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Technical Report EL-93-17
August 1993

**US Army Corps
of Engineers**
Waterways Experiment
Station

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Legacy Resource Management Program

Summary Report: Biological Resources Program Development Task Area

by *Michael R. Waring*
Environmental Laboratory

Darrell E. Evans
Stephen F. Austin State University

WES

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Prepared for Office of the Deputy Assistant Secretary
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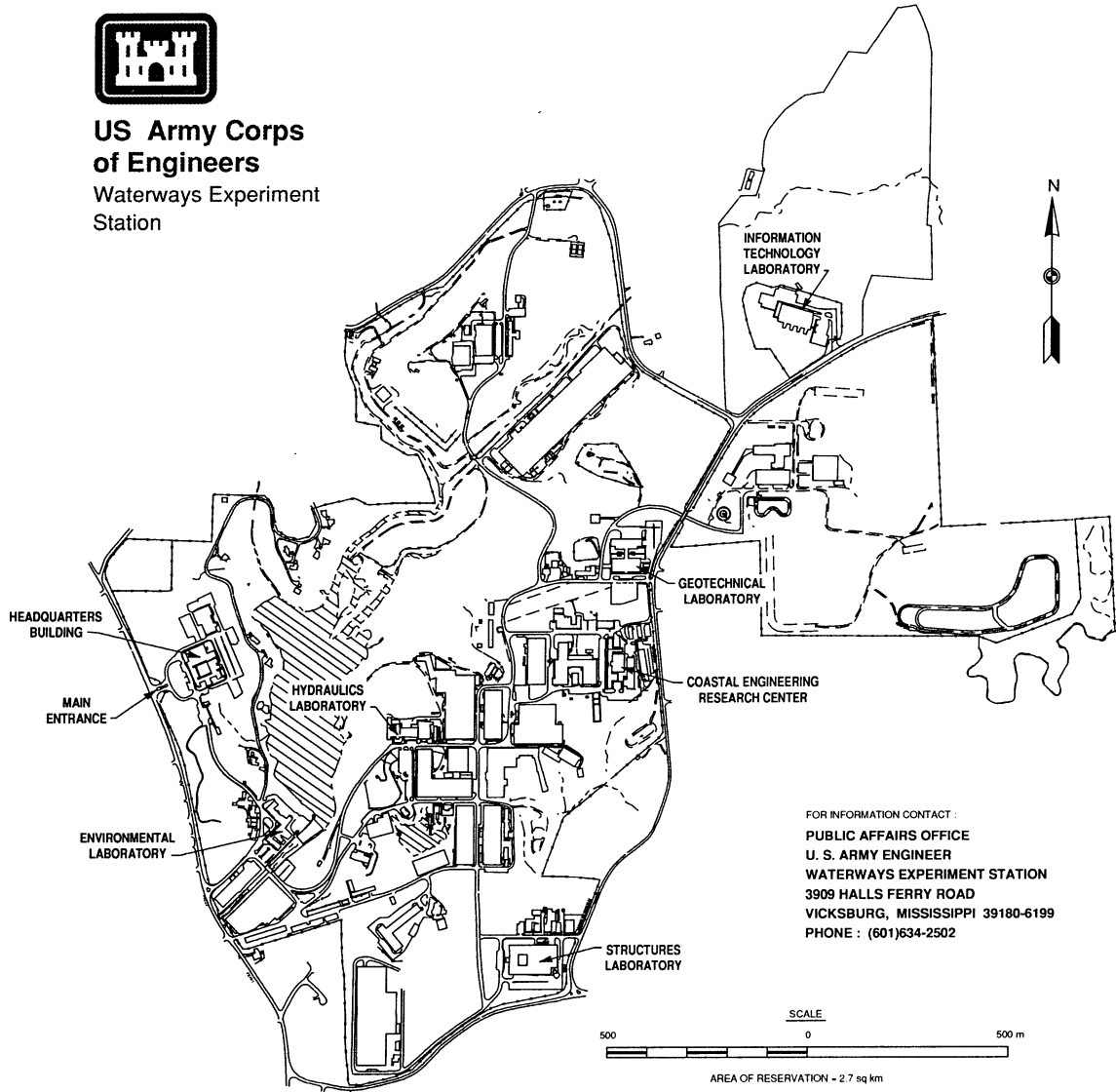
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Preface

The report herein was prepared as part of the Department of Defense Legacy Resource Management Program. The overall program is managed by the Office of the Deputy Assistant Secretary of Defense for the Environment, with administration by the U.S. Army Engineering and Housing Support Center Natural and Cultural Resources Division. The Biological Resources Program Development Task Area was managed at the U.S. Army Engineer Waterways Experiment Station (WES). The Task Area Manager was Mr. Michael R. Waring of the Stewardship Branch (SB), Natural Resources Division (NRD), Environmental Laboratory (EL) at WES.

