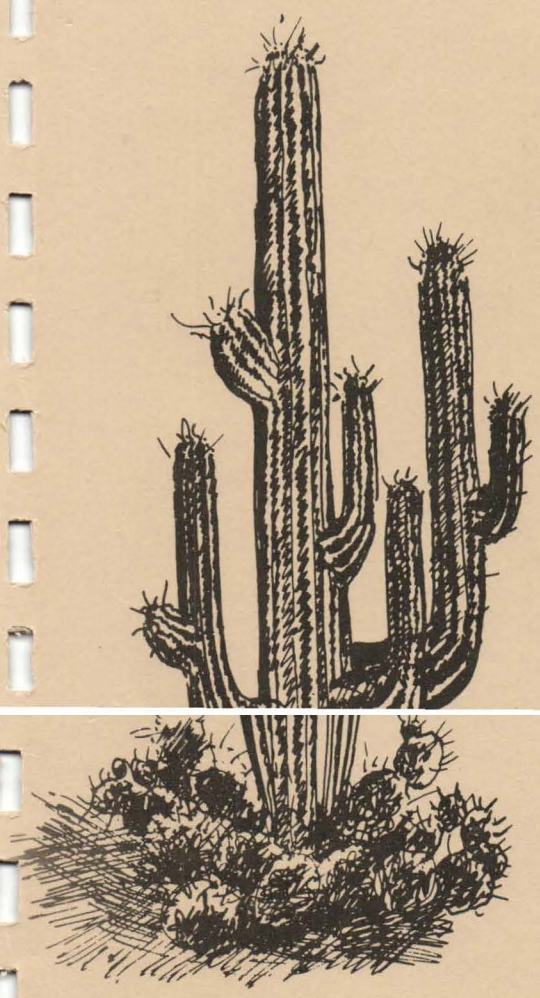

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COOPERATIVE NATIONAL PARK RESOURCES STUDIES UNIT
University of Arizona/Tucson - National Park Service

The Cooperative National Park Resources Studies Unit/University of Arizona (CPSU/UA) was established August 16, 1973. The unit is funded by the National Park Service and reports to the Western Regional Office, San Francisco; it is located on the campus of the University of Arizona and reports also to the Office of the Vice-President for Research. Administrative assistance is provided by the Western Archeological and Conservation Center, the School of Renewable Natural Resources, and the Department of Ecology and Evolutionary Biology. The unit's professional personnel hold adjunct faculty and/or research associate appointments with the University. The Materials and Ecological Testing Laboratory is maintained at the Western Archeological and Conservation Center, 1415 N. 6th Ave., Tucson, Arizona 85705.

The CPSU/UA provides a multidisciplinary approach to studies in the natural and cultural sciences. Funded projects identified by park management are investigated by National Park Service and university researchers under the coordination of the Unit Leader. Unit members also cooperate with researchers involved in projects funded by non-National Park Service sources in order to obtain scientific information on Park Service lands.

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SPECIAL REPORT NO. 7

ORGAN PIPE CACTUS NATIONAL MONUMENT BIOSPHERE RESERVE SENSITIVE ECOSYSTEMS PROGRAM

Peter S. Bennett and Michael R. Kunzmann

October, 1987

National Park Service
CPSU/UA
Tucson, Arizona

NATIONAL PARK SERVICE/UNIVERSITY OF ARIZONA
October 1987

ORGAN PIPE CACTUS NATIONAL MONUMENT
BIOSPHERE RESERVE
SENSITIVE ECOSYSTEMS PROGRAM

EXECUTIVE SUMMARY

October, 1987

Organ Pipe Cactus National Monument (ORPI), established by Presidential Proclamation fifty years ago, covers one-third million acres along the boundary with Mexico. Designated an International Biosphere Reserve, it has an international setting attracting persons interested in the cultural and natural history of the northern Sonoran Desert.

Past land management and research efforts lacked a coherent integrated management approach. As a result, there are large gaps in knowledge about the magnitude and diversity of problems affecting the resources.

In 1984, the ORPI Resource Management Plan identified four high priority research projects: 1) Effects of Mexican Agriculture on ORPI Resources, 2) Inventory of ORPI Herpetofauna, 3) Survey of Terrestrial Invertebrates, and 4) Weather Monitoring. Following application to the National Park Service Western Regional Office, approval and high priority for funding were given to these four projects. The projects were administratively combined into one (Sensitive Habitats Project). Funding was set at $82,000 per year for three years (the sum of the cost of the four projects identified in the Resource Management Plan). No provision was made by the Regional Office for integration of the four independent studies.

In the fall of 1985, the CPSU/UA staff and other scientists having wide experience in Sonoran Desert ecology held a series of informal discussions about the possibility of integrating past vegetation research with the four disparate projects now combined as the Sensitive Habitats Project. In California, Christine Schonewald-Cox (CPSU/UCD) was investigating the biological effects of political boundaries imposed on ecological edges; and, Although she could not attend these meetings, her ideas had influence. Incorporating the ideas of these scientists, the CPSU/UA began preparing a proposal to integrate the NPS research effort. Late in 1985, prior to completion of the proposal, the $82,000 funding for the project was withdrawn for use in Alaska and work on the proposal ceased.

Spring, 1986, found Superintendent Harold Smith seeking funds for project reactivation. At the Congressional Field Hearings in Phoenix, he asked for $82,000 per year for three years ($246,000) to replace the funds withdrawn. In the meanwhile, CPSU/UA staff were preparing smaller proposals related to the project. In May of 1986, the Western Regional Office found $22,000 and asked the CPSU/UA to prepare a proposal in this amount for laying the foundation of the larger study should funds become available. In late May, the $22,000 was withdrawn by the Regional Office and reserved to fund an inter-

national interdisciplinary science and resource management workshop to prepare an integrated long range management plan.

The International Panel met in Tucson in September, 1987. The 27 members of the Panel made their recommendations in the form of a step-down plan (Figure 1) based on the Superintendent's single objective: "Develop a management program, based on synthesis reports, to determine: 1) Condition of Organ Pipe National Monument ecosystems; 2) Alternatives available for ecosystem management; 3) effectiveness of implemented action programs." The Panel identified ninety-two tasks necessary to meet this objective and prepared a Scope of Work, detailing what was to be accomplished (Appendix F). The Panel estimated that $1,401,000 would be required to accomplish the 92 tasks, now called the Sensitive Ecosystems Program.

In the meantime, Congress passed an appropriation amendment sponsored by Senator DeConcini that provided $247,000 per year increase to the National Park Service base funding to cover the cost of the integrated program. The Service's Washington Office determined that only the first year's $247,000, followed by $82,000 for two additional years would be made available to the program. This was more than originally asked for by the 1985 four project plan but only 29 percent of the funding called for by the International Panel's Step-Down Plan.

The Western Regional Office directed that a Steering Committee of National Park Service employees meet for the purposes of reducing the project budget by 71 percent in conformance with the funding available and to prepare requests for proposals necessary to begin the projects. This meeting was held on February 10, 1987.

The Steering Committee achieved the economies ($990,000) required by: 1) confining the geographical project scope to lie within the monument, not addressing the neighboring land use; 2) elimination of 70 tasks entirely; and 3) only partially funding the balance of the work. These steps were taken reluctantly to stay within budget, but effectively undermined the integrity of the International Panel Step-Down Management Plan. Because each portion of that Plan is necessary, and no portion is superfluous, the Superintendent's primary objective cannot be met. Those portions of the Management Plan that have been eliminated are graphically presented in Figure 2.

The projects (or portions of projects) funded are those of the highest priority. The Steering Committee added several projects to bridge over others that were deleted. Inclusion of Schonewald-Cox's Boundary Effects project is an important example. Another addition is the Study Site Selection Project which is a substitute for the integration tasks cut from the Step-Down Management Plan.

The curtailed Sensitive Ecosystems Management Program will generate about half of the data required to decide what and how to monitor and one fourth of the data required for ecosystem synthesis. Even this reduced amount of data will provide much more information for management than is currently available.

In the event that more money becomes available, priority should be given to completely funding the 22 projects in Echelon 5 of the "Evaluate Ecosystem Conditions" branch of the Step-Down Management Plan. Then the rest of the tasks in this branch should be activated. These actions will result in a completed product. The next priority for funding is the "Prepare Synthesis Reports" branch. This can logically be followed by activation of the balance of the program.

The International Panel did not intend that the Step-Down Management Plan should represent a one-time effort. The research activities can be completed but the monitoring, synthesis, alternatives, literature review, and audit program activities will continue indefinitely. Resource management is an ongoing activity requiring that staff and tools be available to identify changing conditions and to develop action plans. The importance of the "Select and Train Personnel" and "Obtain Long-term Funding" tasks specified in the Step-Down Plan cannot be overemphasized.

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ORGAN PIPE CACTUS NATIONAL MONUMENT BIOSPHERE RESERVE SENSITIVE ECOSYSTEMS PROGRAM

Dennis Fenn, Program Coordinator

Special Report No. 7
Program Design and Status Report

October, 1987

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and

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National Park Service
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Revision 1 - 11/1/87

ACKNOWLEDGEMENTS

Many persons have unstintingly contributed their efforts to making this project possible. Dr. Dennis Fenn (CPSU/TAMU) agreed to serve as Program Coordinator, bringing with him his years of experience managing large science programs, his knowledge of how to get things done in the National Park Service, as well as his calm good sense. My Unit Leader, Dr. R. Roy Johnson (CPSU/UA), has served as a co-author in early attempts to design this program and has given much valuable advice and time to the project. Dr. Gary Davis (CHIS) had the vision to introduce Step-down Planning into the process of designing large NPS research projects and contributed this knowledge to the Sensitive Ecosystems Program. Gary prepared a statement about Step-down planning that I have liberally paraphrased in this paper. Mr. Carlos Nagel has served as translator and cross-cultural interpreter with our Mexican colleagues during the meeting of the international team.

Susan Shaw and Michael Kunzmann, CPSU/UA, have both "had the strength to get up and do what needs to be done," working in capacities far beyond their NPS position descriptions and contributing many hours of their time. Carla Martin (Chief, WACC) has provided the assistance of her staff and meeting facilities for the project.

Dr. Charles Lowe (University of Arizona) has generously drawn upon his vast knowledge of ecology and biology of the Sonoran Desert and contributed this to the program. He has the ability to ignite enthusiasm and ideas in those with whom he comes in contact. Dr. L. Susan Anderson (GRCA), Peter Warren (Arizona Nature Conservancy), Dr. Christine Schoenwald-Cox (CPSU/UCD), and Dr. Ken Kingsley played instrumental parts in the inception of the program and have contributed many useful ideas on integration of multi-disciplinary research findings.

Harold Smith, Superintendent of Organ Pipe Cactus National Monument (ORPI), has created an unusually favorable atmosphere for research and resource management during his administration. Bill Mikus, Resource Management Specialist (ORPI), has generously given his time to many aspects of project design and the selection of the special Study Sites. Bill and Harold both have a large vision for Organ Pipe and have been willing to fight for their views.

Many other persons have made contributions, too many to name them all; but, Dr. William Halvorson, Mike Rose, Steve Viers, Dr. Gary Fellers, Dr. Mietek Kolipinski, and Richard Anderson have given especially significant assistance.

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INTRODUCTION

Organ Pipe Cactus National Monument (ORPI), established in 1937 by Presidential Proclamation, covers an area of 330,690 acres along the international boundary with Mexico. The monument has an international setting, attracting laymen and professionals interested in the cultural and natural history of the regional plant and animal assemblages of both the Lower Colorado Valley and the Arizona Uplands subdivisions of the Sonoran Desert. Twenty-six species of plants or animals are known to reach their range limits within the monument. Some are found nowhere else in the United States, making this area a fascinating laboratory for the study of biogeography and desert evolution.

Most of the Sonoran Desert, both in the United States and in Mexico, has been adversely impacted by development, especially grazing. Friar Eusebio Francisco Kino, the great geographer and Jesuit missionary, pastured livestock in the ORPI area in 1697; the last cattle were not removed until the mid-1970's. Elimination of both cattle grazing and mining changed the perspective of park management from overwhelming internal problems to a more holistic view. This view was enhanced by designation of ORPI as an International Biosphere Reserve. Park management concerns are no longer predominately internal but extend well beyond its geographical boundaries.

Reflecting this holistic view, an international working group of managers and scientists convened in September, 1986 to produce an integrated management plan for the development of a scientific program to assess ecosystem conditions at the Organ Pipe Cactus National Monument International Biosphere Reserve. Strong emphasis was placed on development of an integrative long-range plan that addresses management needs, alternatives for ecosystem management, and auditing of resource management action plans for efficacy. Implementation of the plan will protect the resource, be cost effective, and will carry the monument forward into the next century in consonance with the mission of the National Park Service.

Planning for the Sensitive Ecosystems Program has been a long and complicated process. The step-down planning technique itself, though appearing to be simple, is quite complex. Therefore, we offer a brief history of the program and a discussion of the step-down planning process and underlying assumptions in the following discussion.

PROGRAM HISTORY

Prior to the current Program, ORPI identified four high priority research projects in its 1984 Resource Management Plan (RMP):

1) Effects of Mexican Agriculture on ORPI Resources,
2) Inventory of ORPI Herpetofauna,
3) Survey of Terrestrial Invertebrates, and
4) Weather Monitoring.

These four projects were administratively combined by the National Park Service Western Regional Office (WRO) and appeared in the 1985 priorities as the Sensitive Habitats Project with proposed funding of $82,000/annually for three consecutive years. High priority was also given for project funding.

The Cooperative National Park Service Resource Studies Unit at the University of Arizona (CPSU/UA) began preparation of a proposal and work plan for the project in the Fall of 1985. During a series of informal meetings held among Dr. Charles Lowe (University of Arizona), Dr. L. Susan Anderson (NPS/Grand Canyon National Park), Peter Warren (Arizona Nature Conservancy), Roy Johnson (CPSU/UA), Michael Kunzmann and Peter Bennett (CPSU/UA), a strategy for merging the four original projects into a meaningful whole began to emerge. The strategy required that all research results from the four above projects be integrated at the ecosystem level. A fifth synthesis project was designed to correlate and analyze the results between projects. Research by each of the four teams working on the four original projects was to be conducted throughout the monument over a wide range of habitats. Preselected study sites were designated to serve as integrative links to assess differential findings across all studies. Thus, a portion of the data collected for each of the four original projects would come from the identical locations and would provide the baseline information necessary for the fifty synthesis project.

The four research teams were to meet, exchange data, and derive integrated interdisciplinary information. The proposed synthesis project was designed so that a definitive statement about the health of preselected habitats could be made. The Bennett and Johnson proposal in preparation delineated and outlined the factors associated with the fifth synthesis project. The overall objectives of the Sensitive Habitats Project were to quantify the present management concerns, identify future threats, and provide management with solid recommendations. Late in 1985, funding for the project was withdrawn and activity stopped.

In 1986, Bennett and Johnson began writing another proposal for a small inexpensive project to standardize vegetation classification of Sonoran Desert ecosystems. The standardization project would be a necessary prerequisite in developing a

consistent framework to adequately describe the vegetation communities that are representative of the monument's vegetation association mapping units. Each representative community would be analogous to a type specimen in plant taxonomy. Information on "type" communities would include, but not be limited to: a species list, species abundance, species diversity, community morphometric variation, distribution dyntamics and patterns, and soil matrix information. Such standardization would be useful if the Sensitive Habitats Project was ever reactivated and for future multi-disciplinary studies. Stop-gap funding of $2,000 a year was requested as an interim solution until additional funding could be identified for the original multi-disciplinary Sensitive Habitats program or subsequent future integrative studies.

