbance of forest reproduction in many parks. Although trapping, additional methods of direct reduction by the Service, and special hunting seasons established by the states outside the parks are presently keeping these herds within tolerable but arbitrarily established limits, this expedient provides little sound basis for long-term management. For the most part, we do not have sufficient information to determine accurately the levels to which populations must be restricted in order to permit range recovery, the levels of population that can be supported by a fully restored range, a process by which restoration of a range can be expedited, or indeed, in some instances, what the exact composition of the

original range was. Since our knowledge of the population dynamics, behavior and subsistence requirements of these animals is incomplete, we are not in a strong position to determine how their presence interferes with maintaining suitable population levels of other desirable animal residents.

On the other hand, despite more than 50 years of "protection," bighorn sheep populations have continued to decline in National Parks. Although poaching, competition with domestic livestock, disease and predation have often been blamed for this condition in the United States as a whole, these factors appear to be insignificant or lacking in the parks. More subtle adverse factors such as excessive human visitation at strategic watering places, competition with other animals for forage and with deer and large bird populations for water, have been suggested in recent years. Until we learn more about the physiological and behavioral requirements of these animals, their interactions with competing species, and other conditions which may limit their survival and well-being, little constructive effort can go forward to restore their populations to earlier levels or to reintroduce them to areas in which they are no longer found.

National Park plains buffalo have been the principal source for restocking preserves in this country and abroad. Because Yellowstone has probably the only remaining truly wild strain, it is extremely important to manage this herd within the limits of the range capacity. This applies, as well, to programs for restoring buffalo to other parks and monuments where they once occurred. In some instances, a major problem is that of restoring suitable range conditions or preventing further deterioration of the present range.

Each year, black bears are responsible for scores of personal injuries, hundreds of "incidents," and thousands of dollars of property damage. Grizzlies cause fewer "incidents," but a single tort claim against the Federal Government due to injuries inflicted by a grizzly bear, has resulted in an award of approximately \$130,000. To permit fullest possible enjoyment of bears by visitors under conditions of maximum safety and naturalness to both, we must have a more effective Service-wide management plan based on a better understanding of the habitat requirements of these animals, their way of life and reactions to man, and their population dynamics and food requirements.

For the most part, park problems involving birds are those associated with sustaining present populations or restoring the numbers to earlier levels. In some cases, the problem is one of reestablishing species which once existed in the parks. Often the requirement is for a more complete understanding of the ecological conditions necessary for these animals to flourish. The need for appropriate restoration of habitat may thus be determined. In other instances where a satisfactory population state exists, we must establish the birds' requirements in order that steps can be taken to prevent deterioration of the limiting environmental features. There are some cases, however, wherein the problem is extraordinarily complex. Here, we must learn not only the species' environmental interactions and requirements, the characteristics of its behavior, the physiological needs and developments during its reproductive cycles, its nutritional requirements, etc., but we must establish, as well, the factors which control the well-being of the food

or other habitat components which ultimately may be critical to the welfare of the bird species concerned. There are some instances wherein features of the habitat have deteriorated so markedly and in such a complex manner that considerable research will be required on factors which do not at once seem to have an obvious relationship to the ornithological problem.

One would be correct in saying that each and every animal and plant species in the Park System constitutes a potential management or interpretative problem. It is quite unrealistic, however, to expect that a comprehensive program of research on all species can or should be undertaken by the NPS or, indeed, to assert that each species is likely to assume a problem position. Nevertheless, there are a number of cases in the parks where individual animal species, other than those discussed earlier, require life history study. Some are predators which can contribute to our game management problems, others constitute a major factor in visitor interest in a park, some are unique to a park and study is required to assure their preservation, there are those who are destructive to other natural history forms, and some play important roles in large-scale environmental changes occurring within the Park Service unit concerned. In each instance, we need to understand the optimal ecological requirements of the animal and establish its interrelationships to other elements of its environment.

b. Types of Information Required

The paramount need, of course, is for data concerning the general ecological requirements of the species in question. Often, data obtained in one location are applicable to the species in other locations as well. Thus,

a carefully planned and conducted investigation of the species in one park usually provides a basis for comparison and application in other areas. This does not mean, however, that the solution to a problem in one park can be applied absolutely to a problem involving the same species in another park where environmental conditions may be different. Ultimately, one must still consider the species requirements in relation to the exact conditions under which the species lives.