The report was coauthored by Mr. Waring and Mr. Darrell E. Evans, College of Forestry, Stephen F. Austin State University, Nacogdoches, TX. Mr. Evans was employed by WES under an Intergovernmental Personnel Agreement between WES and the College of Forestry at Stephen F. Austin State University. General supervision was provided by Mr. Chester O. Martin, Acting Chief, SB; Mr. J. L. Decell and Dr. Edwin A. Theriot, Acting Chiefs, NRD; and by Dr. John Harrison, Director, EL.

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1 Introduction

Background

The Defense Appropriation Act of 1991 created the Legacy Resource Management Program (LRMP) to evaluate, enhance, and expand the various Department of Defense (DoD) natural and cultural resources to their fullest potential. As custodian of some 25 million acres¹ of land and water containing valuable natural and cultural resources, the DoD is the fifth largest Federal land-managing agency. Additional agreements among individual military branches, States, and other Federal land-managing agencies, such as the Bureau of Land Management and the U.S. Forest Service, permit the use of another 15 million acres in the United States. While the management of the natural resources on these lands has historically been an important part of DoD's activities, these resources have generally been managed as separate entities, rather than as an integrated system. The concept of stewardship, one of the cornerstones of the LRMP, embraces the principles of truly integrated inventory and management of the resources.

The LRMP initiated a broad spectrum of activities designed to support and enhance DoD stewardship of these significant and often irreplaceable natural and cultural resources (U.S. Department of the Defense 1991, 1992). The Legacy legislation specifically directs DoD to give high priority to inventorying, conserving, and restoring biological, cultural, and geophysical resources, using cost-effective and state-of-the-art methods, while at the same time fully integrating these endeavors with DoD's mission activities. Nine legislative purposes (Figure 1) were identified to create better integration of natural and cultural resources management needs with the dynamic requirements of military missions. Biological resources were specifically addressed in five of the nine purposes (numbers 1, 3, 4, 6, and 7) and implied in purpose number 2.

Completion of the legislative mandates of the LRMP involved two general types of activities. Ten task areas were established to undertake the necessary elements of Legacy program development. Concurrently, Legacy-funded demonstration projects were initiated for cultural and natural resources on military installations throughout the United States. Management of the Biological

¹ To convert acres to square meters, multiply by 4,046.873.

1. To establish a strategy, plan, and priority list for identifying and managing significant biological, geophysical, cultural, and historical resources existing on, or involving all Secretary of Defense lands, facilities, and property.
2. To provide for the stewardship of all Department of Defense controlled or managed air, land, and water resources.
3. To protect significant biological systems and species including, but not limited to, those contained on the Federal endangered list and those which are candidates for that list.
4. To establish a standard Department of Defense methodology for the collection, storage, and retrieval of all biological, geophysical, cultural, and historical resource information which, in the case of biological information, should be compatible with that used by State Natural Heritage Programs.
5. To establish programs to protect, inventory, and conserve the artifacts of Native American civilization, settler communities, and others deemed to have historical, cultural, or spiritual significance.
6. To establish inventories of all scientifically significant biological, geophysical, cultural, and historical assets on Department of Defense lands. In addition to the specific attributes of the assets, these inventories are to catalog their scientific and/or cultural significance as well as their interrelationship to the surrounding environment, including the military mission carried out on the land upon which they reside.
7. To establish programs for the restoration and rehabilitation of altered or degraded habitats.
8. To establish educational, public access, and recreation programs designed to increase public appreciation, awareness, and support for these national environmental initiatives.
9. To establish and coordinate by Fiscal Year 1993 with other Federal departments, agencies, and entities a project to inventory, protect, and conserve the physical and literary property and relics of the Department of Defense, in the United States and overseas, connected with the origins and the development of the Cold War, which are not already being carried out by other capable institutions or programs.

Figure 1. Legislative purposes of Legacy

Resources Program Development Task Area was assigned to the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. Specific objectives of this task area were (a) to evaluate the capability of existing DoD resource management programs to meet Legacy purposes, and (b) to address shortfalls by recommending modifications to existing programs or development of new programs as appropriate.

Procedures and Methods

Several approaches and activities were used to gather information necessary to meet the defined objectives. These included interviewing knowledgeable individuals, direct contacts with other Federal and State agencies, literature searches of several computerized databases, letter and telephone surveys, and the Biological Resources Workshop held in Denver, CO, in May of 1992. Another valuable procedure involved attendance and participation at a number of Legacy-sponsored meetings. Additional information on the procedures used to collect data related to the task area are more fully discussed in the individual sections of this report.

Key Terms

A glossary of terms is found in Appendix A. Some of those terms that need to be emphasized include the following:

Biological Resources - The biotic component of natural resources, including, but not limited to, wildlife, fish, and vegetation.

Natural resources - All products of nature and their environments of soil, air, and water. Natural resources are usually broken down into two categories:

- a.* Abiotic or nonliving, nonrenewable resources such as minerals and soil components.
- b.* Biotic or living, renewable resources such as plants and animals.