During preparation of the vegetation project proposal, $22,000 became available for pilot projects to lay ground work for the Sensitive Habitats project. With very little lead time, Bennett and Johnson prepared a new (third) proposal to cover this work, including the vegetation standardization project. The new proposal was submitted for review and informally rejected as being too narrow in scope. In the Spring of 1986, funding was again withdrawn leaving only enough to support the convening of an interdisciplinary panel charged with the responsibility of designing a much larger project.

Concurrently, Superintendent Smith had presented the monument's cost estimate of the original Sensitive Habitats Project (based upon the four small original projects and the synthesis project) to Senator DeConcini's staff in April, 1986. During his testimony at the Congressional field hearings of July 1-2, 1986, held in Phoenix, Arizona, he again presented the project's needs as they were then understood. Subsequently, Senator DeConcini presented an amendment that added $247,000 annually to the National Park Service's base funding to cover the cost of the project. This bill was passed late in 1986 (Appendix H).

In June 1986, the Superintendent's staff held a meeting with personnel from the CPSU/UA and the NPS Southern Arizona Group Office (SOAR). To eliminate confusion with several past unfunded studies, a new title, Sensitive Ecosystems Project, was suggested for the latest project. The new title more accurately reflected the new vision of a large integrative management program as recommended by WRO and monument staff. With funding identified, the principal topic of discussion was how to efficiently obligate NPS funds and address the resource issues that had been previously identified. It was determined that a variety of academic disciplines and expertise would be required to sufficiently address all Sensitive Ecosystem Project goals. Consequently, an international panel of scientists, resource managers, and administrators was convened to design a much larger integrative program than the original Sensitive Habitats Project.

The International Panel was charged with responsibility to develop a management plan to incorporate all Sensitive Ecosystem Project goals through Step-Down Planning processes (q.v.). The meeting date was set for mid-September and was to be hosted jointly by CPSU/UA and ORPI (Appendix G).

On September 17-20, 1986, the international interdisciplinary panel met in Tucson to design an integrated management program that would finally examine all the resource management needs of Organ Pipe. The new program would be called the Sensitive Ecosystems Program, encompassing numerous projects and including the former Sensitive Habitats Project. The Southwest Regional Office of NPS agreed to donate 25 percent of the time of Dr. Dennis Fenn, Unit Leader of the CPSU at Texas A&M University [CPSU/TAMU] to the Sensitive Ecosystems Program. Dr. Fenn would function as Program Coordinator and provide the guidance necessary to lead the international meeting.

Twenty-seven managers and scientists participated in the formulation of the Sensitive Ecosystems Program Step-Down Plan (Appendix D). Dr. Gary Davis and Dr. William Halvorson, National Park Service, chaired the step-down meetings and were instrumental in adapting the Step-Down planning technique to the management goals of the Sensitive Ecosystems Program.

The international panel identified twenty-two projects as necessary and placed them in priority order. A detailed scope of work statement was prepared by the panel for each project with concomitant funding requirements estimated. Requests for proposal documents (RFP's) were prepared and directly integrated from scope of work statements. Subsequently, the RFP's were utilized to solicit, evaluate, and award Sensitive Ecosystems Program research contracts.

Based on the Panel's estimates, a conservative budget for the project was prepared; it totaled $1,401,000. The step-down plan and scope of work statements were edited jointly by the CPSU/UA and the Office of the Chief Scientist (WRO). This document became the basis for all subsequent project planning.

In the interim, the Washington Office (WASO) had administratively determined that funding for the project would be $247,000 in FY 1987, and $82,000 in FY 1988 and FY 1989. The total funds available for the project were reduced to only 29 percent of the budget originally identified by the international team in the step-down management plan.

On February 10, 1987, a small group of NPS employees, called the Steering Committee, representing the WRO, SOAR, CPSU/UA, and Dr Fenn (CPSU/TAMU) met to implement the Sensitive Ecosystems Program. The first task of the Steering Committee was to reset priorities and restructure the Step-Down Plan studies for partial implementation and funding.

The Committee's job was difficult - How to deal with an inadequate budget, still get a useful product, and not destroy the fabric of the step-down management plan. One of the powerful features of step-down planning is that all of its parts (tasks) are logically derived in a 'step-wise' hierarchical manner. However, each component must be fully accomplished to meet the management goal.

The Committee did this (insofar as possible) by subdividing the tasks into subprojects that were in proportion with the budget and by adding a few elements, not part of the original plan, to bridge gaps. Currently, as the matter stands, the step-down management goal cannot be completely met; but, should additional funding become available, the plan can be reactivated and completed.

The second task of the Steering Committee was to divide the administrative workload for the project between CPSU/TAMU and CPSU/UA. CPSU/TAMU was to do most of the work necessary for solicitation of bids and contracting. CPSU/UA did the advance field work, fiscal accounting, and day to day project coordination with the monument.

One of the elements added to the step-down plan by the Steering Committee called for identification of geographically defined study sites within the monument that are sensitive to ecological change. The idea was to incorporate the Bennett/Johnson integration scheme of (1985 q.v.) to quantify large scale ecosystem changes over selected study sites. This research integration method is a technique utilized to compensate for uneven and insufficient project funding levels. The technique was first suggested in the earlier Sensitive Habitats Project.

Because of the severe time and budgetary constraints, fourteen research sites were selected using subjective criteria. The fourteen research sites were selected to provide a framework to measure ecological change and provide synthesis information for future evaluations. All site selections and corresponding descriptions were required by March 10 to complete the RFP's. All RFP's, advertisements, proposal evaluations, best and final offers, and contract awards were to be completed by September 15, 1987 (Appendix E).

The first annual principal investigator's meeting is scheduled to be held on October 22-23, 1987. The October meeting will be organizational, but future meetings will be used to prepare the way for the integration of data across numerous disciplines and projects.

STEP-DOWN PLANNING

INTRODUCTION

The International Panel collectively thought it important to define and clearly delineate the objective of the workshop and the specific actions required to address the management goal. Step-down planning, a particularly powerful planning technique, was selected as the means to accomplish this goal. Step-down planning requires that a single purpose primary objective that communicates the identity, nature, and depth of the problem be developed. After the primary objective is adequately defined, all sequential steps necessary to accomplish this primary objective, in logical order from the large to the small, are identified. Each step is tested for relevance against the primary objective. Each subordinate step must be completed before any step above can be accomplished or the objective met. In this step-wise fashion the plan is logically integrated, details are not omitted, and the planners do not lose sight of the original management objective while considering details of a complex management program.

This deductive thought process simplifies the complex problem-solving by breaking a relatively complex problem into its constituent components, each being less and less complex. It assures focus of attention on the primary management objective and specifies all actions necessary, and only those necessary, to attain that objective.

This planning process involves six steps:

1. Establish the primary management objective to be accomplished. Proper formulation of the primary management objective directly affects all subordinate tasks that support it. This is no easy task. The Superintendent, ORPI, developed this objective with the help and support of the group.

2. To attain this management objective, what obstacle(s) must be overcome? In answer to this question, develop a secondary (subordinate) items required to accomplish the first.

3. The question is repeated for each level and succeeding echelon task. This will create series of echelon levels, each with their own respective subordinate objectives and supporting steps.

4. Continue logical derivation of subordinate objectives until terminal items are reached, that is, items that cannot [Citation to Phenicie & Lyons, 1973] reasonably be further subdivided into components.

5. Reexamine the plan to determine that the composite attainment of each item, beginning with the terminal items, will build back to accomplish the primary management objective. This step assures that no necessary actions have been omitted.

6. Reexamine the plan to determine that each item is necessary to accomplish the primary objective. This step assures that unnecessary actions are eliminated.

The plan presented in this paper presents the details of the technical work to be accomplished to reach primary management objective, but it does not account for administrative procedures and processes required to accomplish any specific task. Administrative techniques are dynamic and diverse. Consequently, project adminstration has been omitted in the interest of limiting the plan to a workable size. The administrative work not shown includes the complex process of research contracting, fiscal accounting, scheduling, making travel and accommodation reservations, preparation of graphics, coordination of the CPSU/TAMU and CPSU/UA activities, and unenumerable other details.

Administration appears in only the working budgets (Appendices B & C). The modest administrative budget covers Program related travel expenses of the Program Coordinator and other CPSU staff, preparing RFP's, assembling the proposal evaluation team, assembling the project steering committee, and preparing all administrative documentation (including this report).

A description of the step-down plan developed to meet the long range needs of Organ Pipe Cactus National Monument follows in both descriptive and graphic form (page 16).

SENSITIVE ECOSYSTEMS PROGRAM STEP-DOWN PLAN (Task Identification)

MANAGEMENT OBJECTIVE:

Develop a management program, based on synthesis reports, to determine:

1) Conditions of Organ Pipe Cactus National Monument ecosystems;
2) alternatives available for management; and
3) effectiveness of implemented action programs.

PROJECT STATEMENTS OF WORK

1.0 IDENTIFY MANAGEMENT ALTERNATIVES (responds to Item 2 of Primary Objectives). Evaluates the options available to management for responding to resource problems. Action(s) based on synthesis reports (2.0), considering the problem encountered, NPS policy, alternatives technically available and the feasibility of those alternatives. Such evaluation is made by management with consultation available from CPSU scientists and/or Synthesis Panel (2.2).

1.1 IDENTIFY ECOLOGICAL PROBLEMS. Identification is based on consultation with experts (1.1.1) and review of ecosystem conditions (1.1.2) by management.

1.1.1 CONSULT WITH EXPERTS. Monument staff and CPSU scientists maintain a list of suitable experts (including CPSU staff) available for consultation about the problems most likely to be encountered.

1.1.2 REVIEW ECOSYSTEM CONDITIONS. Monument staff reviews ecosystems conditions available in synthesis reports.

1.2 REVIEW POLICY. An important part of finding management options available is consideration Government policy, treaties, and agreements (3.1.1.3.3). Monument staff prepares pro and con briefing for the Superintendent's consideration.

1.2.1 LEGISLATION, PRESIDENTIAL PROCLAMATIONS & EXECUTIVE ORDERS.

1.2.2 TREATIES, BOUNDARY COMMISSION, MAN AND THE BIOSPHERE, ETC.

1.2.3 N.P.S. MANAGEMENT POLICY AND REGULATIONS.

1.2.4 COOPERATIVE AGREEMENTS AND AGREEMENTS OF UNDERSTANDING.

1.3 GENERATE ALTERNATIVES. Options available are generated through consultation with experts, review of literature, and evaluation of potential actions in view of knowledge of monument ecosystems.

1.3.1 CONSULT WITH EXPERTS. Monument staff and CPSU scientists maintain a list of suitable experts (including CPSU staff) available for consultation about the problems most likely to be encountered.

1.3.2 INTEGRATE POTENTIAL ACTION WITH PRESENT KNOWLEDGE OF THE MONUMENT ECOSYSTEMS.

1.3.3 REVIEW SCIENTIFIC LITERATURE.

1.4 DETERMINE FEASIBILITY OF POTENTIAL MANAGEMENT ALTERNATIVES. Evaluate generated alternatives (1.3) in light of political, cost, technical, and manpower constraints.

1.4.1 COST

1.4.2 TIME REQUIRED

1.4.3 EXAMINE AVAILABLE KNOWLEDGE, TECHNOLOGY, AND EXPERTISE.

1.4.4 EXPLORE POLITICAL CONSIDERATIONS, INCLUDING PUBLIC REACTION.

2.0 PREPARE SYNTHESIS REPORTS. Synthesis reports incorporate in summary form, the status of the monument ecosystems (3.0), problems (actual or potential) identified as well as alternatives available for action (1.0), efficacy of action programs (5.0), and the availability of applicable information in the scientific literature. These reports address objective #1 of management's Primary Objectives. Synthesis is achieved through gathering of multi-disciplinary team(s) as needed to update old syntheses and incorporate new information. The synthesis report is the primary document used to make resource management decisions.

2.1 SYNTHESIZE NEW UNDERSTANDING AND KNOWLEDGE. New knowledge is synthesized through organized meetings called by the Program Coordinator for this purpose between Principal Investigators (P.I.'s), CPSU staff, and monument staff. Additionally, each P.I. undertakes to keep themselves informed about new information appearing in the literature that is relevant to their project and to report this information at synthesis meetings. The proceedings of these meetings, suitably published and distributed by the CPSU, will form a principal component of the synthesis report.

2.1.1 REVIEW SCIENTIFIC LITERATURE (4.0).

2.1.2 EXAMINE DATA AND RESULTS OF MONITORING AND RESEARCH PROJECTS AND INTEGRATE THEM WITH INFORMATION FROM THE SCIENTIFIC LITERATURE.

2.1.3 CONVENE A MULTI-DISCIPLINARY GROUP TO REVIEW AND SYNTHESIZE INFORMATION ABOUT MONUMENT ECOSYSTEMS. Provision for attendance by P.I.'s at such meetings is written into all research contracts and agreements.

2.2 CONVENE A WORKING GROUP AND RECOMMEND MANAGEMENT ACTIONS BASED ON SYNTHESIS REPORTS. This working group will normally be the Program Coordinator, Resource Management Specialist, WRO representative, and CPSU staff. Meeting will be held on an as-needed basis.

2.3 PREPARE AND REVISE RESOURCE MANAGEMENT PLAN AND PROGRAM SHEETS. This activity will be undertaken by the Superintendent and monument staff. The Working Group (2.2) will be available for consultations as needed.

2.4 REVIEW MANAGEMENT IMPLICATIONS AND PREPARE EXECUTE SUMMARIES OF MONITORING AND RESEARCH REPORTS. This activity will be undertaken by the Working Group (2.2) on an as-needed basis and will prepare reports for the Superintendent's consideration.

3.0 **EVALUATE ECOSYSTEM CONDITIONS** (responds to Item 1 of Primary Objectives). Included here are the gathering of all resource information (research and monitoring) as well as the mechanisms by which such data is stored, retrieved, and compared. Most of the initial work will be contracted, with CPSU and monument personnel undertaking a minor role. Following the third year after start-up, monument personnel will undertake all work. It is anticipated that 5-6 resource management Full Time Equivalency (FTE's) will be required to run the monitoring program.

3.1 **MONITOR MONUMENT ECOSYSTEM CONDITIONS.** Includes factors for selecting what to monitor, how to monitor, and monitoring activity itself. If funding or time constraints prohibit examination of the entire monument, selected ecosystems or tracts of land must be identified for study at this stage.

3.1.1 **SELECT ECOSYSTEM COMPONENTS (INCLUDING PROCESSES) TO MONITOR.** Through literature review and research, ecosystem components suitable for monitoring are found and selected by scientists working in narrow subject fields.

3.1.1.1 **REVIEW SCIENTIFIC LITERATURE**

3.1.1.2 **ESTABLISH AND APPLY CRITERIA TO SELECT COMPONENTS AND PROCESSES TO MONITOR.** A suitable choice is a component that is sensitive to changes in ecosystem condition and that can be economically monitored by trained lay personnel.

3.1.1.3 **SURVEY THE ECOSYSTEMS TO DISCOVER AND DOCUMENT COMPONENTS NOT ADEQUATELY KNOWN FROM THE LITERATURE.** Eleven such components have been identified for study.