The precise bits of information that may be needed to solve the problems described are too numerous to list here. Although the types of data required may vary from problem to problem and species to species, one can cite areas of inquiry which should not be overlooked in investigations of this sort because the limiting or manageable factor which is the basis for the problem may be included in one of them:

- (1) Accurate identification of the species involved.
- (2) Current and seasonal changes in population structure, density and distribution.
- (3) Nutritional requirements as well as food, water, and shelter availability, preference and abundance. Problems associated with food supply.
- (4) Behavioral activities under various conditions of population density. Migratory behavior, if appropriate.
- (5) Reproductive potential, success and survival and problems associated therewith in relation to population density and food supply. Life span, age structure and mortality rate.
- (6) Specific and unique environmental requirement during some phase of the animals' life cycle.

(7) Social, physiological and behavioral response to competition and ability to compete with own or other species for food, water, space, etc.

2. Vegetation Ecology

a. The Problems

The basic living resource of any area is its vegetation, for, ultimately, upon it depends all animal life. Moreover, certain vegetation phenomena such as Sequoia, Saguaro, rare flowering plants, high mountain meadows, and balds are important natural features in their own right. Whenever the naturally occurring factors responsible for the development of the vegetative cover are altered or removed, the change sets off chain reactions affecting the whole spectrum of the biological community. Often the particularly important and desirable vegetative species and phenomena are threatened. The most critical changes appear to be those resulting from the impact of human activities, overprotection of forest and meadows, lowering of water tables, pollution of soils by toxic substances, physical destruction of plant cover, introduction of exotic species, and the like. The results of these changes have been many and varied within the National Parks. Thus, decreases in the reproduction of Sequoia trees, of the Hawaii silversword, and the New England Rhodora threaten the continuing existence of these remarkable species as significant elements of the landscape. Similarly, the invasion of mountain meadow areas by forest trees threatens the maintenance of these scenic features. Invasions by weed species and changes in the overall plant composition of certain environments are also evidences of poor "ecological health."

Plant diseases and destruction of range plants or forest species by native and/or exotic animals also produce problems of restoring the

vegetation to its former vigor and distribution. In many cases, however, there is not yet an active management problem associated with the vegetation but, we need to understand the processes responsible for the normal conditions in order that they can be better interpreted to the public and that suitable management procedures can be followed to assure a continuing minimum of deterioration.

b. Types of Information Required

Although not all will necessarily be required to solve a particular vegetation problem, the following types of information are ultimately necessary for each Service administered area:

(1) The composition of the natural vegetation at the time the park was established.

(2) Changes which have occurred in the vegetation in response to natural and man-related influences and the mechanisms whereby these changes took place.

(3) Environmental conditions necessary for the restoration and maintenance of vegetation in its natural state and the means by which this can be accomplished.

To answer these questions the Service must obtain other data among which are included:

(1) Specific environmental requirements and tolerances of individual plant species and the characteristics of the habitats in which they occur.

(2) Plant composition of the problem vegetation types and the degree and rate of change from the original condition.

(3) Influence of human use such as the amount and rate of soil

compaction, changes in soil composition and biota, and alterations in ground water and other moisture patterns.

(4) Effect of the presence of introduced plant and animal species and of overabundant native animals on the welfare of natural vegetation.

3. Aquatic Resources

a. The Problems

Marine and fresh-water habitats and their resident biota constitute one of the most poorly understood natural resources in the Park System although fishing is the only consumptive recreational use of park resources permitted by law. Relatively gross surveys have been made of the game fish found in some of the aquatic habitats but the number of lakes and streams in which complete inventories of all vertebrate species present have been accomplished is remarkably sparse. Probably not one of the Service administered marine or fresh-water resources has been subjected to an exhaustive study of its life forms and their ecology or of its physical, chemical and morphometric characteristics. The obvious management problems are those related to assuring native fish populations which yield a reasonable catch-per-unit-of-effort and to removal of exotic species which may be displacing endemic populations. Far more disconcerting, however, is our lack of complete inventories of the living forms found in these bodies of water, failure to know the environmental requirements of these organisms, an almost complete absence of information about the specific characteristics of the habitats, and literally no baselines of biological or physical data from which to measure ecological deterioration in lakes, streams and estuaries. Undoubtedly, there are a multitude of additional aquatic resource management and interpretation problems which remain unreported simply because we have failed to recognize them on the basis of the limited background information available.