Significant Biological Resources - A term used to describe any unique, irreplaceable, biological resource, especially native flora and fauna. Can include resources that are endemic to specific geographic areas, resources that are important to a threatened/endangered species for food, cover, or habitat, or irreplaceable resources that are in threat of being irreversibly lost or damaged. Includes any forest, wildlife, range, and watershed resources.

Stewardship - The moral responsibility to manage resources entrusted to one's care in a way that respects the intrinsic value of those resources, and respects as well the needs of present and future generations of people who depend or will depend on those resources.

Purpose and Organization of the Report

This report presents a summary of the work accomplished within the Biological Resources Program Development Task Area in 1991 and 1992. A review of the literature, addressing the use and management of biological resources by other agencies, is found in Chapter 2. Chapter 3 provides information on data needs for biological resources, as obtained from a survey of selected DoD installations. Chapter 4 is a description of the Biological Resources Workshop, while Chapter 5 describes the relationship of the Demonstration Program to Biological Resources Program Development. Conclusions and recommendations resulting from all facets of the Biological Resources Program Development Task Area area are presented in Chapter 6.

2 Literature Review

Literature was extensively reviewed to evaluate, in very general terms, how other major Federal resource agencies approach the management of biological resources on their lands. The use and management of these biological resources on Federal lands has been defined by a large body of environmental laws (LaRoe 1986). These include the Sikes Act, the Federal Land Policy and Management Act (FLPMA), the National Forest Planning Act (NFPA), the Renewable Resources Planning Act (RPA), the Endangered Species Act, and the Multiple Use Act (MUA) (Halls and Holbrook 1975; Salwasser and Tappeiner 1981). These early laws emphasized the multiple benefit, non-deleterious approach to the use and management of biological resources on lands in the public domain. Unfortunately, the demands placed on our nation's resources have increased (Schlapfer 1975; Barlow 1980; Brooks and Grant 1992) as the Federal land base has remained fixed (Crumpacker et al. 1988). Laws once designed to protect these resources have not necessarily kept pace with these demands and in some cases have become prohibitive and often hinder the use of Federal resources under the guise of regulation (Schallau 1991). Wetland regulation, watershed protection, and threatened/endangered species laws often limit management of the same resources they were designed to protect. This is not to say that these laws are overly protective or ill-conceived, since many of our resources owe their continued existence and management to these laws; but there are instances where the inflexibility of these laws has created problems for resource managers in the field. The environmental arena has become so complicated with various groups proposing to know the "best" or "most wise use" of DoD resources that land management decisions are often settled in court rather than by trained natural resources professionals (Niemi, Mendelsohn, and Whitelaw 1991).

The management and use of natural resources on lands controlled by the Federal government is a widely debated issue, which is often complicated by different groups competing for concurrent use (consumptive and non-consumptive) of the same resources (Culhane 1981; Braden and Rosen 1983; Clawson 1983; Daniels 1987; Foss 1987; Behan 1990; Bingham and DeLong 1990; Niemi, Mendelsohn, and Whitelaw 1991; Brooks and Grant 1992). Commercial interests (i.e., timber, range-livestock, mineral, etc.) often question practices they feel will decrease their ability to derive a profit from the utilization of Federal resources, and environmentalists commonly question the justification and impacts of commercial and military activities on fish and wildlife

populations, watersheds, and habitats (Niemi, Mendelsohn, and Whitelaw 1991).

Conflicts arising over the use and management of Federal lands are most commonly related to future or proposed management actions under consideration by the responsible agency. Management decisions that were once made with minimal outside resistance and very little supporting data are now coming under fire from regulatory agencies and environmentalists; and Federal land managers must now justify their resource management decisions and present supporting data to corroborate those decisions (Brooks and Grant 1992).

Past land use and management practices and the importance of the resources in local economies also play a role in these conflicts (Roth 1991). When discussion over the proper use of these lands and resources becomes deadlocked and compromise is unlikely, the responsible Federal agency(ies) often becomes involved in long, costly litigation and is forced to justify its management decisions (Bingham and DeLong 1990; Kessler 1991; Niemi, Mendelsohn, and Whitelaw 1991).

The use of DoD lands and the management of biological resources on lands under its control has also been reexamined in recent years. Conflicts concerning the impacts of military operations on the preservation and management of biological resources are commonplace, and management decisions made by DoD resource managers affecting the health and vigor of these resources are closely scrutinized by other Federal, State, and private environmental organizations.

The past experiences of other Federal land-management agencies could undoubtedly aid DoD in developing a natural resources management program that is widely acceptable to the military, public, and private sectors. Niemi, Mendelsohn, and Whitelaw (1991) and Gale (1986 and 1992) discuss the necessity of Federal land-management agencies reviewing past Forest Service experiences in resolving resources issues so that the same problems are not continually perpetuated within each agency.

