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MORRO BAY RESEARCH NEEDS

*Summary of a workshop sponsored by the
The Morro Bay State Estuary Watershed Council
California Sea Grant Cooperative Extension Program
The National Estuary Program*

Editor
Deborah A McArdle

A Publication of the University of California Sea Grant Cooperative
Extension Program

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The Morro Bay State Estuary Watershed Council
California Sea Grant Cooperative Extension Program
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1996

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INTRODUCTION

The significance of Morro Bay has recently been recognized by its designation in 1994 as the first State Estuary and, in 1995, as one of 28 National Estuaries. As directed by these programs, the Morro Bay Watershed Council is guiding the development of a management plan that will address water quality related issues facing the Morro Bay estuary and its watershed. The Council has established several workgroups, comprised of citizen, agency, business, university and industry representatives, that are identifying issues and suggesting improvements or solutions to these issues using a consensus-based approach. In previous workgroup meetings, participants identified the need for increased communication between workgroups, as well as with other landowners, scientists, resource managers, and policy makers. The workgroups also identified the need for a Research Needs Workshop.

In an effort to address those needs, Deborah McArdle, from the University of California Sea Grant Cooperative Extension Program and Melody Kreimes, from the Morro Bay National Estuary Program (NEP) organized a one-day workshop that brought scientists from related disciplines together with resource managers, non government agencies and citizens to identify and prioritize the research needs of Morro Bay (Appendix I). The workshop was held on March 2, 1996, in Morro Bay. Seventy-one individuals attended the workshop which was held at the Inn at Morro Bay (Appendix II).

Deborah McArdle introduced the workshop by explaining the need for additional Morro Bay research studies, as well as the integration of research results into resource management decision-making. NEP Program Director, Dave Paradies, provided a summary of the NEP Morro Bay Management Plan Program and NEP Scientific Director, Karen Worcester, explained the relationship of the NEP Program to scientific research. Mark Silberstein, Director of the Elkhorn Slough Foundation, and Dr. Tim Hollibaugh, Senior Scientist at the Romberg Tiburon Center, provided participants with examples of how research has been incorporated into management plans created for the Elkhorn Slough Estuary, San Francisco Bay and Tomales Bay. Walt Bremer, Head of the Landscape Architecture Department at Cal Poly State University, followed with an overview of how Geographical Information Systems (GIS) can be used to identify research needs in Morro Bay.

A general overview of research needs identified at previous workgroup meetings was provided by workgroup representatives including, Steve Soderstrom, Mark Angelo, Dave Paradies, Karen Worcester, Donald Funk, Steve Rebeck and Diane Ludin. Participants used the research needs presented in the morning as a foundation for afternoon discussion groups. In the afternoon, participants were divided into five topic-related discussion groups, facilitated by Karen Worcester, Melody Kreimes, Katie Kropp, Deborah McArdle, and Steve Rebeck. The goal of the discussion groups was to develop more specific ideas for research needs, cooperators and funding sources. The results of each group were summarized and presented to all meeting participants. The workshop was concluded by an overview of Morro Bay's Past, Present and Future, given by Bill Newman.

A draft document of research priorities was written based on discussion group and workgroup summaries and then sent out to all of the workshop participants for review. This document incorporates the results of discussions that occurred at the meeting, as well as comments received from subsequent reviews. The following list of research priorities addresses recommendations for what is needed with respect to understanding, researching and managing Morro Bay and it's watershed.

OVERVIEW

The majority of prioritized research needs for Morro Bay related primarily to the effects of sedimentation, toxins, fresh water inflows and land use on water quality and ultimately biological resources. These issues are not new, as many of the needs identified here parallel those identified by the Morro Bay Task Force in 1991 (Appendix III).

The effect of sedimentation on water quality and biological resources is a major concern. A primary gap in research knowledge, needed to address the issue of sedimentation, is baseline data on the sources, distribution and quantities of sediments in both the Bay and watershed. It is also necessary to gain a better understanding of how various factors, such as land use, affect the rates of sedimentation. Coupling the disciplines of Biology and Geology is also needed to determine what the effect of sedimentation is on plant and animal species and their associated habitat.