3.1.1.3.1 **VEGETATION.** Conduct a survey to define and delimit our understanding of plant communities of the Sonoran Desert both within and without the Biosphere Reserve. Examine the past history of ORPI vegetation and its present regional distribution and composition. Design a monitoring system (including instruments and protocols) that include species composition, importance and distribution components sensitive to change. (3 yrs., $135,000 total)

3.1.1.3.2 **INVESTIGATE ECOLOGY OF TERRESTRIAL INVERTEBRATES.** Provide information about species presence, distribution, importance, abundance, growth rates, mortality rates and causes, and food habits of species deemed to be of importance. Establish criteria for selecting species and study sites to be included in a long-term monitoring effort. Design a monitoring system (including instruments and protocols) that include species sensitive to change. (3 yrs., $150,000 total)

3.1.1.3.3 **LEGAL AGREEMENTS.** Inventory agency, bilateral international agreements; treaties; memoranda of understanding; letters of agreement; etc. with Mexico and it's governing entities; the monument's neighboring land managing agencies; and semi-private agencies as may affect resource management activities of the monument. (1 yr., $9,000)

3.1.1.3.4 INVESTIGATE FLORISTIC COMPOSITION. Determine status of plant species whose distribution and abundance are poorly known on the monument as well as on adjacent emphasis to invasive, rare, or growing at or near their geographical range limits. Provide detailed distributional data and autecological information (to the degree reasonably possible) for such species. Identify species and sites suitable for long-term monitoring and develop monitoring instruments and protocols useful for detecting change in species composition. (3 yrs., $120,000 total)

3.1.1.3.5 INVENTORY HERPETOFAUNA. Provide information about species presence, distribution, importance, abundance, growth rates, mortality rates and causes, and food habits of species deemed to be of importance. Pay particular attention to species that are federally protected, known to be rare but not accidental in distribution, or popular with professional collectors. Establish criteria for selecting species and study sites to be included in a long-term monitoring effort. Design a monitoring system (including instruments and protocols) that include species sensitive to ecosystem change. (3 yrs., $135,000)

3.1.1.3.6 HYDROLOGY INVESTIGATION. Make a preliminary surficial hydrology investigation and map for each biological monitoring station. Establish hypothetical model monitoring system (including instruments and protocols) that predicts groundwater change. (1 yr., $9,500)

3.1.1.3.7 AQUATIC INVERTEBRATES INVESTIGATION. Prepare a summary of existing but scattered literature and data. Design a study that will provide information about species distribution, abundance, recruitment, and food habits of significant species. Based on this information, establish criteria for selecting significant taxa and study sites suitable for long-term monitoring, and develop monitoring instruments and protocols useful for detection of long-term ecosystem change. (2 yrs., $40,000)

3.1.1.3.8 LAND USE AND SOCIO-ECONOMIC STUDY. Itemize and outline of land use policy for lands adjacent to the monument. Assemble maps, air photos and photographs showing: transportation corridors and commercial/industrial activities; mining and mineralized areas; location of grazing, farming, urban and "reurbanized" areas; location of nature reserves; location of drainages, wells, and other water resources; and areas with special problems such as flooding and erosion. Establish socio-economic profiles of: the Sonoyta Valley, the Why-Ajo area, the western O'Odham reservation. Consider population and population growth, type of residency, economic status, education, health, sources of employment and financial security, environmental awareness, rates, business and commerce characteristics. Determine attitudes toward resource concerns, ORPI and other reserves, and Man and the Biosphere Reserves. Develop a plan for procedures and contacts for updating socio-economic profiles and for monitoring on adjacent lands. (3 yrs., $190,000)

3.1.1.3.9 **SOILS STUDY.** Prepare first order for each of the selected study areas. Establish criteria for selecting sites and soils for long-term monitoring. design necessary instruments and protocols for monitoring soil changes. (1 yr., $9,500)

3.1.1.3.10 **GEOLOGICAL MAPPING AND LITHOLOGY.** Prepare a geological map for each appropriate study area. Describe the lithology, structural geology, and land form of each site. Discuss the relevancy of site geology to the abiotic habitats present. (1 yr., $9,500)

3.1.1.3.11 **BOUNDARY EFFECTS STUDY.** Determine the effects of generated and natural boundaries on the ORPI biota. Establish criteria for selection of sites to be included in a long-term monitoring effort. Design instruments and protocols for assessing and long-term monitoring of edge effect. (3 yrs., only $14,000 funded from this project)

3.1.2 **DESIGN MONITORING PROTOCOLS.** Through literature review and research, the methodology for monitoring selected ecosystem elements or species is developed. The investigator designs instruments (paper forms) for recording data and writes the monitoring protocols (detailed step by step instructions) for performing the work.

3.1.2.1 **SUMMARIZE AND ANALYZE INFORMATION FOUND IN SCIENTIFIC LITERATURE TO PROVIDE A BASIS FOR TREND IDENTIFICATION AND MONITORING ACTIVITIES.** Searches the literature to find existing methodologies that can be adopted or adapted to the specific problem at hand.

3.1.2.2 **DESIGN SAMPLING SYSTEMS TO MONITOR ECOSYSTEM COMPONENTS.** In most cases, the information to be gathered is collected from a subset of an entire ecosystem. Selection of such subsets is a matter requiring careful attention if the result is to faithfully represent the whole.

3.1.2.3 **DESIGN STANDARD ANALYTICAL SYSTEMS TO REPORT AND ARCHIVE MONITORING DATA.** Uniform analytical methods, data storage and retrieval, and data reporting methodologies must be developed. Such a system must be transferable to the technology available to the resource manager. Develop guidelines to interpret analytical results into management terms.

3.1.2.4 **DESIGN STANDARD REPORT FORMATS AND PROTOCOLS OF MONITORING INFORMATION.** Designs the instruments (forms) for recording data gathered according to the monitoring protocols (instructions) developed. Such instruments and protocols must be intelligible to resource managers of ordinary technical ability.

3.1.2.5 **FIELD TEST SAMPLING, ANALYTICAL, AND REPORTING SYSTEMS TO INSURE EFFICACY.** Instruments and protocols for monitoring of selected ecosystem elements or species must be field tested for appropriateness and ease of use by monitoring personnel.

3.1.2.5.1 VEGETATION. See comments under 3.1.1.3.1.

3.1.2.5.2 TERRESTRIAL INVERTEBRATES. See comments under 3.1.1.3.2.

3.1.2.5.3 LAND USE AND SOCIO-ECONOMIC. See comments under 3.1.1.3.8.

3.1.2.5.4 SPECIAL PLANT SPECIES. See comments under 3.1.1.3.4.

3.1.2.5.5 GROUNDWATER. Project divided into two phases: Phase I calls for drilling three test wells near Blankenship Ranch; develop monitoring instruments and protocols for groundwater depth in these new wells and in other suitable pre-existing wells. Phase II calls for drilling three wells of suitable depth in the area constituting the recharge area for Quitobaquito Springs; develop monitoring instruments and protocols for groundwater depth and chemical composition of the waters in the new wells and well as of the Springs; conducting a gravimetric survey across the Quitobaquito recharge area. (Phase I: 1.5 yrs., $45,000. Phase II: 1.5 yrs., $58,000)

3.1.2.5.6 WEATHER. Select sites in each major airshed within ORPI and install long-term recording electronic weather stations. Develop instruments and protocols for managing and analyzing these data. (1 yr., $54,000)

3.1.2.5.7 HERPETOLOGICAL FAUNA. See section 3.1.1.3.5.

3.1.2.5.8 HYDROLOGY. See section 3.1.1.3.6.

3.1.2.5.9 AQUATIC INVERTEBRATES. See section 3.1.1.3.7.

3.1.2.5.10 MAMMALS. Summarize existing literature and data for species suitable for monitoring. Provide information about species distribution, abundance, age and size structure, growth rates, mortality and recruitment, and food habits for these species. Special attention should be given to: protected, rare or endangered species; species that occupy different trophic levels; endemic species; species subject to poaching, hunting, or professional collecting; alien, exotic, or feral species; species that are of special interest to the public; and species that occupy sites that are subject to dramatic change (habitat loss). Develop instruments and protocols suitable for monitoring changing status of these species. (3 yrs., $105,000)

3.1.2.5.11 AIR QUALITY. Summarize existing air quality data by airshed, attempting to identify emission sources. Establish a visibility monitoring station. Develop suitable instruments and protocols to incorporate existing visibility data into a long-term monitoring effort. (1.5 yrs., $25,000)

3.1.2.5.12 **BIRDS.** Summarize existing literature and data for species suitable for monitoring. Provide information about species distribution, abundance, age and size structure, growth rates, mortality and recruitment, and food habits for these species. Special attention should be given to: protected, rare or endangered species; species that occupy different trophic levels; endemic species; species subject to poaching, hunting, or professional collecting; alien, exotic, or feral species; species that are of special interest to the public; and species that occupy sites that are subject to dramatic change (habitat loss). Develop instruments and protocols suitable for monitoring changing status of these species. (2 yrs., $60,000)

3.1.2.5.13 **POACHING.** Summarize existing literature and data related to poaching, including agency reports, gray literature, newspaper articles, etc. Develop a protocol for maintaining communication with USFWS, USFS, BLM, Border Patrol, Customs, Arizona Game and Fish, Pinacate National Park and various Mexican officials, CITES, IUCN, and various conservation organizations including Pronatura, Friends of Pronatura, Nature Conservancy, Arizona Native Plant Society, etc. Develop instruments and protocols for long-term monitoring of changes in species status caused by poaching. (2 yrs., $14,000)

3.1.2.5.14 **WATER USE.** See Land Use and Socio-economic Study (3.11.1.3.8), Groundwater (3.1.2.5.5)

3.1.2.5.15 **AGRO-CHEMICAL.** Determine which, when, where, and what amounts of biocides are being used in proximity to the monument. Develop instruments and protocols for long-term monitoring of selected ecosystem elements such as soil, surface waters, vegetation, and animals for biocide effects. (2 yrs., $50,000)

3.1.2.5.16 **EROSION.** Summarize literature and data on erosion, especially that associated with overgrazing, that is relevant to the monument. Locate map sites of accelerated erosion identified in a monument-wide survey. Design instruments and protocols for long-term monitoring of erosion on selected sites and evaluate the effectiveness of erosion control measures now in place or devised in the future. (1 yr., $9,000).

3.1.2.5.17 **VISITATION.** Conduct a summary of existing literature and data about visitor use of and impact on monument natural resources. Select components of visitor use to be monitored and design instruments and protocols for long-term monitoring of ecosystem changes resulting from visitor use. (2 yrs., $15,000)

3.1.2.5.18 **HISTORIC FABRIC.** Assess the effects of natural attrition as well as the removal of parts (even whole structures, on occasion) on the historic structures fabric of the monument. Select suitable structures for monitoring and design monitoring instruments and protocols suitable for long-term monitoring of deterioration as well as efficacy of restoration measures. (1 yr., $9,000)

3.1.2.5.19 **BOUNDARY EFFECTS.** See section 3.1.1.3.11.

3.1.3 **IMPLEMENT MONITORING.** Set up the action program: obtain funding, FTE's, and personnel to implement the action program.

3.1.3.1 **OBTAIN LONG-TERM FUNDING.** Prepare necessary funding documents and justifications based on science supported management concerns.

3.1.3.2 **SELECT AND TRAIN PERSONNEL** (contractor or NPS).

3.2 **ESTABLISH CRITERIA TO EVALUATE ECOSYSTEM CONDITIONS.** Establish the criteria (thresholds) to be used for implementing management or restoration programs. These criteria are to be jointly developed by management and science.

3.2.1 **ECOLOGICAL FACTORS.**

3.2.2 **POLITICAL FACTORS.**

3.3 **COMPARE EVALUATION CRITERIA WITH ECOSYSTEM CONDITIONS.** Compare existing conditions (based on synthesis reports and stored information (3.2.1)) with thresholds for action (3.2). Notify management for necessity for action.

3.3.1 **DEVELOP AN INFORMATION MANAGEMENT SYSTEM.** This system stores and retrieves resource information needed for comparison with action thresholds criteria.

3.3.1.1 **DATA BASE MANAGEMENT.** Conventional data base storage of resource data (usually numerical).

3.3.1.2 **GEOGRAPHIC INFORMATION SYSTEM.** Information such as vegetation, soils, biological distribution, erosion, and other maps are electronically stored, recalled and overlaid to provide visual resource status information.

4.0 **REVIEW SCIENTIFIC LITERATURE.**

4.1 **DEVELOP AN ANNOTATED BIBLIOGRAPHY OF PERTINENT SCIENTIFIC LITERATURE.** Compile an annotated bibliography of research and resource management literature applicable to the monument. Establish a format for recording these data.

4.2 **ESTABLISH AN AUTOMATED SYSTEM FOR HANDLING, UPDATING, AND REPORTING BIBLIOGRAPHIC INFORMATION.** Install and maintain the bibliography in a computer searchable form. Prepare a protocol for managing the bibliography system. Perform frequent searches of libraries and commercial bibliographic data bases such as BIOSIS, SCISEARCH, AND AGRICOLA, for pertinent items. Establish a system for providing these items to interested parties (3.2.1.1).

5.0 MONITOR ACTION PROGRAMS IN THE MONUMENT. Sets resource management goals and audits achievement of these goals.

5.1 IDENTIFY ACTION PROGRAMS AND THEIR GOALS. Sets goals to be reached through resource management action and selects appropriate action plans from alternatives available (1.0).

5.2 EVALUATE EFFECTIVENESS OF ACTION PROGRAMS REGARDING THEIR EFFECT ON MONUMENT ECOSYSTEM CONDITIONS. Tests effectiveness of actions undertaken in reaching the goals defined.

5.2.1 IDENTIFY CONDITIONS PRIOR TO PROGRAM INITIATION. Examines and selects appropriate baseline conditions for consideration. Data comes from evaluation of ecosystem conditions (3.0)

5.2.1.1 SELECT APPROPRIATE BASELINE DATA.

5.2.1.2 SURVEY CONDITIONS.

5.2.2 MEASURE CHANGES IN CONDITIONS.

5.2.2.1 SELECT ECOSYSTEM COMPONENTS TO MEASURE.

5.2.2.2 SELECT METHOD FOR EVALUATING CHANGES.

5.2.3 COMPARE RESULTS WITH GOALS.

THE STEP-DOWN PLAN

RESTRUCTURED BY FISCAL CONSTRAINTS

The primary task of the Steering Committee at its February 10, 1987 meeting was to find ways to restructure the $1,401,000 step-down plan down to $411,000 without compromising the integrity of the plan.

The most obvious adjustment was that the scope of work had to be severely limited. The Committee had five choices for limiting the project:

1) to fund projects in priority order as set by the International Team;

2) to partially fund various projects;

3) to drop some projects from consideration;

4) to limit the geographical scope; or

5) to work out a combination of choices 1 through 4.

If choices 1-4 had been elected, funding available would have reached through priority 5, leaving many of management's concerns totally unaddressed (See Appendix A). Option 5) became the optimum choice because of the inherent flexibility and overall balance that was required to meet the greatest number of resource management goals.