b. Types of Information Required

In general, the Service needs comprehensive analyses of the chemical, biological and physical characteristics of all park streams, lakes and marine or estuarine habitats contained within the System. Specifically, the requirements include:

(1) A complete inventory or survey of all animal and plant life resident in these aquatic habitats as well as an understanding of the interactions between these living forms.

(2) Measurements of dissolved oxygen and carbon dioxide concentrations, alkalinity, turbidity, temperature at different depths throughout the year, lakebed morphometry, thermal stratification, rates and volumes of stream-flow, and presence of pools and pollutants. Measurements of salinity and other dissolved substances are needed as well for estuarine and marine waters.

(3) Quality, abundance and sequence of phytoplankton and zooplankton population development throughout the year.

(4) Qualitative and quantitative survey of littoral and benthic invertebrate fauna available as fish food at different seasons.

(5) Qualitative and quantitative analysis of fish fauna (both game and nongame) present, growth analysis of each species, year-class success and population-age structure, mortality rate, fecundity, longevity, parasites, condition of plumpness, food habits, and fishing effort and success.

(6) Identification of potential spawning areas and analysis of other habitat conditions conducive to spawning for each fish species, including adequate depth, substrate, temperature conditions, stable water levels, and submergent vegetation or other sources of protection for the fry and juveniles.

(7) Analysis of watersheds for source of nutrients, minerals, and adequate seasonal water supply.

(8) In estuaries--establishment of stability of salinity conditions, turbidity, temperature range, pollution, food habits and supply, and developmental stages of fish and shellfish which occupy the estuary.

4. Geological Resources

a. The Problems

The fundamental relationships between the geological and other natural resources of the parks, though better understood than the complexities of the aquatic systems, are still most inadequately known. In many parks, the Service has neither an adequate inventory and map of these physical features nor an accurate comprehension of the roles they can play in construction and development problems and similar practical operations, or in determining the characteristics of associated vegetative, aquatic and animal resources. Though direct management of the geological resources often may not be feasible, this kind of information is necessary in order to permit: implementation of management practices which do not encourage destruction or deterioration of these features, formulation of well-founded policies for management of other natural resources as well as for planning for construction of roads and facilities, preparation of park master plans, and development of water supply and drainage systems; and a sound basis for any other undertakings which involve possible modification of or dependence upon the original geological conditions in the parks. Finally, greater and more accurate knowledge and understanding of the parks' remarkable geological features are essential to the development of an impressive interpretative program.

b. Types of Information Required

The Service's most urgently needed geological information includes inventories and maps of these phenomena, and collateral data on the relationship of substrate characteristics and composition, origin and structure of soil and geological parent material to the development and maintenance of resident vegetation and animal life. In addition, there is a requirement for a thorough understanding of thermal features such as geysers, hot springs, and volcanoes, the processes involved in these phenomena, their distribution and extent, and the bases for their changing behavior. Similarly, we need to have year-to-year data on the growth, recession and general condition of glaciers as well as on the factors associated with their origin and decline. The depths and areas permeated by permafrost should be delineated in those park areas concerned. The several large cave systems within park areas need to be thoroughly studied for knowledge of the factors associated with their development, extent, growth, deterioration and preservation. Finally, it is desirable to have an understanding of subsurface drainage and water conditions in all Service administered units.