The sources and impacts of toxic substances into the Bay and watershed is also a priority research area. Baseline survey data is needed to more fully understand the sources, distribution and extent of inorganic and organic toxic substances in the Bay. Because toxic substances may be transported through sediments, more extensive data is also needed on sediment content and distribution in the watershed. Because areas affected by toxins may have the potential to be restored, studies need to determine appropriate rehabilitation strategies. Information is particularly needed on abandoned mine rehabilitation and the feasibility of using constructed wetlands for water improvement of sewage and stormwater.

Fresh water inflows into the Bay are still not well enough understood. A baseline streamflow study is needed to identify stream volumes, during peak and low flow periods. To assist in projecting changes in flow rates, a water consumptive uses budget of freshwater consumption and changes of fresh water flow discharge should be developed.

Land use affects the Bay and watershed, both directly and indirectly. Many of the identified research questions addressed the need for a better understanding of sedimentation, toxins, and fresh water inflows (as described above). In addition to the scientific aspects, preserving the cultural use of land is also a top priority. Areas for restoration and preservation of plant life for cultural purposes need to be identified and a sensitivity map of cultural resources should be developed for land use planning.

All of the water quality related issues including sedimentation, toxic substances, fresh water inflows and land use affect biological resources. The impact of these, however, cannot be understood unless there is first a basic survey of exactly what species exist, how many there are and how they are they distributed. Fluctuations in populations, due to these impacts, cannot be recognized unless this survey is ongoing and on a long-term basis. For this reason, a top priority for biological resources is the need for a comprehensive ongoing survey of species and their associated habitats.

To understand how Morro Bay and its watershed function as an ecosystem, the development of a hydrological model of both the Bay and watershed is needed. Such a model would assist in understanding how all of the aforementioned topic areas interact and interrelate with each other. A Bay model should include parameters such as salinity, turbidity, temperature, nutrients, and circulation. A watershed model should include storm events, first flush and dry season flows. Chemical and pathogen monitoring of water quality at baseline and targeted sites is also needed.

MORRO BAY RESEARCH NEEDS

Participants identified five primary areas in which research is needed: Sedimentation, Toxins, Fresh Water Inflows, Land Use, and Biological Resources. Identified research questions for each topic area are listed below. Research Needs listed in bold were identified, by workshop participants, to be high priority. Following each need is an abbreviation of the workgroup or discussion group which identified that need.* A list of potential funding and human resources (Appendix IV) are also signified by superscript numbers which follow some needs.

I. WATER QUALITY

A. Sedimentation

Members of all discussion groups determined that the factors influencing sedimentation are still not well enough understood. Discussion groups generally agreed that the top priority was to identify soil and sediment sources as well as sedimentation rates. Identified questions include:

Baseline Data & Monitoring

- **What are the sources, quantity and quality of silt and sediment (suspended, non-suspended and dissolved)? WQ, BBR, WSBR 1**
- **What are the rates of sedimentation and how do they fluctuate over time? BBR, WQ, FW 2**
- **Additional (more detailed) data on soils and geology specifically for population centers and intensively farmed areas. WQ, BBR**
- **Modeling of Hydrographic Qualities including salinity, turbidity, temperature, nutrients, circulation) (Also including interaction between ocean and estuarine waters). WQ, FW 3**

Impacts and Influences

- **What is the effect of land use on sedimentation rates? BBR, WQ, FW**
- **What is the effect of sedimentation on biological species? BBR**
- **What is the impact of fires on runoff intensity? FW**

Restoration

- **What is the feasibility and effectiveness of using constructed wetlands for water improvement of both wastewater effluent and stormwater? WQ**
- **Development of fire management zones for a preresponse strategy (GIS). LU**
- **What is the frequency at which burns are needed? LU**
- **What are the impacts of seeding as an erosion control strategy following burns? LU**
- **In terms of road maintenance: What roads are necessary, which can be removed? LU**

*LU (Land Use), BBR (Bay Biological Resources), WSBR (Watershed Biological Resources), WQ (Water Quality), FW (Fresh Water Inflows).