The consensus of the International Team was that ORPI ecosystems did not exist in a vacuum; that they were vitally dependent upon the status of the adjacent ecosystems being managed by numerous neighbors with a wide variety of interests. Accordingly, the original Step-Down Plan called for investigations outside of the monument boundaries as well as within. It was thought to be particularly vital that the project should extend into the Rio Sonoyta Valley upstream from the monument and downstream to include the Sierra de Pinacate, Mexico.

To understand the ecological processes of ORPI; we must study the processes in Mexico. Many of the species subject to ecological change at ORPI originated in Mexico prior to their northward expansion into the monument, and they still flourish there. However, as important as the study of the adjacent management areas are to understanding ORPI, cutting them out of the Sensitive Ecosystems Program offered a savings of approximately $500,000. The Steering Committee reluctantly took this step because it achieved the greatest savings and did least damage to the overall Program. Should project funds become available, these cuts have high priority for restoration.

The projects most affected by confining the project within the monument borders were:

Agro-chemical (3.1.2.5.15).
Amphibians and Reptiles (3.1.1.3.5, 3.1.2.5.7).
Birds (3.1.2.5.12).
Floristics (3.1.1.3.4, 3.1.2.5.4).
Land Use and Socio-economics (3.1.1.3.8, 3.1.2.5.3).
Mammals (3.1.2.5.10).
Terrestrial Invertebrates (3.1.1.3.2, 3.1.2.5.2).
Vegetation (3.1.1.3.1, 3.1.2.5.1).

Of these, the Vegetation and Agro-chemical projects were completely eliminated, and the rest were greatly reduced in scale. Vegetation was eliminated because the monument already has a good vegetation map and partial site specific information could be collected by NPS researchers. Agro-chemical was eliminated because pesticides are not in use in the monument, and significant answers to pesticide problems cannot be gained entirely within monument boundaries.

The Air Quality (3.1.2.5.11), Poaching (3.1.2.5.13), Visitation (3.1.2.5.17) and Historic Fabric (3.1.2.5.18) projects were dropped since they have lower priorities than most other items. The Aquatic Invertebrates study was dropped because a small amount of work was done in the past and the project had only moderate priority. The Information System (3.2.1.1) was dropped because much of the data required could not be generated without full Program implementation. Without manpower to collect and enter the data, the hardware cannot be adequately justified. In addition, hardware needed is expected to be less expensive in the future. Thus, the Information System project can be deferred. The money saved by postponing projects amounted to $256,000.

Portions of several projects were funded, mainly for those portions that deal with the biota whose status is unknown, that pose special problems, or that lie near their biogeographical distribution limits at ORPI. The Special Status Plants, Grazing Recovery, and Weed Ecology portions of the Floristics project were retained. The Special Status Birds and the Special Status Mammals were also retained in their respective projects. Those portions of the Soils, Geology, and Hydrology projects that relate to the project study plots were also retained. Only $21,000 of the Groundwater study was funded, anticipating that supplemental funds may be found in the Division of Water Resources. $10,000 was saved in the Weather Project by reducing the number of complete weather stations from 8 to 5. The Agreements package was reduced by deemphasizing the private agreements portion of the study and calling for fewer bilingual products. Savings from partially funded projects amounted to $330,000.

Several projects and expenses were added. An administrative account was set up to cover Program travel by CPSU staff, expenses for meetings of the Steering Committee and for synthesis meetings, publication expense, and supplies. Identify Vulnerable Ecosystems was added for locating and evaluating potential sites nominated for intensive study by all appropriate projects. A multi-purpose interpretive display was purchased and graphics acquired for interpretation of the Sensitive Ecosystems Program to the public and other NPS areas. The Erosion study was reduced in scope and added to Grazing Recovery (a part of the Floristics project). Funding for Data integration was added, but the $15,000 designated for this purpose is inadequate.

The Boundary Effects project was added, but only $14,000 for it came from Sensitive Ecosystems, the balance coming from WASO. Finally, $15,000 was added (FY 1990) for Curatorial Cataloging to cover the expenses associated with natural history collections resulting from the entire program. The additions increased the program budget by $96,500.

The consequences of these decisions are graphically presented in Figure 2. The solid black ovals shown there represent those projects and tasks that are totally unfunded. Projects that are partly funded remain white.

The Steering Committee clearly understood that the decisions made necessary by funding constraints would prevent achievement of the step-down plan -- that the Primary Objective at the top of the Figure 2 would not be achieved. The Identify Management Alternatives (1.0) and Audit Program (5.0) hierarchies are totally unaddressed.

The Research and Monitoring hierarchy will generate about half of the data required. The principal investigators can reasonably be expected to develop a quarter of the information necessary through the review and synthesis process (2.1.3) to select what to monitor (3.1.1). Similarly, partial information will be available for the design of monitoring protocols (3.1.2). But, the critical factors Establish Evaluation Criteria (3.2) and Compare Criteria and Conditions (3.3) will remain unaddressed. In other words, none of the items in Echelons 1 and 2 can be even partly accomplished. Consequently, there will be no input into the Primary Objective to meet the overall management goal of the program.

RECOMMENDATIONS

In the event that more money becomes available to the Program, emphasis should be given to completing the tasks already begun. Next,the unfunded higher priority projects in Echelon 5 should be activated, extending the scope of these projects outside of the monument boundaries, especially into Mexico.

The next priority is activation of the remaining tasks below Evaluate Ecosystem Conditions (3.0) and the synthesis activities (2.0). These steps will give the manager synthesized ecosystem condition information and an active monitoring program, the bare minimum for managing the resource.

The alternatives (1.0), Literature Review (4.0), and Auditing (5.0) activities can be safely activated after the research (3.0) and synthesis (2.0) are begun, since they will require information generated by the latter activities, and, therefore, have a lower priority.

Finally, the manager must be aware that the Organ Pipe Cactus National Monument Step-Down Plan is an action plan and will remain so even after the Primary Objective is answered. The answers found one year will not necessarily be valid the next. The research phase of the program has a finite limit -- it can be completed. The monitoring (3.1, 3.3), alternatives (1.0), auditing (5.0) and literature (4.0) sections will never be completed, and must continue year after year if we are to successfully monitor the health of the monument's resources.

Because of the initial focus on completion of research, the goal-oriented manager may lose sight of the much larger ongoing nature of the plan. As research and initial synthesis activities wind down, the manager must plan for a future that will require a permanent monitoring staff of a half-dozen people. The Superintendent must have adequate monetary support through the addition of funds to his base for salaries and support, transportation and supplies for this additional staff. Otherwise, the initial step-down management effort will be greatly minimized and the concomitant expenses will have been obligated inefficiently.

Current funding has been released in the following manner:

$247,000 (less 1% withheld by WRO for other projects) in FY 87,
$ 82,000 in FY 88, and
$ 82,000 in FY 89.

No funding is available for the out-years. The uneven distribution of funds required that the bulk of money had to be obligated immediately and priorities juggled to meet FY 88 and FY 89 administrative constraints.

APPENDIX A. **Sensitive Ecosystems Program**
FUNDING RECOMMENDED BY INTERNATIONAL TEAM

Priority and Project Name	Time (yrs.)	Estimated Total Cost
1. Vegetation (3.1.1.3.1, 3.1.2.5.1)*	3	$135,000
2. Floristics (3.1.1.3.4, 3.1.2.5.4)	3	120,000
3. Agreements (3.1.1.3.3)	1	9,000
4. Bibliographic Systems (4.2)	1	6,000
5. Groundwater, Border Phase	1	45,000
Groundwater, Quitobaquito (3.1.2.5.5)	1	58,000
6. Terrestrial Invertebrates (3.1.1.3.2, 3.1.2.5.2)	3	150,000
7. Amphibians and Reptiles (3.1.1.3.5, 3.1.2.5.7)	3	135,000
8. Information System (3.2.1.1)	3	120,000
9. Weather (3.1.2.5.6)	1	54,000
10. Aquatic Invertebrates (3.1.1.5.7, 3.1.2.5.9)	2	40,000
11. Mammals (3.1.2.5.10)	3	105,000
12. Birds (3.1.2.5.12)	2	60,000
13. Land Use & Socio-economic (3.1.1.3.8, 3.1.2.5.3)	3	190,000
14. Hydrology (3.1.1.3.6, 3.1.2.5.8)	1	9,500
15. Agro-chemical (3.1.2.5.15)	2	80,000
16. Soils (3.1.1.3.9)	1	9,500
17. Erosion (3.1.2.5.16)	1	9,500
18. Air Quality (3.1.2.5.11)	1	25,000
19. Poaching (3.1.2.5.13)	1	7,000
20. Geology (3.1.1.3.1)	1	9,500
21. Visitation (3.1.2.5.17)	2	15,000
22. Historic Fabric (3.1.2.5.18)	2	9,000
TOTALS	42	$1,401,000

Note: *Numbers refer to items in Project Statement of Work (q.v.)

APPENDIX B

Sensitive Ecosystems Program
Priority List and Funding Schedule
Reduced Funding Basis ($247,000 + 82,000 + 82,000)

PROJECT	Total Cost X 1000	Cost By Yr. X 1000 '87	'88	'89	'90
1. Project Overhead	22.5	9.5	6	7	0
2. Identify Vulnerable Ecosystems (2.1.2 *)	10	10	0	0	0
3. Interpretive Display (3.1.3.1 *)	5	5	0	0	0
4. Spl. Status Plants (3.1.1.3.4, 3.1.2.5.4	60	35	10	15	0
5. Weed Ecology ** (3.1.1.3.4, 3.1.2.5.19 *)	5	5	0	0	0
6. Agreements (3.1.1.3.3)	3	0	0	0	0
7. Bibliography (4.2)	7	10	0	0	0
8. Groundwater (3.1.2.5.5 *)	21	0	21	0	0
9. Land Use (3.1.1.3.8, 3.1.2.5.3 *)	21	21	0	0	0
10. Grazing Recovery (3.1.1.3.1 *)	15	15	0	0	0
11. Cryptogam Inventory (3.1.1.3.4, 3.1.2.5.4 *)	20	20	0	0	0
12. Herpetology Inventory (3.1.1.5.7, 3.1.2.5.9)	55	30	10	15	0
13. Terrestrial Invertebrate Survey (3.1.1.3.2, 3.1.2.5.2 *)	55	25	10	20	0
14. Weather Data (3.1.2.5.6 *)	25	15	5	5	0
15. Boundary Studies (3.1.1.3.11, 3.1.2.5.19 *)	14	14	0	0	0
16. Special Status Vertebrates (3.1.2.5.10, 3.1.2.5.12 *)	30	30	0	0	0
17. Data Integration (3.1.1, 3.1.2)	15	0	5	5	5
18. Soils and Geology (3.1.1.3.10, 3.1.1.3.9 *)	30	0	15	15	0
19. Curatorial Cataloging (3.3.1.1 *)	15	0	0	0	15
TOTAL	428.5	244.5	82	82	20

Note:* Represents only a portion of a larger project.
** $5000 additional funding added to this project from Tamarisk Task Force.

APPENDIX C.

Sensitive Ecosystems Program
Actual Funds Spent During F.Y. 1987

Project	Original Allocation	Actually Spent	Forwarded to FY '88
Project Overhead	9,500	7,646	1,854
I.D. Vulnerable Ecosyst. (2.1.2 *)	$10,000	$10,000	0
Interpretive Display (3.1.3.1 *)	5,000	5,000	0
Spl. Status Plants (3.1.1.3.4, 3.1.2.5.4 *)	35,000	20,928	14,702
Weed Ecology * (3.1.1.3.4, 3.1.2.5.19 *)	5,000	4,900	100
Agreements (3.1.1.3.3)	3,000	5,000	-2,000
Bibliography (4.1)	10,000	10,000	0
Land Use (3.1.1.3.8, 3.1.2.5.3 *)	21,000	24,867	-3,867
Grazing Recovery (3.1.1.3.1 *)	15,000	9,900	5,100
Cryptogam Inventory *** (3.1.1.3.4, 3.1.2.5.4 *)	20,000	0	20,000
Herpetology Inventory (3.1.1.5.7, 3.1.2.5.9)	30,000	19,625	10,375
Terrestrial Invertebrates (3.1.1.3.2, 3.1.2.5.2 *)	25,000	31,821	-6,821
Weather Data (3.1.2.5.6 *)	15,000	15,000	0
Boundary Studies (3.1.1.3.11, 3.1.2.5.19 *)	14,000	14,000	0
Special Status Birds (3.1.2.5.12 *)	15,000	5,989	9,011
Special Status Mammals (3.1.2.5.10 *)	15,000	9,500	5,500
Boundary Vegetation ** (3.1.1.3.1 *)	27,000	27,000	0
TOTALS	$271,500	$218,176	$53,334

Note: * $5,000 added to this project from Tamarisk Task Force funds.
** $27,000 added by Director Mott to program for this project.
*** No satisfactory proposals received, deferred to FY '88.

APPENDIX D.

WORK GROUP
SENSITIVE ECOSYSTEMS WORKSHOP
September 17-20, 1986
Tucson, AZ

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Martha Patricia Celis Salgado
Jefe, Depto.de Prevencion,
Conserv. y Control Ecologico
Delegacion SEDUE en Sonora
Pedro Moreno y Jose Ma Avila
Hermosillo, Son. 83000 Mexico

Staff Participants:

Organ Pipe Cactus NM Route 1, Box 100 Ajo, Arizona 85321	Supt. Harold Smith Mr. Bill Mikus Mr. Dick Anderson
Cooperative National Park Resources Studies Unit, University of Arizona P.O. Box 41058 Tucson, Arizona 85717	Unit Ldr. Roy Johnson Scientist Peter Bennett Bio. Tech. Michael Kunzmann Dr. L. Susan Anderson

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MASTER PROGRAM TEAM
September 20, 1986

Dennis Fenn	Mietek Kolipinski
R. Roy Johnson	Peter Bennett
Larry May	Gary Davis
Bill Halvorson	Mike Kunzmann
Kathy Davis	Harold Smith
Fernando Lizzaraga	Dick Anderson

List of offices and agencies that participated in all or a portion of the workshop, September 17-20, 1986:

University of Arizona	Pinacates National Park, MEXICO
U.S. National Park Service	Arizona Nature Conservancy
Sierra Club	Depto. de Prevencion, Conserv. y
Control, Arizona Republic	Delegacion SEDUE en Sonora
SWC Associates	Colegio de la Frontera Norte
Arizona-Sonora Desert Museum	Arizona State University
Pronatura	Friends of Pronatura

APPENDIX E.

SENSITIVE ECOSYSTEM PROGRAM SCHEDULE

1.	Steering Committee Budget	February 15, 1987
2.	Begin Study Site Selection	February 15, 1987
3.	Prepare CBD advertisement	March 3, 1987
4.	Review draft RFP's	March 4, 1987
5.	Advertise in CBD	March 10, 1987
6.	Complete Study Site Selection	March 10, 1987
7.	Finalize RFP's	April 9, 1987
8.	Prepare rating sheets	April 10, 1987
9.	Construct review panels	April 10, 1987
10.	Send out RFP's	April 10, 1987
11.	Receive proposals	July 15,1987
12.	Review proposals	August 1, 1987
13.	Receive revised proposals	August 15, 1987
14.	Review revised proposals	September 1, 1987
15.	Award contracts	September 15, 1987
16.	First Annual P.I. Meeting	October 22, 1987
17.	First Supt's Ann. Investigator's Rpt.	January 7, 1987

APPENDIX F.