5. Initial Surveys

a. The Problems

As stated earlier, the components of the natural resources present in a number of the areas administered by the National Park Service have not yet been assessed thoroughly. In others, such inventories were taken long ago but have not been kept up-to-date. Indeed, it seems odd that the resources of these areas which were set aside in order that their remarkable and, often, unique natural features might be preserved for posterity, are far less well known than

are those of very rare and rare regions of our country. It is essential to sound judgments, of course, to determine the kind, quantity, and, in nature, the distribution of the resource. The parameters of the resource to be considered in formulating management policies are thus identified and a baseline is established from which to measure change and, hence, reveal the need for modification of management practices. The inventory, when followed up with additional, periodic review, provides the information necessary for a comprehensive program of interpreting the resources to the public.

b. Types of Information Required

Essentially the need is for a detailed analysis of the kinds, distribution and relative abundance of animal and plant components of each park ecosystem. An attempt should be made, as well, to obtain as much information as is possible relative to the habitat and other ecological requirements of the organisms. The minimum product expected from such studies is an accurate checklist and/or distribution map of the faunal and floral elements present. Similarly, geological resources in each park must be evaluated, catalogued and charted.

6. Special Projects

a. The Problems

Day-to-day management of park resources sometimes reveals or leads to the desirability for study of complex situations involving these natural features. Although such problems might well be identified with one of the categories discussed earlier, they are usually of a more interdisciplinary nature. Included as well are special projects such as those involving the evaluation and analyses of the success and broad-scale ramifications of pest-

control programs, the role of insect vectors in the transmission of plant disease, unusual ecosystems, the influence of microclimatic factors in the maintenance of special habitats, and the publication of results from unusually comprehensive floral and faunal studies.

b. Types of Information Required

Delineation of the various types of investigations and subsequent data needed to provide solutions to many of these problems, would result in an impressive and lengthy list. Generally speaking, however, the Service needs the kinds of information that result from highly sophisticated inquiries into the controlling but, sometimes subtle, interrelationships and interactions between all components of the total environment. Whereas the information required to solve the majority of the Service resource problems described heretofore can be obtained simply by a massive measuring and analysis effort using time-tested techniques and principles, many of the special projects involve probings into relatively unexplored areas of science. Such studies require the development of new methodologies, new concepts, new approaches and new thinking. Normally, this kind of research would not be considered to be within the purview of the National Park Service. It is quite clear, however, that some of our resource management problems are not likely to be resolved until information of this nature is available.

Some \$974,000 will be required in FY '67 to launch this attack on the poverty of natural resource knowledge prevalent in NPS administered areas. It was anticipated that the program would be initiated in FY '66 at a lesser level of magnitude in order to permit the time and effort required for planning and development of the larger effort. However, the necessary funds will not be

forthcoming in FY 1966, the necessary arrangements and planning are well ahead of schedule, and the need for the larger scale program has become more urgent. The additional increases requested for subsequent fiscal years manifest continuation and expansion of the initial investigations as well as the initiation of new studies on problems revealed by the preliminary research or associated with areas newly added to the Park System.

Personnel

The effectiveness of a research program may be limited, in part, by the resources available to support the effort. Financial support is quite obviously necessary but the quality, coverage and quantity of investigations undertaken may be equally dependent upon the quality and quantity of personnel available for the assignment.

Research of the kind needed in the Park Service is investigative activity requiring a high degree of modern specialized training, dedication, zeal, imagination, initiative, analytical ability, inquisitiveness, integrity and a profound appreciation of the intricacies of natural phenomena. The Service has a number of fine individuals who, at one time, shared these qualities but who have been dissociated with research for such a long period of time that their ability to carry out high-grade research has been somewhat lessened. Other individuals who are capable of doing certain kinds of creditable research also excel in other duties which appear to be more critical in the Service's continuing efforts to meet the immediate requirements imposed by the ever mushrooming utilization of NPS areas by the American public. The less than half-dozen individuals in the Service who are assigned full-time field research activities are well trained and very capable but the sum total of their highly productive efforts is pitifully inadequate to meet the overall needs for new information in the more than 213 present or approved Park Service administered areas.