B. Toxins

The impacts of toxins on water quality, sediment and biological resources was highly recognized by participants. Following are the identified research needs:

Baseline Data & Monitoring

- What are the sources and quantities of toxins (e.g., organic and inorganic sources including, nickel, chromium, lead, petroleum products (TPH), pesticides, herbicides, etc.)? WQ, BBR, LU 1
- Modeling of the Hydrographic Qualities including salinity, turbidity, temperature, nutrients, circulation (also including interaction between ocean and estuarine waters). WQ, FW 2
- Additional (more detailed) data on soils and geology, specifically population centers and intensively farmed areas. WQ, BBR 3
- Monitoring of storm water runoff and waste discharge. WQ
- Eelgrass studies and maintenance of mooring area. WQ
- How can macroinvertebrates be used as indicator species in the Bay? WQ, BBR, WSB

Impacts and Influences

- What is the impact of groundwater contamination from landfills and underground storage tanks? LU
- What is the relationship between dredging and the commercial fishing industry and aquaculture (e.g. resuspension and recirculation of toxins)? WQ, BBR
- What are the impacts of homeowner hazardous material use? LU
- What is the relationship between eelgrass and concentrations of inorganic nutrients? WQ
- What are the impacts of mooring area maintenance on eelgrass beds?

Restoration

- What are appropriate rehabilitation strategies for abandoned mines (e.g., dredging spoils, mycorrhizal inoculations, native species, revegetation, etc)? LU 4
- What is the feasibility and effectiveness of using constructed wetlands for water improvement of wastewater effluent and stormwater? WQ 5
- Prioritization of impacts from mines. LU
- How can existing pesticide data be formatted in a site specific way? LU

C Fresh Water Inflows

Participants concluded that the relationship between stream flow and sediment transport is not well enough understood and should be a top research priority. Long-term studies are needed in order to detect fluctuations and patterns in stream volumes and velocities. Additional research on how freshwater affects Bay water quality also remains a top priority. Listed below are the identified research questions: 1

Baseline Data & Monitoring

- **What are streamflow characteristics including velocities and flows? (Flow gauges possibly at Twin Bridges and S. Bay Blvd, Los Osos CK) FW, WQ 2**
- **Define water quantity and quality objectives/standards for watershed. Conduct background studies to develop justifications for standards. FW**
- **Develop water consumptive uses budget (sources, input, projections), including sustainable yield calculations. FW, WQ**
- **What are run-off velocities? FW, WQ**
- **Hydrological modeling of watershed (including storm events), in conjunction with pollutant loading modeling. FW**

Impacts and Influences

- **What are the existing and potential negative/positive impacts of stream flow quantity on watershed water quality? FW**
- **Where are fresh water seeps entering the Bay? FW 3**
- **What is the condition of riparian corridors? FW, WSBR**
- **Do healthy riparian corridors improve summer surface water flows? (e.g. what is the influence of riparian vegetation such as willows on instream flow diversion? WSBR, FW**
- **Stream and riparian habitat evaluations (as related to instream flows). FW**
- **Stream geomorphologic evaluations (effects of channelization, sediment transport flow regimes). FW**
- **What are the effects of land uses on flow rates? FW**

Information Needs

- **What were historical flows and what has been the effect of subsequent stream diversions and channel modifications (including personal anecdotal and historical accounts through interviews)? FW**

D. Land Use

Many of the top priority research needs identified by participants were associated with the impacts of sedimentation and toxins on water quality and are therefore listed under those topic headings. The impact of land use on cultural resources was also given high priority from participants. Their recommendations for research questions include:

Baseline Data & Monitoring

- **Sensitivity map of cultural resources for land use planning. LU 1**
- **Impacts and Influences**
- What is the carrying capacity of land for various land uses? LU
- How does actual land use compare to existing zoning. What is anticipated change? LU
- What are early warning indicators of a dysfunctional watershed? LU

Impacts and Influences

- What are the impacts of urban expansion? Where should growth occur? LU
- What are the impacts of septic tank use on the Bay LU.
- What are impacts of recreational uses on the Bay such as hunting and boating? LU
- What are impacts (both positive and negative) of dredging projects?
- What are methods of controlling yellow star thistle and other exotics (particularly on a large scale)? LU

Restoration

- **Identify areas for restoration and preservation of plant life for Native American or cultural use. LU 2**
- Prioritization of restoration projects based on erosion, soils, etc. LU