SCOPE OF WORK STATEMENTS

Vegetation Survey and Monitoring Design Study

Introduction:

Data concerning the distribution, composition, structure, evolution, and aerial extent of vegetation is essential for the achievement of Primary Objective of the Step-Down Plan. Since vegetation characteristics profoundly influence soils, mammals, birds, reptiles, and other animals, understanding of it is essential for the design of monitoring programs, and ultimately, for the understanding of the condition of ORPI ecosystems.

Ecosystems do not exist in isolation but interact through import and export of organisms and materials. They modify the soil and climatic. Ecosystems cannot be effectively studied within the confines of strictly political boundaries . Ecosystems are functional, not political units. ORPI ecosystems near political boundaries are being severely influenced by adjacent multiple-use land management practices. The composition and distribution of plant and animal communities are affected. Consequently, vegetation data must be collected across NPS political boundaries to assess the gradient changes occurring over ORPI's borders.

A survey needs to be conducted to better define and delimit our understanding of plant communities of ORPI and their relationships to plant communities of the Sonoran Desert both within and outside of the Biosphere Reserve. This study should examine past climatic history, short term resilience, population dynamics, distribution, and structure of the vegetation. Ecosystem changes currently being expressed should be documented. Following the survey portion of this study, a monitoring system needs to be designed for determination of stability or direction of ecosystem change. Permanent plots lying within diverse indicator ecosystems need to be established and monitored. An integral part of this effort is the preparation of instructions for gathering and interpreting monitoring data for the use of Resource Management personnel.

Statement of Work:

1. Survey

   A. Review Scientific Literature and Data. Data are available for a portion of the monument from a vegetation map, vegetation report, preexisting quadrats and exclosures, and photo points. The CPSU/UA maintains a small bibliography of literature relevant to the Sonoran Desert.

B. Sampling design. Sampling should be compatible with previous work (especially the existing vegetation map) and is to be applicable to long term monitoring.

C. Select components to be monitored. The existing map needs to be refined and the quadrat studies need to be augmented. Selection criteria need to be established for determining the location of long term monitoring sites. These criteria should include as diverse vegetation types as possible which are representative of all Biosphere Reserve communities, sensitive habitats and/or characteristic habitats, and communities with relict species.

2. Monitoring Design Study

A. Monitoring design. Protocol for long term vegetation monitoring at those sites identified in (c) above needs to be developed to provide information on community dynamics including species composition, importance, and distribution.

B. Report design. A report format needs to be developed for the Monument staff to utilize in its long term vegetation monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instructions on how to continue monitoring the vegetation of the monument including base line information, vegetation maps, maps of site locations, report formats, and data base management techniques.

D. Test monitoring design procedures as described in (c) above. The purpose of this test is to ensure that the monument staff will be able to continue monitoring program at a high level of precision.

Products Expected:

1. A report of the survey including maps, as appropriate.

2. List of Selected Sites to be monitored.

3. An implementation monitoring handbook.

Park Support Available:

In 1984, the monument established the Sonoran Desert Biosphere Resource Center. The 1600 sq. ft. facility houses a small research library including some park files pertinent to resource management concerns. Collections of park resources include plants, mammals, birds, invertebrates, reptiles and amphibians.

Work and lab space are generally plentiful. Maps, aerial photos, historic photographs and other location references are maintained. Approximately 47 years of observation records of many biotic species are on file.

The port-of-entry at Lukeville offers limited facilities, including a 12 room motel, coffee shop, grocery store and associated services.

A larger variety of services are located 2 miles south of the border in the frontier town of Sonoyta, Mexico.

Duration of Work: 3 years

Estimate of Cost: $135,000

Investigate Ecology of Terrestrial Invertebrates

Introduction:

Insects and other invertebrates are sensitive indicators of the health of the ecosystem. An understanding of invertebrate ecosystem interactions is essential for the achievement of the Primary Objective of the Step-Down Plan. With the Biosphere Reserve designation, the monument assumed greater resource inventory responsibilities than are expected of other natural units of the NPS system. Although a survey of the invertebrates has been completed for Quitobaquito, other water sources at Organ Pipe Cactus National Monument, and at a couple of small sites in the Ajo Mountains, little work has been accomplished elsewhere in the monument. The status of the invertebrates is known for only 0.3 percent of the park.

Because of the high mobility of invertebrates and the various impacts received from adjacent multiple-use land areas this study is intended to consider both Organ Pipe Cactus NM and adjacent lands. Information about the taxa present, distribution, abundance and demographics of terrestrial invertebrates away from water sources are lacking. Undoubtedly, terrestrial invertebrates are the single most important group of animals at Organ Pipe Cactus NM and the lack of information about them reflects the difficulty of work more than their significance. Of special concern is the monitoring of the status of the butterfly Ascia howarthii, the endemic snail at Quitobaquito, native and non-native pollinators, and disease vectoring species. The degree of threat, internal or external to the park, existing for species such as these is unknown. Data from these studies will be used to nominate rare, sensitive and other invertebrates of special interest as ecosystem health indicator species and invertebrates that have significant relationships with other elements of the biota.

An integral part of this effort is the preparation of instructions for gathering and interpreting monitoring data for the Resource Management Personnel.

Statement of Work:

1. Survey Phase

   A. Summary of existing literature and data. Recent work by Smith, Kingsley & Bailowitz, Van Devender, and Bailowitz have summarized all that is known about species presence from the literature and supplemental field work. The monument maintains an insect collection containing specimens from the area.

B. Study Design. Design a study that will provide information about species presence, species distribution, abundance, age and size structure, growth rates, mortality rates and causes, reproduction and recruitment, and food habits of species named in Statement of Problem section and/or such other species as may be deemed to be of importance. Methods should be compatible with those generally acceptable to science and should be applicable to long term monitoring.

C. Selected components to be monitored (criterion. Establish criteria for selecting species and study sites to be included in a long term monitoring effort considering the following:

1) Special status species, e.g., endangered threatened, or covered by legislation, proclamations, etc.

2) Species that occupy different trophic levels, feeding guilds, etc. so that all levels are represented.

3) Species that are common or dominant.

4) Endemic species.

5) Species that are harvested by hunting, poaching, and collecting for commercial or domestic purposes.

6) Alien, exotic, feral species.

7) Species that are of special interest to the public, managers, interpreters, and/or scientists (heroic species).

8) Species that occupy sites that are subject to dramatic change such as precipitant loss of habitat.

2. Monitoring Design Study.

A. Monitoring design. Develop protocols for long term fauna monitoring at those sites identified in 1.c. above. Include consideration of 1.c.1-8.

B. Report design. A report format needs to be developed for the utilization of the monument staff in its long term invertebrate monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instructions on how to continue the monitoring of the invertebrates of the area,

including baseline information, distribution maps, sample site maps, report formats, and data base management techniques.

D. Test monitoring design procedures as described in the handbook created above. The purpose of this test is to ensure that monument staff will be able to continue monitoring the program at a high level of precision.

Products Expected:

1. The investigator is to submit data (both alpha and numeric) in an intelligible and consistent format. Raw data, especially if voluminous, may be submitted on IBM-PC compatible media.

2. A report of the survey phase.

3. A monitoring handbook.

4. Deposit voucher specimens in Park Study Collection and/or University of Arizona. Multiple specimens not accessioned are to be preserved by appropriate means for future studies.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Project: 3 years.

Cost Estimate: $150,000

Bilateral Institutional Agreements

The project would review and inventory Agency agreements, bilateral international agreements, treaties, and memorandum of understanding for management implications at Organ Pipe Cactus National Monument Biosphere Reserve.

Since the monument was established, park managers have developed many interagency and cooperative agreements with Department of Treasury, U.S. Fish and Wildlife Service, etc. In addition, many governmental agencies, Secretariats, and Commissions and Departments in the United States and Mexico have established agreements which delineate interactions and protocols between institutions. Many of these agreements have management implications and could affect management of the monument/Biosphere Reserve. Many may produce resource and land use information, and some offer funds to support resource management goals and environmental educational outreach programs.

Statement of Work:

Park files should be thoroughly reviewed to ensure agreements are assembled. In addition, agencies and organizations in Mexico and the United States should be contacted to obtain copies of relevant agreements. "Law Reporters" from the United States and Mexico should be examined for references to agreements, treaties, etc. of direct and indirect implication to Organ Pipe Cactus National Monument. Once copies are obtained, each document should be closely examined, summarized for monument/Biosphere Reserve relevance in annotated form and referenced in a bilingual archival system for easy use by spanish or english speaking researchers.

Products Expected:

A file of agreements, treaties, etc. relevant to Organ Pipe Cactus National Monument, and an annotated listing in english and spanish, of document content, implications to Organ Pipe Cactus National Monument, whether technical assistance or funding can be obtained under document authorities.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: one year (this includes review of authorities in Mexico as well as the United States).

Estimate of Cost: $9,000.00

Potential Researchers (Sources of Information):

Dr. William P. Gregg, Coordinator, MAB, Science & Technology (498), NPS-USDI, 1100 L Street NW, Washington, D.C. 20240

Office of the Solicitor, Department of Interior, Washington, D.C. and San Francisco, CA

LAW Department, University of Arizona, Tucson, Arizona

Rob Milne, National Park Service, Office of International Affairs, Washington, D.C.

Carlos Nagel (Friends of Pronatura), 240 E. Limberlost, Tucson, AZ 85705

Rosalva Gallardo, Colegio de la Frontera Norte, Aptdo. Postal 339-A, Nogales, Sonora 84080, Mexico

Exequiel Ezcurra, Instituto de Ecologia, Apartado 18-845, 11800 Mexico, D.F., Mexico

Martha Patricia Celis Salgado, Jefe, Depto. de Provencion, Conservation y Control Ecologico, Delegacion SEDUE en Sonora, Hermosillo, Sonora 83000 Mexico

Municipal Government

SARH (Secretaria de Agricultura y Recursos Hydraulicos)

Fernando Lizarraga, P.O. Box 296, Lukeville, AZ

SEDUE (Secretaria de Sarollo Urbano y Ecologia)

CFE (Comision Federal de Electricidad)

SEDENA (Secretaria de la Defensa Nacional)

SCT (Secretaria de Communicacion y Transfordad)

SEP (Secretaria Education Publica)

Aduana/Migracion

United States Border Patrol

COLFRONJ and ITESM

U.S. State Department

IBWC (Interstate Boundary and Water Commission)

LaPaz Agreement of 1903

Mexico, International Agreements re: Sierra del Pinacate in SARH and SEDUE

Arizona State Governor's Commission agreements with Sonora State Governor's Commission

Floristic Studies

Introduction:

Floristics is a branch of phytogeography which examines individual plant species from a taxonomic standpoint. The emphasis is on the biological significance and existence of individuals rather than the competitive interactions between species and their surrounding community components. Identification of resource components is a prerequisite for the achievement of the Principal Objective of the Sensitive Ecosystem Management Plan. The floras of adjacent land use areas such as the Sierra de Pinacate, the Cabeza Prieta reserve, and Tohono O'Odham reservation, are poorly understood. In addition, the magnitude and extent of infiltration of agricultural exotic plant species from the Rio Sonoyta valley has not been determined. A floristic study emphasizing the identification of indicator species that may be representative of ecosystem health should be undertaken to fullfil the Principal Objective of the Sensitive Ecosystem Management Plan. A comprehensive flora is needed as a basic resource for the studies of vegetation, invertebrates, biogeography, and the selection of sensitive plant species and to evaluate the significance of exotic plants in the flora. A floristic analysis is an element required to design a monitoring program. The floristic analysis should consider geographic and ecological affinities, systematic compositions, phenology and life forms.

Statement of Work:

1. Survey Phase

   A. Summary of existing literature and unpublished data on the habitat of plant species in the monument and adjacent areas. A preliminary flora by Bowers (1980) is available.

   B. Collect plants over entire monument with emphasis on poorly collected areas such as higher elevations in Ajo Mountains, Santa Rosa Mountains, and adjacent agricultural and grazing areas. Choose sample areas to evaluate the influence of native and exotic plants from agricultural areas in the Sonoyta River Valley in the vicinity of Organ Pipe Cactus National Monument. Cryptograms should be collected along with vascular plants. Be alert for taxa, native and non-native, spreading into the monument as a result of climatic changes underway. Revise list of special plants for the monument and specify the criteria for the inclusion on the list.

   C. Select the plants to be monitored form the list generated. The criteria should include distribution (endemic, range limits, disjunct populations, etc.) and protection status

(U.S. Fish & Wildlife Service, State of Arizona, Bureau of Land Management, The Arizona Nature Conservancy, etc.). Designate and map specific populations to be monitored.

2. Monitoring Design Study

A. Monitoring design. Protocol for long term special plant populations monitoring of species and sites identified in (C) above needs to be developed to provide information on population dynamics.

B. Report design. A report format needs to be developed for the monument staff to utilize in their long term special plant population monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instructions on how to continue monitoring the special plant populations of the monument including temporal and spacial fluctuations, map or maps of site localities, report formats, and data base management techniques.

D. Test monitoring design procedures as described in (c) above. The purpose of this test is to insure that the monument staff will be able to continue the monitoring at a high level of precision.

Products expected:

1. A summary of the flora of the monument that includes the following for each species: Scientific name, authority, common name in english and spanish if available, distribution (entire range, range in monument, native or exotic), phenology, habitat (elevational range, special substrates or other important factors), cultural uses, and protection status. Information should be presented in a format designed to be useful to the monument staff. The floristic analyses should consider geographic and ecological affinities, systematic compositions, phenology and life forms.

2. Voucher specimens to be deposited in the herbarium at the monument, pending space available, or at the University of Arizona.

3. A report evaluating the importance of perturbations (disturbance and climatic) on native and exotic plants of the monument with special emphasis on the agricultural and other land use areas adjacent to Organ Pipe Cactus National Monument Biosphere Reserve.

4. List of special plants and selected populations to be monitored.

5. A handbook to direct implementation of the monitoring program.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Work:

Surveys should be conducted during the rainy seasons (winter and summer) over a three year period.

Cost Estimate: $120,000

Groundwater Evaluation and Monitoring in Selected Zones

Introduction:

Irrigated acreage adjacent to the international boundary of the monument has increased substantially in the past few years, and additional acreage is currently under development. The Service is concerned, among other things, that continued or increased irrigation withdrawals may lower the groundwater table within the monument and thus reduce the regional hydrostatic pressure responsible for such spring flows as Quitobaquito, Burro, and Williams Springs. Areas of special concern are: the headquarters area domestic water supply, Quitobaquito Springs, riparian ecosystems dependent upon reachable groundwater, and the Lukeville domestic water supply and groundwater levels in the Blankenship area.

Approximately five years of water level data has been collected for all wells within the monument and at Lukeville. These data have been collected in conjunction with a complete water resources inventory conducted by Water Resources Division of the Western Regional Office, National Park Service and by park personnel. This inventory also includes water quality data. USGS personnel, under NPS contract, have installed a gauge-height recorder at one level in Lukeville. Additionally, USGS monitors six wells bi-monthly along the border. An initial report submitted by USGS concerning groundwater conditions uses a finite-difference model to construct a rough hydrograph of estimated future drawdown near the international boundary at Lukeville after 100 years of pumping. The NPS/USGS contract has allowed for the updating of the existing V-notch weir at Quitobaquito Springs by installing a continuously recording system which is maintained by USGS.