The general operating practices for four other major land-managing agencies—the Bureau of Land Management (BLM), U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), and the National Park Service (NPS)—were reviewed based on available literature. Emphasis was placed on inventory, monitoring, data management, and interagency coordination requirements. Each agency is discussed separately in the remainder of this section.

Bureau of Land Management

The BLM is the largest Federal land manager with 270 million acres under its control. The agency also manages the mineral resources on 300 million acres administered by private interests and Federal-State agencies. BLM land holdings encompass several states and numerous habitat types, but most of its land is represented by rangelands of the western United States (Templeton 1985; Almand and Jurs 1989). Lands managed by the BLM support approximately 20,000 ranchers and farmers and provide grazing for approximately 20 million cattle and sheep (Shay 1981; Sheridan 1981). BLM policies can be found in the BLM Manual, Title 43 of the Code of Federal Regulations, and Bibles (1982). Special policy documents and Memoranda of Understanding provide guidance in special situations and for new management programs. A recent BLM publication, *Fish and Wildlife 2000: A Plan for the Future*, details the agency's philosophy and future approach to resource management on lands under its control.

Inventory

BLM conducts periodic inventories of soil, vegetation, and wildlife on all lands under its control (Cooperrider, Boyd, and Stuart 1986). Authority for these biological inventories can be found in the FLPMA-1976, which states "The Congress declares that it is the policy of the United States that... the national interest will be best realized if the public lands and their resources are periodically and systematically inventoried..." and section 2012c, which states "In the development and revision of land use plans, the secretary shall...coordinate the land use inventory, planning, and management activities of or for such lands with the land-use planning and management programs of other Federal departments and agencies and of the states and local governments within which the lands are located..."

Soil, woodland, and vegetation mapping on BLM lands are done using standardized techniques and systems developed by the U.S. Department of Agriculture (USDA)-Soil Conservation Service (SCS). Soils are mapped to the Order 3 level, and vegetation is mapped according to SCS rangeland standards. Forested lands are mapped using an SCS system primarily designed for forested areas associated with farms (The Keystone Center 1991).

Terrestrial and aquatic habitat inventories are conducted using integrated classification and inventory systems specially designed by BLM. Terrestrial habitat inventories are done using the Integrated Habitat Inventory and Classification System (IHICS), and riparian/aquatic inventories are done with the Riparian/Aquatic Information Data Summary System (RAIDS). Species inventories (game and nongame) are conducted in both terrestrial and aquatic habitats (Armantrout 1980a, 1980b; The Keystone Center 1991).

Monitoring

Biological monitoring on BLM lands is usually done to evaluate potential impacts of proposed land use and management practices and to determine the effectiveness of ongoing management programs (Bedell and Cox 1983; U.S. Department of the Interior (USDI)-BLM 1985). Wildlife habitat and population monitoring is used primarily to evaluate the success of BLM's management programs (The Keystone Center 1991). Rangeland monitoring is primarily in the form of range surveys to assess the impacts of livestock grazing on range vegetation (Bedell and Cox 1983; USDI-BLM 1984).

Data management

BLM is no different from any other large land-management agency in that it has the same immediate needs for the storage, retrieval, manipulation, and analysis of its natural resource data. BLM is presently developing a large-scale automated information management system (Land Information System (LIS)) to be used in its natural resources management program. The LIS is scheduled to be operational some time in 1993; however, data acquisition is currently underway and will probably require 10 years to complete. The LIS will reportedly integrate Geographic Information System (GIS) technology into an information management system with a traditional alphanumeric system, and upon its completion, will automate every function of BLM data (administrative and biological) storage, management, and analysis.

Interagency cooperation and coordination

The BLM has cooperative agreements (i.e., memoranda of understanding) between several Federal, State and private agencies. Most interagency coordination involving the BLM and other agencies occurs at the local/regional level and involves resource management and administrative issues. In most cooperative agreements, the BLM is responsible for habitat management, and cooperating State agencies are responsible for population management (Olendorff et al. 1975). The USFS, the USFWS, and the NPS work cooperatively with BLM on local resource specific issues. BLM also has a cooperative agreement with the State Heritage Program in several states, which provides data management expertise for rare or significant species and communities occurring on BLM lands. An agreement with the Center for Plant Conservation provides expertise and rare plant material for BLM reintroduction programs. Several BLM state offices have agreements with The Nature Conservancy dealing with management and inventory of biological resources.

In 1985, Congress authorized the Challenge Cost-Sharing Program to provide BLM with matching funds for fish and wildlife habitat management with the private sector (Almand and Jurs 1989). BLM funds are matched by contributions from the private sector, and BLM scientists have successfully used the funds to improve wildlife and fisheries habitat on lands under its

control. National cooperators in the BLM's Challenge Cost-Sharing program include The Rocky Mountain Elk Foundation, Quail Unlimited, The National Wild Turkey Foundation, the Foundation for North American Wild Sheep, and Trout Unlimited. Field level cooperators include local chapters of Ducks Unlimited, Trout Unlimited, the National Wildlife Federation, The Nature Conservancy, and the Audubon Society. The BLM's Challenge Cost-Sharing program has been an overwhelming success, and Congressional appropriations have increased annually since 1985.