Information Needs

- What are various agency mandates and missions, and what are opportunities for participation, coordination and implementation? LU
- What barriers prevent landowners from implementing BMP's? LU
- Are the existing rules and regulations effective? Should they be modified? LU
- Examine potential uses of GIS databases. LU
- What is the impact of types of ownership on future land uses (Private land on sandspit, etc)? LU
- Cost/Benefit Analysis of BMP Implementation. LU
- Demographic study of the watershed. LU
- Develop trail plans (for government lands) to provide access, reduce trespassing and erosion. LU

II BIOLOGICAL RESOURCES

The participants of the 1991 research needs assessment, as well as the participants of this workshop, expressed a priority need for the implementation of long-term monitoring programs to allow often undetectable large-scale patterns in the temporal and spatial fluctuations of Bay and watershed communities to be recognized. High-priority issues and related research questions include:

Baseline Data & Monitoring

- **Comprehensive ongoing species survey (including species of special concern and indicator species) BBR, WSBR, LU, WQ 1**
- **Comprehensive ongoing habitat survey, including periodic aerial surveys (including habitats of special concern). BBR, WSBR, LU 2**
- **Status of exotic species and associated habitat? BBR, WSBR, LU**
- **Quality and quantity of Steelhead and Tidewater Goby habitat in Chorro and Los Osos Creeks, including minimum water flow needs. WSBR, FW**
- **Areas currently being used extensively by birds and areas potentially available for use in the future (particularly for non-migratory species such as the snowy plover and great blue heron). BBR, WSBR**
- **Benchmark references for desired conditions (standards against which existing conditions can be compared). BBR, WSBR**
- **Basic description of primary production in the Bay. WSBR**
- **Monitoring of "yardsticks" of Bay health. BBR, WSBR, WQ**
 - Eelgrass: distribution and abundance
 - Clams: distribution, abundance and recruitment
 - Green algae: distribution and abundance
 - Fish: distribution and abundance, and species composition by habitat type
 - Waterfowl: use of Bay, hunting
 - Coliform bacteria: monitor Bay contamination
 - Shellfish mariculture: growth and survival of oysters
 - Benthic invertebrates: distribution and abundance, and species composition

Impacts and Influences

- **What is the relationship/effect of human use on biological resources (systematic study)? BBR, WSBR**
- **What is the relationship between dredging and the commercial fishing and aquaculture industry (e.g., resuspension and recirculation of sediments and toxins)? WQ, BBR**
- **What is the value of Morro Bay estuary as a nursery ground for commercial species? BBR**
- **What are the effects of birds and humans on Heron Rookery habitat? WSB, BBR**

- What are the consequences of the "Bath Tub Ring Effect" on Bay habitats? What critically unpreserved habitat exists (with an emphasis on the Bay uplands)? BBR
- What are the long-term effects of sea level changes? WSBR

Information Needs

- What have the historical uses of Bay habitats been for particular species? WSBR, BBR
- How have other estuaries fared? Was there a management plan? How have they been implemented? Results of those plans? WSBR
- What are the management practices underway by land users (e.g., agricultural, cattle, government land use)? WSBR

III. INFORMATION EXCHANGE

An essential component of developing research and management strategies is information exchange. Some information needs include:

- Improvement in the exchange of information among scientists, legislators, resource managers, resource owners and resource users. Forums are needed that would foster discussions on topics such as the integration of scientific information into the formation of management strategies and the role of resource management in the development of political objectives.
- The continuation of conferences and workshops that update scientists, resource managers, citizens and industry representatives on the most recent developments in Morro Bay and watershed research, enhancement, and management.
- Centralization of existing raw data, resources and literature in order to improve accessibility and data management.

APPENDIX I WORKSHOP AGENDA

Morning Session I:

BACKGROUND AND EXPERIENCES

Introduction, Deborah McArdle, UC Sea Grant Cooperative Extension

Morro Bay Management Plan Overview, Dave Paradies, NEP Program Director

Morro Bay Management Plan and Research, Karen Worcester, NEP Scientific Director

Research Development at Elkhorn Slough National Estuarine Reserve, Mark Silberstein

Estuarine Research and Management: San Francisco and Tomales Bay, Dr. Tim Hollibaugh

Morro Bay and GIS, Walt Bremer, Dept. Head, Landscape Architecture, Cal Poly State Univ.