Statement of Work:

The project will involve two phases of work, each separately funded, for completion. These two phases are discussed below:

1. Phase I.

   This phase will involve the following actions:

   A. Auger drill three test wells to 200 feet depth in the Blankenship area at sight selected in consultation with the park staff. These wells should be four inches in diameter, cased, developed and fixed with continuous depth recording devises.

   B. Monitor the new wells and other wells along the border west to the Quitobaquito area and on to the southwest corner the monument. These extant wells are currently part of an

on-going monitoring program. Continue this monitoring for one year after the new wells are drilled.

C. Report results to the monument.

2. Phase II.

This phase will involve the following actions:

A. Drill three test wells at sites elected in consultation with the monument staff in the suspected recharge zone of Quitobaquito Springs northeast of the Quitobaquito Hills. those wells should be drilled at six to eight inch diameter and the geologic strata sampled as drilling proceeds to a depth of 200 feet or until bedrock is reached. Wells should be fully developed and continuous depth recorders installed.

B. Monitor newly drilled test wells for one year.

C. Conduct aerial photo survey of the international border region covering the full northern extent of agricultural development. Determine crops and acreage from this development.

D. Conduct thorough water quality analysis of the groundwater from the new test wells as it relates to understanding hydrologic systems and subterranean water flow toward Quitobaquito Springs.

F. Conduct gravimetric survey across the suspected recharge zone feeding Quitobaquito Springs.

Products Expected:

1. Phase I.

A. Three new test wells in the Blankenship area.

B. Quarterly progress reports.

C. Final report summarizing and analyzing the data to further quantify and clarify the suspected groundwater drawdown problem.

2. Phase II.

A. Three new test wells in the Quitobaquito area.

B. Quarterly progress reports.

C. A final report summarizing and analyzing the water level monitoring, water quality analysis, agricultural withdrawals

south of Quitobaquito Springs and the gravimetric survey of the suspected recharge zone. This report should provide good understanding of the hydrologic system that support Quitobaquito Springs.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Work: Phase I - 18 months
Phase II - 18 months

Estimate of Cost : Phase I/$45,000; Phase II/$58,000 Total - $103,000

Develop a Database Management System

Introduction:

Organ Pipe Cactus National Monument is accumulating an ever increasing amount of information in the form of data and collections of photographs, specimens, books, etc., and needs a system to manage this resource. This system will need to include a computerized data management system (including a Geographic Information System) and a collections management system. In addition to hardware and software needs, this project also requires the development of a data storage and retrieval design to be used for the various types of information.

Statement of Work:

1. Review and summarize the various types of information currently being accumulated by the monument and the uses to which the information is or potentially will be put.

2. Design a management protocol for the various types of information, including recommendations on appropriate hardware and software, which will allow the park staff to input and manipulate data easily to fill their needs of managing the data and answering resource questions based on the data.

3. Create a handbook which allows the park staff to implement the information management system created in 2. above and gives step-by-step details on how each aspect of the management system works on a day-by-day basis.

Product Expected:

1. Appropriate computer hardware,

2. Appropriate computer software.

3. Documentation in the form of a handbook which details the workings of the overall system and each of its parts.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Work: 2 years

Estimate of Cost:

Hardware:	$40,000
Investigators	80,000
TOTAL	$ 120,000

Weather Monitoring

Introduction:

Long Range Needs: Several plant and animals species found at Organ Pipe Cactus National Monument are not known to exist elsewhere in the United States. Some of these forms are existing at or near the extreme northern geographical limit of their ranges. Temperatures and rainfall are thought to be significant factors limiting their distribution. Because of the large size of the monument and the uneven distribution of the biota, climatological data collected at the headquarters area is not adequately representative. The existing station is not adequately equipped and more stations are needed.

Statement of Work:

This project is a monument-wide (or wider) investigation of climatological factors thought to be significant in determining/impacting sensitive habitats and in evaluating impacts of land management policies by the Monument's neighbors.

The study should review published and unpublished climatological data to form an historic information base. Climate data from Mexico should not be overlooked.

The researcher should consult with park staff to select locations for five or more climate-monitoring stations. Site selection will be based on:

1. identification of sensitive species habitat where a better understanding of climate related habitat factors is needed for protection of a species;

2. identification of habitat areas associated with long-term monitoring projects to establish climate parameters that may affect changes in naturally occurring populations;

3. identification of specific habitats (major vegetation types) where future research can utilize data collected as baseline and germane to the research project;

4. Identification of major airsheds.

5. Each station will record:

   A. wind speed,

   B. wind direction,

   C. relative humidity,

D. soil temperature,

E. air temperature,

F. rainfall,

G. solar radiation,

H. soil moisture.

Equipment will record measurements every one or two hours, or each/1mm event for rainfall. Data will be retrieved monthly from each automated station.

Weather stations should be selected in consultation with park staff. The actual purchase of the weather stations will be done by the National Park Service.

Research Proposal and Report Designs:

The researcher will establish, operate, and maintain the four stations five the first year. Then he will summarize and analyze the year's data. He will train park staff to operate and maintain the equipment and analyze the data. The sampling and location design will be such that it can be continued for years to come by monument staff or by technicians, rather than by professional meteorologists, climatologists, or electricians.

Product Expected:

1. Quarterly report,

2. Final report,

3. Four operating weather stations,

4. Computerized data management system,

5. Long-term monitoring plan.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Work: 20 months

Estimate of Cost: $54,000

Investigate Ecology of Amphibians and Reptiles

Introduction:

Although an inventory and checklist of reptiles and amphibians for the monument exists, information about the distribution, abundance, and demographics is generally lacking. The degree of threat, internal or external to the park, existing for species such as the Desert Tortoise, Gila monster, Organ Pipe Shovel-nosed Snake, Mexican Rosy Boa, Ajo Mountain Whipsnake, and the Arizona Coral Snake, Sonoran Green Toad and others is unknown. Data from these studies will be used to nominate rare, sensitive, and other reptiles and amphibians of special interest as indicator species and those that have significant relationships with other elements of the biota.

Statement of Work:

1. Survey Phase

A. Summary of existing literature and data. Recent work by Lowe Germano & Hungerford, Burger & Hensley have summarized species presence from the literature and supplemental field work. The monument maintains a sight observation file filled out by park staff and visitors. The validity of these latter data are problematical.

B. Study Design. Design a study that will provide information about species distribution, abundance, age and size structure, growth rates, mortality rates and causes, reproduction and recruitment, and food habits of species named in Statement of Problem section and/or such other species as may be deemed to be of importance. Methods employed should be compatible with those generally acceptable to science and should be applicable to long-term monitoring.

C. Selected components to be monitored. Establish criteria for selecting species and study sites to be included in a long-term monitoring effort considering these criteria:

1) Special status species, e.g., endangered, threatened, or covered by legislation, proclamations, etc.

2) Species that occupy different trophic levels, feeding guilds. etc. so that all levels are represented.

3) Species that are common or dominant.

4) Endemic.

5) Species that are harvested by hunting, poaching, and collecting for commercial or domestic purposes.

6) Alien, exotic, feral species.

7) Species that are of special interest to the public, managers. interpreters, and/or scientists (heroic species).

8) Species that occupy sites that are subject to dramatic change such as precipitant loss of habitat.

II. Monitoring Design Study

A. Monitoring design. Develop protocols for fauna long-term fauna monitoring at those sites identified in I.C. above. Include consideration of points I.C.1-8.

B. Report design. A report format needs to be developed for the utilization of the monument staff in its long term reptile and amphibian monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instructions on how to continue the monitoring of the reptiles and amphibians of the area, including baseline information, distribution maps, sample site maps, report formats, and data base management techniques.

D. Test monitoring design procedures as described in the handbook created above. The purpose of this test is to ensure that the monument staff will be able to continue monitoring program at a high level of precision.

Products Expected:

1. The investigator is to submit data (both alpha and numeric) in an intelligible and consistent format. Raw data, especially if voluminous, may be submitted on IBM-PC compatible media.

2. A report of the survey phase.

3. A monitoring handbook.

4. Deposit voucher specimens in Park Study Collection and/or University of Arizona.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Work: 3 years

Estimate of Cost: $135,000

Site Specific Information on Soils and Surficial Geology and Hydrology

Introduction:

Site descriptions are needed for soils and surficial geology and hydrology in conjunction with biotic study to provide a detailed database. Such data are important for a more complete understanding of ecosystems and individual resources.

Statement of Work:

Once study and monitoring sites are selected for the biological investigation, the abiotic descriptions (stated above) will be needed.

The work will entail a summary of literature and other data relevant to the park.

Soils should be mapped to first order in the specific sampling locations being used for the biological transects and locations. Standard soil nutrient and pH analysis should be conducted. Field data gathering should be done with the vegetation mapping researcher.

Superficial hydrology should be mapped for each biological monitoring area.

Surficial geology should be mapped for each biological monitoring area.

Product Expected:

1. Summary of literature and data,

2. Site description and map.

Park Support Available:

See Vegetation Survey and Monitoring section,

Duration of Work: 14 months

Estimate of Cost:		
	Soils	$9,500
	Hydrology	$9,500
	Geology	$9,500
	TOTAL	$ 28,500

Design ORPI Bibliographic Data Management

Introduction:

Bibliographic references have been compiled through a number previous studies and are currently available. Further, during a Man in The Biosphere funded science assessment in 1982 a computerized bibliographic data management system was developed.

Statement of the Work:

In order to make the bibliography most useful to the monument staff, it will be necessary to develop the hardware at ORPI to either access the information stored at the University of Arizona or to store and manipulate the data on-site. Further, a protocol for annual or semi-annual updates to the bibliography needs to be designed and provided to the park staff.

Products Expected:

1. Procurement of computer hardware and software including at least a twenty megabytes of hard disk memory, one megabyte of RAM, modem, and a letter quality printer.

2. A report or handbook which gives a protocol for semi-annual or annual updates of the bibliography and gives the instructions on manipulating the bibliography and to meet the various needs of the park staff and visiting researchers, including such things as condition searches (Name, Subject, Title, Date, Source, keyword and user defined fields) and creating off-line summary reprints.

Park Support Available:

See Vegetation Survey and Monitoring section, above.

Duration of Work: One year

Estimate of Cost:

A.	Computer hardware & Software:	$ 4,500
B.	Investigators Cost:	$ 2,000
	Total cost :	$ 6,000

Contact:

Pete Bennett/Mike Kunzmann, CPSU University of Arizona

Aquatic Invertebrates

Introduction:

Aquatic invertebrates are sensitive indicators of the aquatic health of an ecosystem. Earlier, superficial surveys suggest there is a high probability of undescribed and, perhaps, endemic species in Quitobaquito and other aquatic habitats in Organ Pipe Cactus National Monument. Other aquatic habitats include tinajas (rock tanks), and other perennial, intermittent, and ephemeral water sources. Invertebrate representatives of interest include the sponges (Porifera), rotifers (Trochel-minthes), snails (Gastropodia), ostrocod and cladoceran crustaceans. Capecod crustaceans, mites (Acarina), and oligochaete worms (Annelida) have not been reported from within the monument borders but they be present. A multidisciplined team effort will be required to survey the Biosphere Reserve and adjacent agricultural land use areas. The existing literature, however, could be reviewed easily. There are few data on the aquatic fauna of Southern Arizona and Mexico. Systematics would require a large percentage of the time.

Sampling techniques would not be complicated. Common coarse-meshed nets, plankton nets, an Ekmann dredge, and a simple coring device for microbenthic species would suffice for most sampling efforts. Four or five sampling trips during the first year should be sufficient to establish a good list of the invertebrates occurring in Organ Pipe Cactus National Monument's aquatic habitats.

The taxonomic groups to be monitored should include those that are preserved and studied easily. The Protozoa, although possibly of interest and importance in the Monument, could be studied profitably only if a protozoologist with proper microscopes and lighting were working near the collecting sites. Other groups such as the Platyhelminthes and nematode worms may have free-living and parasitic representatives with turtles and Cyprinodon fishes possibly carrying some species. The turtles, for example, might serve as hosts of parasitic acanthocephalan worms. Specialists, perhaps rare, would be required to study the animals discussed in this paragraph.

Reports to Organ Pipe Cactus National Monument would in most instances be based on information supplied by specialists in American and Canadian museums and universities. For example, the aquatic insects alone belong to many families, and any one entomologist would be unable to work with all of them. Specialists, however, usually are pleased to contribute their services gratis.

Statement of Work:

1. Survey Phase

A. Summary of existing literature and data. Cole & Whiteside; Smith, Kingsley, & Bailowitz; and Larson have completed survey work in geographically limited areas of the monument. Cole and Whiteside are the only authors to include mollusks, sponges, entomostracans, and Malacostricans. Smith, et al. and Larson confined their work to insects. No work has been done on protozoa. The Quitobaquito snail and a sponge found in the pond may be species new to science. Both remain undescribed.

B. Study Design. Design a study that will provide information about species distribution, abundance, age and size structure, growth rates, mortality rates and causes, reproduction and recruitment, and food habits of species included in Introduction and/or such other species as may be deemed to be of importance. Methods employed should be compatible with those generally acceptable to science and should be applicable to long term monitoring.

C. Selected components to be monitored. establish criteria for selecting species and study sites to be included in a long term monitoring effort considering these criteria:

1) special status species, e.g., endangered, threatened, or covered by legislation, proclamations, etc.

2) Species that occupy different trophic levels, feeding guilds, etc. so that all levels are represented.

3) Species that are common or dominant.

4) Endemic

5) Alien, exotic, feral species.

6) Species that are of special interest to the public, managers, interpreters, and/or scientists (heroic species).

7) Species that occupy sites that are subject to dramatic change such as precipitant loss of habitat.

2. Monitoring design.

A. Monitoring design. Develop protocols for long term fauna monitoring at those sites identified in I.C. above. Include consideration of points I.C.1-7.

B. Report design. A report format needs to be developed for the utilization of the monument staff in its long term aquatic invertebrates monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instruction on how to continue the monitoring of the aquatic invertebrates of the area, including baseline information, distribution maps, sample site maps, report formats, and data base management techniques.

D. Test monitoring design procedures as described in the handbook created above. The purpose of this test is to ensure that the monument staff will be able to continue monitoring program at a high level of precision.

Products Expected:

1. The investigator is to submit data (both alpha and numeric) in an intelligible and consistent format. Raw data, especially if voluminous, may be submitted on IBM-PC compatible media.

2. Report of the survey phase.

3. A monitoring handbook.

4. Deposit voucher specimens in the park study collection and/or the University of Arizona.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: 2 years.

Estimate of Cost: $40,000.

Investigation and Control of Accelerated Erosion

Introduction:

Perennial grasses and forbs, except for unpalatable species not used by cattle, horses, and burros, are almost completely absent from problem areas. The lack of vegetative ground cover either from grazing or in some cases from roads has permitted large areas of critical gully erosion to develop unchecked. Revegetation will occur as former unrestricted grazing ceases with continued removal of domestic animals.

Small scale attempts at reducing active headcutting by placing brush and rocks in the cuts have been tried on an experimental basis. Seven hundred acres of contoured water spreading dikes have been constructed in the vicinity of Blankenship Ranch and the Growler Valley. Badly eroded sites were inspected by representatives of the Soil Conservation Service and recommendation made for a recovery plan in 1968. Three years of monitoring studies have been conducted under the direction of Terrance Marsh (North Central College, Naperville, Illinois) to assess further headcutting and width increases in existing gullies at the north and south boundary areas. Indication is that some stability has been attained and revegetation is occurring in certain gully sections. While this is encouraging, a definite need is identified to monitor gully status in the future to assure no further soil losses.