U.S. Forest Service

The USFS is the second largest Federal land manager in terms of area managed with approximately 191 million acres under its control. The primary mission of the USFS is to ensure sustained yields of resources and usages of the National Forest System (NFS) in a manner that does not impair the long-term productivity of the land. Thirty-two percent (60 million acres) of National Forest lands are suitable for timber production, 17 percent (32 million acres) are designated and managed as wilderness areas, 3.8 million acres are managed as part of the National Grassland System, and the remaining 94.2 million acres (49 percent) are managed for a variety of land uses or have been placed in protective management (West 1990; The Keystone Center 1991).

In 1897, Congress passed the Organic Administration Act, which created the National Forest Reserves. The Nation's timber resources had been over utilized, and Congress felt the need to protect some of the remaining forest lands. This act not only established the forest reserves system, but also mandated that these lands be managed to "improve and protect the forest within the boundaries, to secure favorable flows of water, and to furnish a continuous supply of timber for the use of the citizens of the United States..." Approximately 13 million acres on 15 forests were set aside as part of the reserve system, and commercial logging was prohibited (Wengert, Dyer, and Deutsh 1979). Responsibility for the management of the National Forest Reserves was delegated to the Department of the Interior. In 1905, the Forest Reserve Transfer Act established the USFS as part of the Department of Agriculture and transferred the responsibility for managing all National Forest Reserve lands to USFS. The Weeks Act of 1911, the Clark-McNary Reforestation Act (1924), and the McNary-McSweeney Reforestation Act (1928) provided for the purchase of additional forested lands (later to become the eastern National Forests), the establishment of cooperative forest and rangeland programs with private entities, and the development of a USFS forest and rangeland research program (Greenfield 1975; Mulhern 1978).

The Multiple Use Sustained Yield Act (MUSY) of 1960 further clarified the purpose and use of the National Forest System when Congress stated that forests be maintained and administered for recreation, range, timber, watershed, and wildlife management. The integrated management of biological resources on Federal lands was mandated in 1976 when Congress passed the National

Forest Management Act (NFMA). The NFMA directed the USFS to develop and implement integrated management plans for natural resources under its control. Guidance for preparing these integrated, multiple-use resource management plans was provided in section 219 of the Code of Federal Regulations. More specifically, the NFMA directed the USFS “to manage habitats to maintain viable populations of native and desired non-native species, well distributed throughout their geographic ranges in the national forests and national grasslands, and to protect and restore natural biological communities.” In 1974, the Forest and Rangeland Renewable Resources Research Act (RPA) called for regularly scheduled assessments and status reports concerning the welfare of forest and range resources managed by the USFS (USDA-Forest Service 1985; Shands 1986; Mills and Snellgrove 1990; Robertson 1990; USDA-Forest Service 1990).

Inventory

Forest Service inventories of lands under its control are usually directed toward the timber resource but inventories of wildlife populations and habitats and vegetative communities are also accomplished on a periodic basis (Brouha 1987). The USFS has recognized the need for more efficient, integrated methods of collecting and maintaining biological resource information for lands under its control. The Forest Service has already made a commitment to developing integrated inventory procedures for gathering more complete data sets on all ecosystem attributes and not just a select, economically important few (The Keystone Center 1991).

Monitoring

The monitoring program of the USFS is primarily directed towards determining the following: (a) if practices included in forest management plans are being implemented as designed (implementation monitoring), (b) if the prescribed techniques/practices are achieving the intended goals of the management plan (effectiveness monitoring), and (c) if the techniques/practices prescribed in forest management plans are valid and scientifically sound (validation monitoring) (The Keystone Center 1991). Threatened/endangered species monitoring plans are distinct from the above monitoring programs and are designed to collect information on the following: (a) presence and distribution of threatened/endangered species, and (b) long-term population levels (i.e., population trends and status, reproductive status, etc.). In recent years, the USFS has also assumed responsibilities for monitoring wilderness area campsites (Cole 1983).

Data management

The Forest Service has one of the largest integrated computer networks in the world with approximately 900 Data General computer systems and

approximately 19,000 terminals. The network serves Forest Service personnel at all levels, and users can instantaneously transmit data files, messages, reports, and documents to any other user on the network. Immediate computing plans call for the refinement of the ORACLE relational database management system and the acquisition and integration of GIS technology into their data management systems (The Keystone Center 1991). Present efforts are directed towards evaluating information and data requirements for compliance purposes and a reexamination of field data collection policy and techniques to maximize the acquisition of field data.