Morning Session II:

WORKGROUP PRESENTATIONS OF RESEARCH NEEDS

Agriculture, Steve Soderstrom

Biological Resources, Mark Angelo

Fresh Water Inflows, Dave Paradies

Government Lands, Karen Worcester

Land Use, Donald Funk

Water Quality, Charmaine Gallagher

Public Outreach, Diane Ludin

Afternoon Session I:

DISCUSSION GROUPS

Topic groups Identification and Prioritization of Research Needs

Afternoon Session II:

Topic groups Summaries of Top Priority Research Needs to all Participants

(Melody Kreimes, Katie Kropp, Deborah McArdle, Steve Rebeck, Karen Worcester)

CLOSING REMARKS

Morro Bay: Its Past, Present and Future, Bill Newman

POSTERS

- MORRO BAY WATERSHED ENHANCEMENT PROJECTS: Muriel Boerboom
- 1992-1994: MORRO BAY TRAWL SURVEY, Sandy Owen
- EELGRASS COVER IN MORRO BAY, Results of Field Sampling, John Chesnut
- BIOLOGICAL CONTROL OF THE YELLOWSTAR THISTLE, Cathy Darling
- ENVIRONMENTAL CENTER OF SAN LUIS OBISPO (ECOSLO), Geoffrey Lands
- MORRO BAY NATIONAL MONITORING PROGRAM, Katie Kropp, Karen Worcester, Dave Paradies
- ENVIRONMENTAL CONSIDERATIONS FOR SERPENTINE DERIVED SOILS, Tom Rice
- TURNING THE TIDE, Diane Ludin, Public Outreach Workgroup

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APPENDIX III
1991 RESEARCH NEEDS LIST

Research Needs
compiled May 5, 1991, by Barry Putnam
for the Bay Foundation of Morro Bay.

1. Wetlands and riparian habitat inventory
2. Estuarine Identification
(describe the physical, chemical, temporal and biological characteristics of the estuary)
3. Fish, wildlife, and plant inventory
(describe existing and historical incidence and extent of fish, wildlife and plant species in Morro Bay)
4. Watershed library and bibliography
5. Bay Mapping
(describe topography and bathymetry of bay)
6. Public Education
(develop self-education programs, self-guided tours that are fun)
7. Wetlands Development from upland habitat
(investigate how to make wetlands from upland habitats as project mitigation)
8. Affects of freshwater diversions
(determine affects of present and potential diversion of fresh water on wetlands and other estuarine functions)
9. Bay Circulation
(determine water and sediment circulation in Morro Bay)
10. Computer model
(develop computer model of Morro Bay ecosystem)
11. Wetlands enhancement
(investigate how to restore and enhance historical wetlands)
12. Measurement of creek sediment transport
(measure sediment transport during major winter storms)
13. Watershed History
(use past activities to learn about present situations and problems)
14. Management strategies to prevent impacts from watershed changes
(determine potential impacts from future development and develop management strategies to address these)
15. Water quality
(monitor trends in contaminants in Morro Bay, particularly bacteria)

16. Rare and endangered species
(inventory present distribution of T&E species)
17. Pacific flyway role
(determine role of Morro Bay in supporting migratory birds of Pacific Flyway)
18. Historic watershed photographs
(identify, copy, catalog and preserve old and current of the bay and watershed)
19. Wetland restoration
(restore pickleweed marsh adjacent to Morro Bay State Park marina)
20. Watershed land use and ownership
(determine watershed land use and ownership patterns)
21. Bay Bottom composition
(determine chemical composition of bay sediments)
22. Potential effects of sea-level rise
23. Marine fisheries role
(role of Morro Bay in supporting Pacific Coast marine fisheries)
24. Institutional / Regulatory alternatives
(survey institutions, structures, and regulatory approaches for conservation & management Morro Bay)
25. Political and regulatory Responsibilities
(identify governmental agency responsibilities and jurisdictions in watershed)
26. Barrier beach stability
(determine historical and current rates of barrier beach movement and the contribution of blowing sand to sedimentation of Morro Bay)
27. Population dynamics of bay clams
28. Geology and geologic history
(better understand geologic processes in Morro Bay)
29. Tidal prism and flow definitions
(determine bay flows and volume, from creek mouths to harbor entrance)
30. Hoary cress infestation
(determine environmental characteristics of Hoary Cress populations and develop elimination program)
31. Littoral processes near mouth of bay
(understand movement of sand and sediment into the Morro Bay Harbor entrance)
32. Effects of dredging of Morro Bay clams
33. Status of brant
(seasonal numbers and distribution within different parts of the bay)
34. Los Osos Groundwater Resource Capacity