If adequate funds become available, contracts can be made with university personnel or the services of scientists from other Government agencies can be obtained to carry out the necessary research. However, the interests and motivation of scientists from other agencies are not always oriented to the

management or interpretation needs of the Park Service with the consequence that maximum use may not be obtainable from the results produced. Further, circumstances are such that it is often more costly to hire another agency to do Service research than it is to have the same research done by NPS or university personnel. University scientists, too, usually want to engage in research which has their greatest interest and will contribute most to their advancement in the scientific community. Funds are available from various sources in such quantities now that almost any high-quality university investigator can obtain sufficient support to underwrite the studies of his immediate interest. Unfortunately, their immediate interests do not always coincide with the types and levels of research required to solve park problems. This difficulty is expected to intensify as the manpower pool of well-trained ecologists is further strained by the demands of the International Biological Program and the increasing interest of Government and industry in problems of the total environment. Thus, it behooves the Service to develop its own strong cadre of research personnel over the long run.

The requested authorization for additional permanent research and supporting personnel in FY 1967 - FY 1970 will permit the assignment of these individuals on a priority basis to parks and areas where the needs are most urgent. The kind of Service scientist assigned to a park will be determined by the type of resource dominating the park and in most need of study--for example, it is proposed to station a marine biologist in the Virgin Islands-Buck Island Reef complex to develop the marine research needed to provide the information which must be available for the development of sound management policies to assure proper preservation of these invaluable marine resources. The data thus

obtained is essential, as well, for a more meaningful interpretation program of the underwater features in our only tropical marine park. As in any professional endeavor, a research project involves more than data gathering. Accordingly, a billet is requested for one field and/or secretarial assistant for each scientist in order that the latter can direct his efforts to research activities more commensurate with the value of his time.

The request for an initially large increase in seasonal research and supporting personnel is based upon the urgent and immediate need for the collection of "inventory" data that is a prerequisite for subsequent research of greater complexity. The paucity of existing data of this nature has been described earlier. The most suitable time to do this kind of research in most of our parks is during the summer months. Fortunately this is also the period when the greatest supply of highly capable scientists from smaller universities and colleges is available to bring their skills to bear on the studies. Two supporting field assistants are requested for each professional investigator in order to greatly augment the production of field data. In most cases, the supporting assistants will be students who will thus be exposed to and possibly become interested in the Park Service as a career.

Although it is not expected that the permanent research personnel, requested herein, will be engaged totally in the projects for which support is sought elsewhere in this document, they will serve to coordinate and supervise the investigations being conducted in their park or area of assignment. It is certain that they will participate in the most urgent research projects. They will participate, as well, in the development of Park Research Plans. It must be remembered that the research requirement already described concerns only that of which we are currently aware and does not reflect equal attention to

the needs of each park. Close scrutiny by Park Research Plan teams and better coverage of other established and new Park Service areas will undoubtedly reveal research requirements which have not yet been identified and appraised.

As funds for personnel become more adequate, it is suggested that small amounts will be used to send some present NPS personnel, who are especially capable and whose earlier training was research oriented, back to a university for 6 months or a year of refresher training in modern research methods and concepts. It would be expected that their subsequent assignments in the Service would be changed to those associated with research. Ultimately, the Service hopes to have a cadre of research personnel of sufficient size and capability to permit the organization of a research team which can be dispatched quickly to make emergency studies in Park Service areas suffering from or threatened by potentially disastrous events.

The substantial increase in travel funds requested for FY '67 is required in order to carry out the Natural Science and Landmarks projected programs outlined elsewhere in this document. The Natural Sciences' staff will necessarily have to travel extensively in order to complete the proposed Research Master Plans proposed for each major Service administered area, existing research personnel must attend national meetings of scientific societies in order to keep abreast of the latest developments and research findings in their fields of responsibility, and research administrative personnel must travel to the parks more extensively in order to have a first-hand knowledge of the existing problems and of the progress being made in research currently underway. Provision is made in the budget, as well, for funds to permit each of the requested new professional research personnel to attend one or more meetings of his professional society. Finally, funds are included to permit a minimum of at least one Servicewide conference of research personnel per year to evaluate progress in the field and to discuss future plans and needs.

An increase in travel for Natural Landmarks is necessary in order that the on-site evaluation phase of the Landmarks program can be conducted. Provision has been made as well for travel by the additional professional personnel sought for the Natural Landmarks Program in FY '67.