Interagency cooperation and coordination

As was the case with the BLM, most USFS interagency coordination is done at the local and regional levels as the need arises. The USFS has entered into cooperative agreements (localized) in several regions with the BLM, the USFWS, and the NPS. These include a cooperative inventory, monitoring, and research program on spotted owl ecology with the BLM, and a grizzly bear management program with the NPS and the USFWS. The Forest Service also works cooperatively with the State Heritage Program in data management of rare species and sensitive ecosystems and the identification of potential USFS Research Natural Areas (RNA) (Burns 1983; Koeln, Konrad, and Muchoney 1991). The Nature Conservancy (NC) works cooperatively with the Forest Service in many areas to share administration and planning costs associated with establishing new/additional RNA's.

U.S. Fish and Wildlife Service

The USFWS is responsible for the management of approximately 90 million acres of land in the public domain. However, 85 percent of USFWS lands are located in Alaska on 16 refuges. USFWS lands include 450 national wildlife refuges, 150 waterfowl management areas, and 55 coordination areas. The mission of the USFWS can broadly be defined as the long-term protection, conservation, and enhancement of fish and wildlife populations and habitats (Doty 1987; Andreasen 1989; The Keystone Center 1991). The USFWS is responsible for the National Wildlife Refuge system, the National Fish Hatcheries program, the listing and recovery of endangered species populations, research on fish and wildlife populations, and issuing opinions on the potential impacts of Federal, public, and private projects.

Inventory

The USFWS is responsible for inventories of the following: (a) threatened and endangered species, and (b) the vegetation, fish, and wildlife resources and habitats on the National Refuge System. Inventory data are used to determine species distribution, develop species listings, and for habitat classification purposes. Habitat assessments are routinely completed using the Habitat

Evaluation Procedures (HEP) developed by the USFWS (USFWS 1980). Individual refuges keep basic inventory data for resident terrestrial and aquatic species (i.e., fish, wildlife, and plants).

The USFWS is also responsible for conducting inventories of the Nation's wetlands. Early wetland classification and mapping efforts by Shaw and Fredine (1956) gave way to the National Wetlands Inventory (NWI) initiated in 1974 by the USFWS-Office of Biological Services. The NWI program did not become operational until 1979 and had the sole responsibility of providing detailed wetland maps of the entire United States. The finished maps are used to evaluate site-specific land and resource management decisions that could possibly affect the well-being of the Nation's wetland resources and, secondly, to provide national wetland statistics (e.g., areal coverage by type, percent change from year to year) to support the development or alteration of Federal wetland policies and management programs (Wilén 1990). Preliminary findings of the NWI are contained in a USFWS report entitled "Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1950s to 1970s" (USDI-USFWS National Wetlands Inventory Group 1985).

Monitoring

Biological monitoring on USFWS lands is done annually to determine the long-term status of (a) migratory waterfowl and colonial waterbird populations, (b) nongame avian species in terrestrial habitats, (c) wetland communities, (d) anadromous fish populations, (e) environmental contaminants, (f) wildlife disease outbreaks, and (g) public use of USFWS lands. The USFWS has considerable experience in the monitoring of biological resources, and its National Contaminant Biomonitoring Program (NCBP) is one of the longest running, most extensive biomonitoring programs ever conducted (Andreasen 1989). The USFWS is also responsible for maintaining banding records on migratory species and conducting the annual Breeding Bird Survey.

Interagency cooperation and coordination

The USFWS has many cooperative working agreements with State, Federal, local, and private agencies. Several international treaties dealing with the management and preservation of migratory birds have been developed with Canada, Great Britain, Japan, Mexico, and the Soviet Union (Ladd 1978). The USFWS also cooperates with the U.S. Army Corps of Engineers (USACE), the Environmental Protection Agency (EPA), and the National Marine Fisheries Service (NMFS) on Section 404 (Clean Water Act) permit applications (Platt 1987). USFWS Cooperative Research Units around the nation work cooperatively with Federal, State, and academic interests to provide technical expertise on wildlife management and research. The USFWS is also able to provide input into the management of Federal, State and private lands under the authority of the Sikes Act (DoD lands), Section 7 of the Endangered Species Act, and Section 10/404 of the Rivers and Harbors and the Clean Water Acts.

The Division of Fish and Wildlife Management Assistance of the USFWS provides technical assistance, data facilitation, and resource evaluation expertise to State and Federal agencies and Indian tribes (Starnes 1988).

National Park Service

Congress established the NPS in 1916 to administer the national parks and other areas of special significance included in the Department of the Interior's land inventory. Today, the NPS is responsible for 354 areas (79.8 million acres) in 49 states. These include National Battlefields, Rivers, and Seashores, National Parks, Preserves, Monuments, and Scenic trails. The NPS has two basic responsibilities: (a) to conserve natural resources on lands under its control, and (b) to provide for the continual use of National Park lands by the American public.