**APPENDIX IV
IDENTIFIED POTENTIAL HUMAN AND FUNDING RESOURCES**

SEDIMENTATION

- 1 In Kind Services: City of Morro Bay, San Luis Obispo County, Camp SLO, RWQB,
UCD, USGS
CWA - 3/9
NSF
Corp. of Engineers
Agricultural Education Foundation
RCD
Natural Resources Conservation Service - Farm Services Agencies
EPA
Congress

- 2 Existing Geographic Information Systems
SLO Creek Study
Cooperative Extension Agriculture Program
CDFG information
Coast Guard Aerial Flights

- 3 Ocean Upwelling Index: Andy Bakum, NOAA

TOXINS

- 1 NSF
EPA
DHS
Corp. of Engineers
Environmental Organizations
Congress
Sea Grant
In Kind Services: City of Morro Bay, San Luis Obispo County, Camp SLO, RWQB,
UCD, USGS

- 2 NOAA, NOS, NMFS
Industry: Chevron, PG&E, etc.
Environmental Organizations
Congress
Sea Grant
In Kind Services: City of Morro Bay, San Luis Obispo County, Camp SLO, RWQB,
UCD, USGS

- 3 RCD, Natural Resources Conservation Service
Farm Services Agency
Corp. of Engineers
Congress
Environmental Organizations
In Kind Services: City of Morro Bay, San Luis Obispo County, Camp SLO, RWQB,
UCD, USGS

4 205 (j) Study
Nacimiento Mine Study
Camp SLO Historical Maps
NRCS, MMS, and EPA studies
Dept. of Conservation
Historical Society

5 Coastal Conservancy
CZMA
Congress
Environmental Organizations
Commercial fishermen
Sportsmen

FRESH WATER INFLOWS

1 Cal Poly Civil Engineering
Dept. of Water Resources
Flood Control District
USDA
NSF
EPA
Mitigation on money/banking
Industries: Chevron/PG&E, etc.
National Guard
RCD/ RC + DC
State and County
Volunteers: CCC, CYA, CalPoly, Cuesta College, BSA, GSA, Americorps, FOE,
Audubon Society, all civic groups
County, State and Federal Paid Staff
UC Cooperative Extension - 4H
CMC
Tenera Staff

2 Three gauges by CMC and City of Morro Bay
Cal Poly Civil Engineering (\$s and students)
Flood Control District (New gauges)

3 The Bay Foundation and Tenera studies (late 1980s)

LAND USE

1 UCSB databases could provide baselines
Chumash databases, oral history
USFWS, public agency reports on file
Caltrans photos

2 Chumash Data History, Human Resources
CalPoly GIS - Fugro
UCSB
Camp SLO
CNPS databases

BIOLOGICAL RESOURCES

- 1 **Camp SLO LCT program**
CalPoly wetlands inventory information
J. Chesnut eelgrass mapping
UCSB and SLOCAS archeological studies
UCSB Photo records
Fairchild Collection at Whittier College
Natural Diversity Database
Breeding Bird Atlas
CDFG 1974 Report on Coastal Wetland Species
Western Society- Camirillo
CDFG Oil Spill Prevention and Response Program inventories
CERIES inventories, CA Resources Agency
CDFG Fines Committee
SLOC Archeology Society
Caltrans Implementation Moneys
EPA Watershed Program
Audubon Society Bird Counts
Docents
NEP
Land Conservation Green Belt

- 2 **Geological Survey at Menlo Park**
Aerial Photos from ~1940s, J. Chesnut
NASA satellite photos?
Wieslander (1930s vegetation map for state)
CDFG Oil Spill Prevention and Response Program inventories
CERIES inventories, CA Resources Agency
Breeding Bird Atlas
CNPS Vegetative Studies