Greater use of consultants for the development phase in the preparation of park Research Master Plans, the proposed development and utilization of a Landmarks Advisory Committee, the proposed expansion in size of the Advisory Committee for Natural Sciences Studies, a proposed schedule of at least three meetings per year by the Advisory Committee, and greater use of the Committee

and other research activities as well as boards of directors or
critical management and research reporting necessitate a special budget for
consultants of the nature indicated for FY '67.

International Biological Program

The International Biological Program is a program established to conduct coordinated studies on a worldwide level of the biological basis of productivity and human welfare. Discussions and planning, initiated by the International Union of Biological Sciences in 1959, culminated in the establishment in 1963 of a Special Committee for the International Biological Program. This Committee, as well as national committees from participating countries, has been actively engaged since that time in preparing an overall research plan oriented to the stated objective. The general Program has reached a stage sufficiently advanced for it to be studied in detail by each country which intends to participate. Each of more than 30 countries is also invited to prepare its own program by selecting and developing those projects which it finds of particular interest. Indeed, this process is already well forward in some countries, although the U. S. National Committee to the IBP (representing the U. S. through the National Academy of Sciences--National Research Council) is just getting started on this phase of the effort.

The objective of the IBP ". . . is to ensure the worldwide study of (a) organic production on the land, in fresh waters, and in the seas, and the potentialities and uses of new as well as of existing natural resources, and (b) human adaptability to changing conditions." The Program will not range through the entire field of biology but should be limited to the basic biological studies related to productivity and human welfare, which will benefit from international collaboration, and are urgent because of the rapid rate of changes taking place in all environments throughout the world.

There are seven sectional plans in the overall program: (a) productivity of terrestrial communities; (b) production processes; (c) conservation of terrestrial communities; (d) productivity of fresh-water communities; (e) productivity of marine communities; (f) human adaptability; and (g) use and management of biological resources. Each sectional plan has a great many ramifications and each contains portions which involve research specifically recommended for conduct in the National Parks of the world. Some phases earmarked for participation by the parks will simply provide the bases for comparison of the biological processes in the natural undisturbed habitats of the parks with the results of identical work conducted in habitats altered by man's activities in the rest of the world. There are many other phases too numerous to mention here which also involve the parks.

The Program, already underway in a sense, is not expected to exceed eight more years, made up of a first phase of two to three years and a second phase of about five years. The first phase will be devoted to design and feasibility studies, to methodology and to development of facilities and establishment of research areas. Within these limits, the duration of both first and second phases will vary according to the needs of particular projects.

It is quite clear that the NPS does not have the staff at the present time to undertake research for the IBP. Thus, unless the additional personnel requested elsewhere in this submission are provided, we will have to contract with university personnel for the work. Unless additional funds are provided, we cannot do that either. While it is not yet clear what the composition of the U. S. participation in the IBP will include, the implication thus far advanced is that an assortment of activities will be expected in the National

Parks. During the preparatory phases these will involve preliminary surveys and initial studies in particular habitats, certain logistic support for research personnel, establishment of research sites, etc.

The \$50,000 requested for this purpose in FY '67 is indeed simply an estimate based on the meager information available to us at the present time. The estimate may be far too conservative. The projections for later fiscal years are even less reliable estimates but, judging on experience gained in budgeting for other international programs in which the U. S. has officially participated, the costs are likely to be of this order of magnitude.

Natural Landmarks

The objectives of the Natural Landmarks Program are to encourage the preservation of sites which illustrate in an important way, the geologic and ecologic character of America; to enhance the educational and scientific value of sites so preserved; to strengthen the cultural appreciation of the natural history of America among people; and to foster a greater concern and involvement in the conservation of America's natural heritage among Federal, state, and local governments, citizens' organizations, and individuals.