Statement of Work:

Summarize literature and data on erosion, especially associated with overgrazing, that is relevant to the monument.

Locate and map sites of accelerated erosion identified in a monument-wide survey.

Establish a monitoring system to document changes in the sites. Teach system to park staff.

Present techniques that can be used to control erosion.

Products Expected:

1. Map of sites of accelerated erosion,

2. Monitoring system to document change,

3. Final report.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: 1 year

Estimate of Cost: $9,500

Evaluation of Biocide Use and Effects on Ecosystems

Introduction:

Biocides such as herbicides and insecticides applied in agricultural areas primarily hit their target species, but a portion of the compounds are carried by a wide variety of dispersal mechanisms such as water, soil, and atmospheric deposition to other areas. The literature contains extensive examples of local as well as world-wide deposition of chemicals from agriculture, industry (e.g. "acid rain"), automobiles, etc. Some evidence exists for presence of biocides in Organ Pipe Cactus National Monument. Biocide monitoring in the MAB Reserve is extremely limited and little is known about the extent of biological amplification or magnification of such toxins in food webs within the ORPI and Pinacate core areas of the MAB Reserve.

Statement of Work:

Resource questions to be answered:

A study is required to determine when, where, and what amounts of biocides are being used. What changes, if any, are occurring to the naturally functioning ecosystems. Questions be answered include:

1. What biocides are used and in what amounts adjacent to MAB Reserve?

2. What are seasonal biocide use patterns? And what changes have occurred in response to changes in historic crop pattern?

3. What are methods of application?

4. What are economics of biocide use in the area?

5. Are biological control methods such as pheronome traps being used, and if so, are they effecting native species?

The study will include monitoring of key biocides in selected ecosystem components such as soil, a wide variety of water sources (such as tinajas), vegetation, and animals. Sampling design must result in a distinction being made between ambient world-wide or broad-region biocide transportation and deposition and local-area deposition.

Data will be analyzed specifically to identify biocide impacts on organisms. For example, indicator species (from the full range of trophic levels) will be selected and determinations will be made whether organisms are killed, reproduction is diminished, physiological stress is occurring, etc.

Product Expected:

1. If significant levels of biocides are present, follow-up research will be proposed by Principal Investigator to cover the following topics:

   A. Decrease of pollination and reproduction of native plants by impacted pollinators such as bees, moths, and bats.

   B. Change in natural genetic diversity (genetic shifts of genomes can occur as species breed biocide-resistant populations.

   C. Changes in prey/predator relationships.

2. Report on whether biocides are having a significant impact in the ORPI and Pinacate core areas of the MAB Reserve. If so, the sources of the involved biocides must be determined and study reports must include recommendations with alternatives for correcting the problem. Also, if biocides pose a significant problem, the final study report will include a recommended monitoring program to track and quantify ecosystem changes.

3. Interim report to be prepared mid-way and a final report to be submitted to NPS by the end of the second year. The principal investigator will provide NPS with detailed work schedule and sampling design protocol.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: 2 years

Estimate of Cost:

First Year:	Monitoring, Protocol Planning, Data Analysis, and Preliminary Report	$ 25,000
Second Year:	Monitoring, Sampling, Data Analysis, and Final Report	25,000
	TOTAL	$ 50,000

Summary of Existing Literature and Data:

In about 1978 Boyd Kynard sampled pupfish, cyprinodon macularius. He reported a level of 0.5 ppm of methyl parathion in this now Endangered fish species. More recent preliminary screening to cover a wide variety of biocides since 1984 by Peter Bennett and Michael Kunzmann failed to detect significant levels of this chlorinated hydrocarbon or organophosphates and chlorinated hydrocarbons with the exception of Dacthal and methyl parathion.

Bennett and Kunzmann established colonies of honeybees, Apis malifera, in Lukeville and in Quitobaquito Management Area in 1984. Biocide and enzyme inhibition levels in bee tissues serve as an indication of the presence of these toxins in the ecosystem. Bee tissues from one sample of dead bees found near the Lukeville hive ranged between 0.5 and 5.0 ppm of methyl parathion. Inhibition of cholinesterase has been demonstrated at about 5 ppm of parathion depending on various factors. The kinds and amounts, and frequency of use of biocides is Mexico are unknown.

This summary is incomplete and literature must be reviewed in detail.

Investigate Ecology of Mammals

Introduction:

Although an inventory and checklist of mammals for the monument exists, information about the distribution, abundance and demographics are generally lacking and especially so for large mammals. The degree of threat, internal or external to the park, existing for species such as the Sonoran pronghorn, desert bighorn, white-tailed deer, mountain lion, bobcat, desert shrew, and others is unknown. Data from these studies will be used to nominate rare, sensitive and other mammals of special interest as indicator species and those that have significant impact on other elements of the biota.

Statement of Work:

1. Survey Phase

A. Summary of existing literature and data. Recent work by Cockrum and Petryszyn have summarized species presence from the literature and supplemental field work. The monument maintains a sight observation file filled out by park staff and visitors. The validity of these latter data are problematical. The literature contains some information about common species (Peromyscus, Neotoma, et al.) and several selected groups such as Dipodomys. Such studies, for the most part, have not been conducted at Organ Pipe Cactus NM.

B. Study Design. Design a study that will provide information about species distribution, abundance, age and size structure, growth rates, mortality rates and causes, reproduction and recruitment, and food habits of species named in Statement of Problem section and/or such other species as may be deemed to be of importance. Methods employed should be compatible with those generally acceptable to science and should be applicable to long term monitoring.

C. Selected components to be monitored. Establish criteria for selecting species and study sites to be included in long term monitoring effort considering these criteria:

1) Special status species, e.g., endangered, threatened, or covered by legislation, proclamations, etc.

2) Species that occupy different trophic levels, feeding guilds, etc. so that all levels are represented.

3) Species that are common or dominant.

4) Endemic

5) Species that are harvested by hunting, poaching, and collecting for commercial or domestic purposes.

6) Alien, exotic, feral species.

7) Species that are of special interest to the public managers, interpreters, and/or scientists (heroic species).

8) Species that occupy sites that are subject to dramatic change such as precipitant loss of habitat.

2. Monitoring Design Study.

A. Monitoring design. Develop protocols for long term fauna monitoring at those sites identified in 1.c. above. Include considerations of points 1.c.1-8.

B. Report design. A report format needs to be developed for the utilization of the monument staff in its long term mammal monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instructions on how to continue the monitoring of the mammals of the area, including baseline information, distribution maps, sample site maps, report formats, and data base management techniques.

D. Test monitoring design procedures as described in the handbook created above. The purpose of this test is to ensure that the monument staff will be able to continue monitoring program at high level of precision.

Products Expected:

1. The investigator is to submit data (both alpha and numeric) in an intelligible and consistent format. Raw data, especially if voluminous, may be submitted on IBM-PC compatible media.

2. A report on the survey phase.

3. A monitoring handbook.

4. Deposit voucher specimens in Park Study Collection and/or University of Arizona.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Schedule of Work: 3 years.

Cost Estimate: $105,000

Air Quality Monitoring

Introduction:

Various sources threaten the air quality of Organ Pipe Cactus National Monument. Casual observation suggests that the single most apparent threat originated from the now idle copper smelter located less than fifteen air miles north of the boundary. At times, smoke from this source blanketed the entire area with an objectionable pall, reducing visibility considerably. This phenomenon is most evident when the normally prevailing south-westerly wind changes to a northerly direction.

Blowing dust is another air quality concern. At times, dense clouds are visible from agricultural lands in Mexico. This dust, agitated by a moderate-to-strong south wind, clearly contributes to diminished air quality. Graded, gravel park roads, too, contribute a certain amount of airborne dust.

Although reduction of scenic values are quite evident during these periods, other air quality problems are harder to detect and are not well documented.

Airborne pesticides are occasionally blown onto park lands and may go unrecognized unless they are in concentrations great enough that the odor is noticed or their presence is detected in tissue analysis later, as was in the case in pupfish at Quitobaquito Pond.

Regional or widespread airshed degradation is suspected but is more difficult to quantify. At times when the wind is from the direction of the larger cities of Phoenix, or Tucson, airborne contaminants are likely to be transported to the park. It is suspected that regional air quality will deteriorate further with the development of additional coal-fired power generating facilities with tall stacks. Data may also be needed concerning air movement at upper levels of the atmosphere to assist in establishing the source-receptor relationships. Little is known to date concerning the effects of acid rain on desert ecosystems.

A high-volume, coarse particulate air sampler has been in operation at this location since 1972. This monitor is maintained jointly by the State of Arizona and park staff. Similar samplers operated by the State are in operation nearby at Casa Grande and Yuma. The mine at Ajo also maintains a high-volume particulate sampler.

In August 1979, an EPA fine particulate sampler was installed. This project is under the direction of the Crocker Nuclear Lab, University of California, Davis, California. It is aimed at gathering baseline particulate measurement data from 40 remote western sites. Parameters monitored include copper, lead, zinc,

sulphur, and soil particulates. This monitoring was suspended in September, 1980, due to lack of funds.

Organ Pipe Cactus National Monument is a designated United Nations Biosphere Reserve. As part of the monitoring program, a National Atmospheric Deposition Program (NADP) wet-fall/dry-fall sampling station was established at Organ Pipe Cactus NM early in the spring of 1980. This long-range pilot study is aimed at detecting changes in the chemical composition of atmospheric deposition, i.e., the acid rain problem.

On June 25, 1980, the Department of Interior recommended Organ Pipe Cactus NM for redesignation from Class II to Class I under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act. If the State of Arizona follows up on that recommendation by preparing reports on the health, economic, energy, social, and environmental impacts of such redesignation and by holding the public hearings, the Organ Pipe airshed will receive the most stringent protection from the air pollution threat.

Statement of Work:

The researcher will summarize existing airshed quality data and literature, attempting to identify emission sources. The researcher will establish a visibility monitoring station which will be located at a site after consultation with NPS staff. The specific visibility monitoring equipment will be selected in consultation with the monument staff. The National Park Service will purchase the equipment.

Product Expected:

1. Final Report

2. One operating visibility monitoring station.

Park Support Available:

See Vegetation Survey and Monitoring section above.
border in the frontier town of Sonoyta, Mexico.

Duration of Project: 15 months.

Estimate of Cost: $25,000

Study Land Use Pattern Changes in Areas Adjacent to and Surrounding Organ Pipe Cactus National Monument and Assess Their Implication to Resource Preservation and Biosphere Reserve Management

Introduction:

Land use patterns in areas adjacent to and surrounding the park/biosphere reserve are changing in nature and intensity. Informal communication with Mexican officials indicates that agricultural expansion in Mexico immediately south of the park has increased from 2,168 hectares in 1978 to nearly 10,000 hectares today and that the population of Sonoyta has increased in recent years from less than 10,000 to more than 15,000 inhabitants. They also indicate that such growth will likely continue, expanding the need for water and use of agricultural biocides. Early in 1983, 155 wells each having a pumping capacity of 1400 gallons per minute, were actively displacing groundwater to the surface. These activities and were expected to continue to grow. Smelter operations to the north have been curtailed and the plant shut down, shifting the economic base of nearby Ajo, Arizona from mining to ranching, tourism and services associated with retirement communities. Ranching on O'Odham lands to the east and on Bureau of Land Management lands to the north continues. Military use of the Luke Field Gunnery Range is predominantly "air-to-air" in nature with strict access permitting requirements for visitors to the Range and the Cabeza Prieta Wildlife Refuge.

These changes and the diverse land use policies applied to adjacent lands by the Military, Fish and Wildlife Service, Bureau of Land Management, Tribal lands and anglo, Indian and Mexican citizens north and south of the border may exert considerable influence on monument resources. We wish to gain an understanding of the nature and magnitude of these changes and how they may affect ecosystem functioning within the monument/Biosphere Reserve. Study results will significantly influence interpretation-environmental education, resource protection and management, and research program design and also permit the National Park Service to employ the monument/Biosphere Reserve as a standard against which man's impact on his environment can be measured.

Statement of Work:

1. Develop a bilingual archival systems and ensure material assembled is referenced for east of retrieval.

2. Itemize and outline implications of land use policy, laws, designations and current status for adjacent lands in Mexico as well as in the United States:

A. Sonoyta Valley, Sonora, Mexico

B. O'Odham

C. Bureau of Land Management lands

C. Military/Fish and Wildlife Service lands

3. Assemble maps, aerial photographs and 35 mm color transparencies of neighboring Sonoyta Valley, O'Odham, BLM and military/FWS lands depicting uses such as:

A. location of transportation corridors and commercial and industrial activities;

B. location of mineralized areas and mining activity;

C. location of grazing, farming, urbanization/ "rurbanization;"

D. zoning ordinances and restrictions;

E. wildlife management units;

F. location of drainages, wells, and natural water sources;

G. subsistence use areas of the O'Odham;

H. location of significant crop lands, water use areas, ejidos and communities, etc.

4. Establish socio-economic profiles of Sonoyta Valley (Mexico) and the Why-Ajo and Western O'Odham reservation areas (United States) to describe population trends and patterns that affect monument/Biosphere Reserve management. Factors to examine may include:

A. population, labor force and related trends including age and sex distribution and education levels;

B. length of residency and place of origin;

C. type of residency (i.e. rent, own, share) and type of residence (i.e. house, shack, apartment, etc.);

D. transportation;

E. public and private health services;

F. public utility and government employment levels;

G. retirement;

H. education, including number and location of schools and their level of instruction, numbers of students, inventory of schools having "environmental education" programs and summary of their curricula;

I. occupation and income characteristics, duration of employment and spending patterns;

J. construction and interest rates (in U.S. and Mexico) as growth indicators;

K. cost of housing;

L. commerce characteristics (i.e. small business, vendors, stores, services, coops, industry, mining, manufacturing, farming, ranching, tourism, etc.).

6. Survey of the attitudes and resource concerns of regional residents toward Organ Pipe Cactus National Monument-Man and the Biosphere Reserve.

7. Develop an outline of contacts and procedures for updating socio-economic profiles in years to come and for monitoring land use changes on adjacent lands.

Products Expected:

Maps, color slides, aerial photographs referenced into a bilingual archival system.

Narrative, with support documents referenced into a bilingual archival system describing the implications of land use policy, laws, designations and current status for adjacent lands in Mexico and the United States.

Socioeconomic profiles of monument area (Mexico and U.S.) and narrative describing trends and patterns and their implications of monument/Biosphere Reserve management. Present specific, prioritized recommendations for management of Reserve resources and for updating profiles.

Develop a protocol for monitoring land use changes on adjacent lands.

Survey of attitudes and resource concerns of regional residents (U.S. and Mexico's Sonoyta Valley) toward Organ Pipe Cactus National Monument-Man and the Biosphere Reserve; and prioritized recommendations for management program changes, additions or deletions that will contribute to achievement of park/Reserve education objectives.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: Three years

1. First year

   A. Develop bilingual archival system. Itemize land policy, laws, designations and current status for adjacent areas in Mexico and O'Odham land.

   B. Assemble maps, aerial photographs and 35 mm color transparencies documenting nature and extent of land use.

   C. Design socio-economic study to obtain profile of the Sonoyta Valley and the Why-Ajo and Western O'Odham reservation areas.