Inventory

Biological inventories on NPS lands have focused on developing checklists of native vascular plants, mammals, birds, and fish (Gimbarzevsky 1976). Individual parks have written descriptions or maps of the major vegetation types found within the park, but much of the inventory data for NPS resources are fragmentary (The Keystone Center 1991).

Monitoring

Biological monitoring on NPS facilities has historically been directed towards collecting data on weather, populations (i.e., fish, wildlife, and vegetation), fire hazards (fuel accumulation), reproduction of threatened or endangered species, and human use. Future direction includes the development of monitoring programs based on statistically sound inventory techniques and the development of standardized, park-specific guidance manuals detailing monitoring procedures (i.e., methods and techniques) and data analysis. Future monitoring of biological resources on NPS lands will be directed toward select indicator species, which NPS officials feel will be indicative of the general health and vigor of NPS ecosystems (The Keystone Center 1991).

3 Status of Natural Resource Inventory and Management Programs on DoD Installations

The approach to resource management on Federal lands has changed drastically in the past 10 to 15 years. The government has placed mandates on Federal land managers to ensure that lands under their control are managed in a sustainable, multiple-use manner with equal consideration being given to all resources and not just a select, economically important few. Management practices that favor any particular resource(s) at the expense of another are now discouraged and can result in serious repercussions. Resource managers who once were free to design their own inventory programs are now finding that their resource-specific inventories do not provide them with the range of data necessary to manage DoD biological resources in a manner consistent with current environmental statutes.

The LRMP has attempted to address this issue by first conducting a survey of DoD installations with large-scale natural resource management programs. Installations were surveyed to determine personnel qualifications, limitations, and needs, and the status of natural resource databases available to installation level biological resource managers. Installation level resource managers and military personnel were asked to describe their current biological, cultural, and geomorphological databases (i.e., contents, age, and format) in terms of the techniques used on their installations to collect the data, the constraints associated with acquiring these data, the type(s) of data collected on resources under their control, and the techniques used to manage these resources.

Response to the survey was variable, but one common concern voiced throughout the natural resources section was the lack of trained natural resource professionals available at the installation level. Fifty-one percent of the installation level natural resource managers did not consider their staffing levels to be adequate for managing the resources under their control. Sixty-one percent of the responding installations had only one full-time staff member involved in natural resource management. Twenty-nine percent had less than five full-time personnel dedicated to natural resource management, and seven

percent of the responding installations had from five to fifteen full-time natural resource personnel. Three percent of the responding installations indicated that they had more than fifteen full-time personnel involved in natural resource management.

When asked about problems associated with the inventory of natural resources on their installations, 55 percent of the installation level resource managers indicated that staffing constraints most affected their ability to collect resource data. Forty-eight percent indicated that lack of funding for natural resource inventories affected their ability to conduct inventories, and twenty-three percent indicated that lack of expertise/guidance hampered their inventory efforts.

Prior to conducting the survey, a list of widely accepted variables, data collection techniques, and management practices was developed by WES researchers using widely accepted reference sources and informal interviews with installation level natural resource specialists, other State and Federal resource management personnel, and DoD research leaders. Since the survey could not adequately address the inventory and management of all biological resources at DoD facilities, a decision was made a priori to address only those resources managed on the majority of DoD installations. It was hoped that commonalities would be noted in the type(s) of data collected and the techniques used to gather these data.

Forest Resources

The forest management section of the LRMP survey was completed only by DoD installations with extensive timber assets and/or outleases and a timber management plan distinct from the installation's natural resource management plan. The average size of installations responding to this section was 17,690 acres. The information on timber management and data collection on smaller installations is extremely useful and will undoubtedly provide vital input into the Legacy program, but the large-scale resource management programs on the larger installations would have provided better insight into DoD-wide natural resources management. A future survey of installations with large-scale timber management programs may be warranted to provide a more accurate account of timber management on DoD lands.

Forest inventory

One of the most interesting findings of the survey addresses the inventory of commercial forest lands on DoD lands. One hundred and fifty-seven installations indicated that currently managed commercial forest lands exist on their installations. Fifty-one percent of these installations (with active forest management programs) have had their commercial forest lands inventoried. Forty-three percent had not been inventoried for timber resources, and six percent did not know the status of their timber inventory.

When asked about the type of inventory system used in their forest management program and the types of data collected for forest management purposes, 74 installations responded. Fifty-eight percent of the installations used a standardized forest inventory system, and forty-two percent used a locally designed, installation-specific inventory system.

A list of 21 commonly measured variables was included in this section of the survey, and installation-level forest management personnel were asked to select the ones they most often used to make forest management decisions. Eighty-seven installations responded to this section of the survey. Basal area and species composition were the most commonly used parameters in DoD forest management programs. Basal area and species composition were used on 69 percent of the installations responding to this section of the survey. Volume and diameter at breast height were used on 67 percent of the installations; and tree height, density, and stocking were used on 63, 62, and 54 percent of the installations, respectively. Growth rate, stand condition, form class, and soils data were used on 54, 49, and 45 percent of the installations, respectively. Tree quality and hydrology-watershed data were used on 41 and 25 percent of the responding installations, respectively.