During most of the Natural Landmarks Program's reasonably brief existence, primary emphasis has been devoted to establishing criteria and techniques for identifying, evaluating, selecting, and recognizing these important sites. This stage in the development of the Program is now relatively complete. Once a site has been nominated as a likely candidate for recognition in the Program, it is visited and evaluated by competent scientists in the field in relation to other sites exhibiting similar features, the status of present ownership is established, and the owner's long-range plans for managing the area are determined. If, on the basis of this information, the site is considered worthy and conditions are satisfactory in other respects, the nomination is submitted for consideration by the Secretary's Advisory Board on National Parks, Historic Sites, Buildings and Monuments. The Board's recommendations are forwarded to the Secretary. If the Secretary approves, the site is designated a Natural Landmark and the owner is presented with a suitably inscribed bronze plaque and a certificate attesting to this recognition.

Although only nine sites have been designated Natural Landmarks during this "tooling up" phase, the Program is now ready to function on a larger

scale. More than one hundred nominations are already in hand and The Nature Conservancy and other conservation organizations are expected to initiate formal surveys to identify additional sites. The Nature Conservancy alone is expected to nominate a minimum of at least one recommended site per state each year for a number of years. Agreements are being developed, as well, with other appropriate government agencies to consider suitable sites located on lands under their jurisdiction.

The two conditions which can prevent this very popular Program from functioning at the desired pace are shortage of funds for travel and lack of personnel. Both of these conditions relate to the need for one or more Service representatives to visit and evaluate the proposed sites to assure consistency in the high quality of areas designated as Natural Landmarks. The addition of two professionally trained personnel in FY '67 to the current one-man Landmarks staff and a suitable increase in travel funds should enable the Service to conduct the necessary visitations. Two positions are requested, as well, to handle the substantial secretarial work associated with the expanding program.

A condition in the designation of a site as a Natural Landmark provides for periodic visits by Service personnel to assure that the Landmark is continuing to be managed in the same manner as when status was granted. The FY '68 and '69 budget estimates include the allocation of additional billets for that purpose.

Division of Natural Sciences - Budget Estimate
(All estimates are increases over previous year base and increase)

	FY 1967	FY 1968	FY 1969	FY 1970
Research.	\$ 974,000	\$144,000	\$132,000	\$200,000
<u>Personnel (Research)</u>				
<u>Permanent</u>				
Plant ecologists (GS-12).	2	2	3	3
Animal ecologists (GS-12)	1	2	2	2
Fresh water biologists (GS-12).	2	2	1	0
Marine biologists (GS-12)	1	0	0	0
Geologists (GS-12).	1	2	3	3
Supporting field and secretarial assistance (GS-5).	7	8	9	8
Total (permanent).	(14)(\$106,750)	(16)(\$122,000)	(18)(\$137,250)	(16)(\$122,000)
<u>Seasonal</u>				
Research biologists and geologists @ \$3,000.	13 (\$45,000)	5 (\$15,000)	5 (\$15,000)	2 (\$6,000)
Field assistants @ \$1,500	30 (\$45,000)	10 (\$15,000)	10 (\$15,000)	4 (\$6,000)
Total (Seasonal)	(45)(\$90,000)	(15)(\$30,000)	(15)(\$30,000)	(6)(\$12,000)
Total Personnel (Research).	59 196,750	31 152,000	33 167,250	22 134,000
<u>Travel</u>				
Natural Sciences staff	\$10 500	\$ 4,000	\$ 4,500	\$ 4,000
Natural Landmarks.	8,000	2,000	2,000	0
Consultants and Advisory Committees	6,000	500	500	0
Total Travel	24,500	6,500	7,000	4,000
<u>International Biological Program</u>				
Preliminary studies - salaries and logistic support.	50,000	Research-salaries & logistic support 350,000	Research 300,000	Research 200,000
TOTAL ANNUAL NATURAL SCIENCES INCREASES NEEDED	\$1,245,250	\$652,500	\$656,250	\$538,000

	FY 1967	FY 1968	FY 1969	FY 1970
<u>Natural Landmarks</u>				
<u>Personnel</u>				
Professional (GS-12).	2 (\$20,500)	1 (\$10,250)	1 (\$10,250)	0
Secretarial (GS-5).	2 (\$10,000)	1 (\$ 5,000)	0	0
Total Personnel	4 \$30,500	2 \$15,250	1 \$10,250	0
Materials (plaques).	1,000	500	500	\$ 500
Total (Natural Landmarks).	\$31,500	\$15,750	\$10,750	\$ 500