   D. Design survey to inventory attitude and resource concerns of regional residents (U.S. and Mexico).

2. Second year

   A. Outline implications of land use policy laws, designations and current status for adjacent lands in U.S. and Mexico.

   B. Conduct socio-economic study to obtain profiles of the Sonoyta Valley and the Why-Ajo and Western O'Odham reservation areas.

   C. Conduct survey to inventory attitudes and resource concerns of regional residents in Mexico and U.S.

3. Third year

   A. Describe socio-economic trends and patterns of their management implication. Prioritized management recommendations should also be provided.

   B. Describe public attitude toward the monument/Reserve and resource concerns of regional residents in U.S. and the Sonoyta Valley. Prioritize recommendations for management and interpretive program changes additions and deletions.

   C. Finalize and test protocol for monitoring land use changes on adjacent lands.

Estimate of Cost:

First year - $50,000

Second year - $90,000

Third year - $50,000

Total $190,000

Potential Researchers/Information Sources:

Staff of the Colegio de la Frontera Norte, Zona del Rio, Abelardo L. Rodriguez #21, Tijuana, Baja California, Mexico

Lic. Roberto del Pardo and Mstro Armand Estrada, Instituto Technologico de Nogales, Nogales, Sonora, Mexico

Staff in Anthropology, Geography, Economics, Political Science at the University of Arizona, Tucson, Arizona

Staff at Universidad Autonoma de Baja California, Facultad de Arguitectura, Mexicali, Baja California, Mexico

Ezequiel Escurra, Instituto de Ecologia, Apartado 18-845, 11800 Mexico, D.F., Mexico

Martha Patricia Celis Salgado, Jefe, Depto de Prevencion, Conservation y Control Ecologico, Delegacion SEDUE en Sonora, Hermosillo, Sonora 83000, Mexico'

Oscar Sicre, Universidad Pedagogica de Sonora, Nogales, Sonora, Mexico

Division of Economic and Business Research, University of Arizona, Tucson, Arizona

Office of Economic Planning and Development, State of Arizona, Phoenix, Arizona

Bureau of Indiana Affairs, Sells, Arizona

Peter Rios, O'Odham Tribal Council, Sells, Arizona

SARH and BANRURAL, Sonora, Mexico

Investigate Ecology of Birds

Introduction:

Although an inventory and annotated checklist of birds for the monument exists, information about the distribution, abundance, and demographics are to a degree lacking. The degree of threat, internal or external to the park, existing for species such as the black vulture, peregrine falcon, and tropical kingbird, Harris hawk, ferruginous pygmy owl, and others is unknown. Data from these studies will be used to nominate rare, sensitive and other birds of special interest as indicator species and those that have significant relationships with other elements of the biota. In addition, birds have the highest profile of any biological group for the public and, although interpretation is not of direct resources management concern, this project will make an invaluable contribution to the interpretive effort.

Statement of Work:

1. Survey Phase

A. Summary of existing literature and data. Recent work by Groschupf, Brown and Johnson, Tallman, Phillips and Pulich, have summarized species presence from the literature and supplemental field work. The monument maintains a sight observation file filled out by park staff and visitors. The validity of these latter data are problematical.

B. Study Design. Design a study that will provide information about species distribution, abundance, age and size structure, growth rates, mortality rates and causes, reproduction and recruitment, and food habits of species named in Statement of Problem section and/or such other species as may be deemed to be of importance. Methods employed should be compatible with those generally acceptable to science and should be applicable to long term monitoring.

C. Selected components to be monitored. Establish criteria for selecting species and study sites to be included in a long term monitoring effort considering these criteria:

1) Special status species, e.g. endangered, threatened, or covered by legislation, proclamations, etc.

2) Species that occupy different trophic levels, feeding guilds, etc. so that all levels are represented.

3) Species that are common or dominant.

4) Endemic.

5) Species that are harvested by hunting, poaching, and collecting for commercial or domestic purposes.

6) Alien, exotic, feral species.

7) Species that are of special interest to the public, managers, interpreters, and/or scientists (heroic species).

8) Species that occupy sites that are subject to dramatic change such as precipitant loss of habitat.

2. Monitoring Design Study.

A. Monitoring design. Develop protocols for long term fauna monitoring at those sites identified in 1.c. above. Include consideration of points 1.c.1-8.

B. Report design. A report format needs to be developed for the utilization of the monument staff in its long term bird monitoring program.

C. Create a handbook to direct the implementation of the monitoring program. Detailed instructions on how to continue the monitoring of the birds in the area, including baseline information, distribution maps, sample site maps, report formats, and data base management techniques.

D. Test monitoring design procedures as described in the handbook created above. The purpose of this test is to ensure that the monument staff will be able to continue monitoring program at a high level of precision.

Products Expected:

1. The investigator is to submit data (both alpha and numeric) in an intelligible and consistent format. Raw data, especially if voluminous, may be submitted on IBM-PC compatible media.

2. A report of the survey phase.

3. A monitoring handbook.

4. Deposit voucher specimens in Park Study Collection and/or University of Arizona.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Project: 2 years.

Estimate of Cost: $60,000

Potential Investigators:

Analysis of Poaching and Destruction of Native Species

Introduction:

Reports from diverse sources point to a poaching and destruction of native species such as small cacti, saguaros, snakes, lizards, deer, pronghorn, bighorn sheep, doves, etc. However, the extent of this problem is unknown. An analysis is required of species being removed, their sensitivity to removal, the location of removal, and the number taken. Also, information is required about private collecting versus commercial collecting and marketing outlets.

Statement of Work:

Investigator will summarize existing literature and data related to poaching, including agency reports, gray literature, newspaper articles, etc. Sampling design will be developed in conjunction with park staff. It will include a protocol for contacting agencies, organizations, etc. (including the Man and the Biosphere Program, USFWS, BIA, Border Patrol, Arizona Game and Fish, Bureau of Land Management, U.S. Air Force, U.S. Customs Service, other park areas, Pinacate National Park, etc.).

This investigation will be designed to be completed within two years from the date of contract. It will follow the standard format given to the researcher by the NPS. The investigator will prepare a work schedule to be approved by the NPS. The investigator will prepare an interim report mid-way through the project and a final report at completion along with appropriate maps. The final report will include a list of poaching information contacts from other organizations and agencies. Investigator will design a field monitoring system for use by monument staff if poaching indeed is a significant problem at particular locations. Investigator in the final report will recommend solutions to poaching problems that will can be resolved. These might include interpretive programs, eradication of pullouts, moving toilet locations, etc.

Investigator will design a data collection system that will be transferred to the monument which incorporates information on all species being destroyed or poached, an estimate of numbers, and location.

Expected Product:

Interim report, final report, computerized final collection system, field monitoring system.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: 2 years

Estimate of Cost: $14,000

Study of Visitation Patterns Within ORPI and the Potential Effects of Visitation

Introduction:

Currently, visitation is monitored by a monthly use report which reports on visitor center, campground and backcountry use. This report is not adequate to address fully all the effects of visitors on the monument's resources. More detailed knowledge of visitation patterns may allow cause and effect correlations in resource impact studies, especially those involving sensitive resource areas.

Statement of Work:

1. Conduct a summary of existing literature and data on visitor use.

2. Design a sampling technique which will fully address visitor use in the monument.

3. Select a set of components of visitor use to be monitored. This selection must be based on a predetermined set of criteria developed in consultation with the monument staff.

4 Design a report format for the monument staff to use in monitoring of visitor resource impacts.

5. Develop a monitoring protocol using the report format from (4) above and test the design to ensure that the monument will have a consistent and precise monitoring program.

Products Expected:

1. Report on the adequacy of the current visitor use reporting methods and the current understanding of visitor use types and effects.

2. Handbook that describes a protocol for monitoring of visitor use in the monument. This handbook will include a set of parameters to be measured, reporting formats, sampling methodology, and data management methods.

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: 2 years

Cost Estimate:

First Year	$ 10,000
Second Year	5,000
TOTAL	$ 15,000

Historic Fabric

Introduction:

The history of human use of the monument goes back to 1540 when Spanish explorers traveled through the area. By 1698 Father Kino had visited the area and found "good pastures....with their irrigation ditches at Quitobaquito and along the Sonoyta River. Through the 1700's and 1800's Spanish and Mexican travelers left records at intervals. In 1849 hundreds of gold seekers passed through the area on the way to the California gold fields. Grazing was becoming more and more evident during the late 1800's and into the 1900's. During the 1860's, (the Civil War period) raids by Apaches, and possibly other Indians as well, became more frequent. In 1887 a family of Sand Papagos, the Oroscos, settled at Quitobaquito. The whole region was being more heavily settled, with the center of the agricultural activity being Sonoyta, as it is today.

Another important early activity was mining, starting as early as 1870 when Cipriano established La Americana, today known as Victoria Mine. By 1871 there was a "Santa Domingo Mining District" apparently consisting of the Victoria, Baker, Lost Cabin, Martinez and Milton mines with milling activities possibly being at Quitobaquito.

Numerous structures associated with grazing and irrigated agricultural, mining, and other human activities include houses; wells, associated windmills, corrals and stock tanks, including earthen tanks, most or all of which have been breached; mine shafts and remains of mining equipment and machinery. Some of these have already been placed on the National Register of Historic Places, others have been nominated and others of concern are reported on the Historic Resources Study for ORPI. This includes such structures as the Growler Mine and Cipriano Well.

Statement of Work:

In addition to agents of normal attrition, e.g. wind, sun and rain, large segments to entire structures are taken by visitors or people living outside the monument. Wood from old buildings, corrals, etc. are taken, presumably for firewood and building materials. In exceptional cases entire windmills have disappeared, leaving nothing but a set of truck tracks heading south and across the border. Although much of this concern is related to law enforcement, protection from both natural elements and vandalism should be addressed.

The investigator will need to bring together all historic reports on both structures and activities and supplement them with any additional information, including verbal (e.g. tape recorded),

obtained from long time residents of the area, and other knowledgeable individuals.

Products Expected:

1. A list of various programs, federal and state, which might give some assistance in protection of historic areas.

2. A monument map and prioritized list for maintenance and protection of historic structures and sites.

3. Detailed maps of each site clearly showing boundaries of historic versus non-historic portions (if any).

Park Support Available:

See Vegetation Survey and Monitoring section above.

Duration of Work: One year.

Estimate of Cost: $9,000

APPENDIX G.

N2219 (WR-RN)

September 5, 1986

Workshop Participants, Sensitive Ecosystems: Organ Pipe Cactus National Monument

Subject: Final Changes in Schedule and Format

We welcome your participation in the forthcoming workshop in Tucson aimed at determining the top priority research needs at ORPI (Organ Pipe Cactus National Monument) relating to their sensitive ecosystems or habitat. In order to insure adequate time to address the extremely important issues involved, we have decided to start the workshop on Wednesday, 09-17-86 at 8:00 a.m. (7:45 a.m. - coffee and donuts) at the Western Archeological and Conservation Center in Tucson instead of on Thursday, 09/18. (We are trying to reach all of you by telephone, but this letter will confirm that phone conversation.)

The format has been somewhat altered. In brief, I have asked Dr. Dennis Fenn, Unit Leader of the CPSU at Texas A&M, Southwest Region, National Park Service, to serve as overall moderator of the workshop. Dr. Fenn will call on Supt. Harold Smith and his staff for a slide presentation to describe the natural resources of ORPI as well as the presentation to describe the natural resources of ORPI as well as the management concerns they wish the workshop to address. Following this, Dr. Roy Johnson will present a brief summary of past research at ORPI. Then Dr. Gary Davis, Research Scientist at Channel Islands National Park, California, will serve as facilitator of the large group brainstorming and priority-setting sessions which will last all day Wednesday and half of Thursday. By approximately noon on Thursday, Dr. Fenn will break the workshop into small project groups, each of which will outline the major elements of research needed on those subject areas determined to be top priority by the large group session.

Once these major contributions have been concluded, the workshop will adjourn--probably late afternoon Friday. I have appointed a smaller group of NPS personnel, the Master Program Team, to do the final editorial work of the master program and the outlines for individual projects. The NPS Master Program Team will compete this job for the Division of Natural Resources and Research of the Western Region, NPS, on Saturday, September 21.

We greatly appreciate your willingness to participate in this workshop which can have results that are of great importance to Supt. Harold Smith of ORPI, to Regional Director Howard Chapman, and more importantly to the future of the natural resources of Organ Pipe Cactus National Monument. We will be pleased to send you a copy of the final Master Program for these research projects when it is completed. If you have any questions, please call me at (415) 556-4968 or Mike Kunzmann at (602) 629-6896 or FTS 762-6896.

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Bruce Kilgore, Chief
Division of Natural Resources and
Research
Western Region, National Park Service
San Francisco, California

P.S. For those who have told us that they wanted to go on the field trip to ORPI, an informal trip is being coordinated by Mike Kunzmann of the CPSU/UA. Cars will be leaving Tucson between 5:00 and 5:30 p.m. for the Western Archeological and Conservation Center on Monday, 9/15. The trip will spend all day Tuesday, 9/16, at ORPI and will return to Tucson that night. For field trip details, please contact Mike Kunzmann.

Note: The above is a verbatim retype of the subject. Letter was retyped to provide clearer copy for reproduction.

APPENDIX H.

DEPARTMENT OF INTERIOR

July 31, 1986
WRO/330

Agency/Bureau: National Park Service

Fiscal Year: 1987

Appropriation: Operation of the National Park Service

Proposed Amendment: $247,000 for Sensitive Habitat Evaluation at Organ Pipe Cactus National Monument

Current Program: Evaluations of sensitive habitats within Organ Pipe Cactus National Monument and their vulnerability to adjacent agricultural activities, pesticide exposure, groundwater draw-down, and poaching are being addressed on a project by project basis. Research and the collection of baseline data is on-going at Quitobaquito Springs, representing a tiny portion of the park's acreage. An inventory of surface water resources has recently been completed. The final report will address the effects of surface waters on small mammals and breeding birds. Bird and small mammal checklists have recently been updated. A herpetological checklist is available. Wildlife observation card files are being maintained. A study of invertebrates at Quitobaquito Springs is also underway, but covers habitat types representing only 0.3% of the park acreage. Precipitation data has been collected since 1962. The currently approved Natural Resources Management Plan identifies a Sensitive Habitat Evaluation Project as a high priority need of the park. The scope and elements of the project are currently being reviewed and refined by an interdisciplinary team of park managers and research scientists.

Amount budgeted in FY 1987: None

Feasibility: The proposed project would include a study of desert washes and their associated biota; identification of sensitive habitats; monitoring of climatic parameters; identification of airsheds and points sources of pollution; location and aerial imagery of riparian study plots, inventories of vegetation, herpetofauna, mammals, and invertebrates; and monitoring of adjacent agricultural activities and pesticide drift into park. This project would evaluate all sensitive habitats at the park as an integrated single subject rather than on a project by project basis.

Capability: The Service has the capability to obligate the funds if appropriated. This study would require $82,250 in FY87, with the remainder to be phased over the following two years. The project would be accomplished by research scientists on the staff of an under contract to the CPSU/University of Arizona. Park staff would assist with development of the research plan and establishment of study plots.

Outlay effect: Fiscal 1987: $82,250

Proposal made by: Senator Dennis DeConcini