When asked about additional natural resources data collected during their timber inventories, 44 percent of the installations indicated that they collected wildlife data concurrently with forest inventories, 32 percent collected wetland information, and 26 percent collected no additional natural resource data during their forest inventories. Watershed, range, and other data were collected on less than 10 percent of the installations responding.

Forest management

When asked about the type(s) of silvicultural systems used on DoD installations, 87 installations responded. Clear-cutting was the most often used high forest silvicultural system on DoD lands with 52 percent of the installations responding to the survey indicating that they regularly used clear-cutting in the forest management program. The next most common high forest silvicultural systems in use on DoD lands were the seed-tree and selection methods, with 44 of the responding installations indicating that they regularly used both methods. Shelterwood systems were used on 31 percent of the installations surveyed. Low forest silvicultural systems appear to be rarely used on DoD lands. Simple coppice methods were used on 17 percent of the installations surveyed, and coppice with standards was used on 3 percent of the facilities.

Timber stand improvement (TSI) techniques on DoD facilities included thinning, release cuts, improvement cuts, salvage cuts, and sanitation cuts. Thinnings were the most common TSI technique practiced on DoD lands with 62 percent of the responding installations reporting that they regularly used thinning in their forest management program. Other TSI techniques used on DoD lands included salvage cuts, improvement cuts, and release cuts. Fifty-three percent of the installations with active forest management programs used

salvage cutting, and forty-seven percent used improvement cutting as part of their forest management program. Forty percent of the installations used release cutting to improve stand conditions.

Site preparation techniques used on DoD lands included prescribed burning, roller-chopping, disking, crushing, bedding, and terracing. Prescribed burning and chopping were the preferred site preparation techniques used on DoD lands with 34 and 23 percent, respectively, of the responding installations indicating that they regularly used these techniques in their forest management program. The use of disking, crushing, bedding, terracing, and chemical site preparation methods was low on DoD lands, and these methods were used only on 15 of the responding installations.

Regeneration of commercial forest lands on DoD installations was most often accomplished by natural means. Natural regeneration methods (i.e., seed-tree cuts and shelterwood cuts) were used on 50 percent of the installations responding to the survey. Installation forest management personnel indicated that 28 percent of lands under their control were regenerated naturally and 23 percent were regenerated artificially. Seed-tree techniques were used on 28 percent of the installations using natural methods, and shelterwood cuts were practiced by 22 percent of the installations using natural methods. Machine planting was used by 29 percent of the installations using artificial techniques, and hand planting was done on 39 percent of the installations regenerating commercial forests artificially.

Wildlife Resources

The wildlife and fisheries section of the survey was completed only by installations with active fish and wildlife management programs distinct from the installations's natural resource management plan. Installation-level fisheries and wildlife biologists were asked to describe their wildlife and fisheries management practices and programs and the types and uses of data collected on their installations.

Wildlife inventory

One hundred and ninety-nine installations with active fish and wildlife management programs responded to this section of the survey. Seventy percent of these installations indicated that wildlife and fisheries resources on their installations had been inventoried to some degree. Of the 140 installations indicating that wildlife and fisheries resources had been inventoried, 38 percent had been completely inventoried, and 33 percent had been partially inventoried. Twenty-six percent of all responding installations had no fish and wildlife inventory data, and 3 percent did not know the status of their fish and wildlife inventory program.

The presence of threatened, endangered, and special interest species often present unique challenges for resource managers on DoD lands. Managers must know the distribution and density of these species in order to develop management plans that provide for their protection and continual survival in the military environment. Inventories of threatened, endangered, or special interest plants and animals are necessary to provide resource managers with the data needed to develop long-term management plans. A series of questions were developed to query installations about the status of their threatened, endangered species inventory program. One hundred and ninety-three installations responded to this section of the survey. Seventy-six percent of the installations indicated that these species had been inventoried to varying degrees on their installations. However, only 46 percent of these had complete inventories of threatened, endangered, or special interest species, and 30 percent had partial, incomplete inventories. Twenty percent had no inventory data on threatened/endangered species, and four percent did not know the status of their endangered species inventory program.

When asked about inventories of nongame species, 197 installations responded. Inventories of nongame species had been completed on 30 percent of the installations. Twenty-nine percent indicated that they had partial inventory data for nongame species on their installation, thirty-two percent had no inventory data, and nine percent did not know the status of their nongame inventory programs.

Wildlife inventory data were divided into two categories in the survey: habitat and population. A list of commonly measured habitat variables was developed, and installation personnel were asked to select the parameters they most often measured (or estimated) and used to develop installation wildlife management plans. One hundred and six installations responded to this section of the survey.

Species composition (vegetation) was the most common habitat parameter measured by wildlife biologists on installations responding to the survey. Forty-six percent of the installations indicated that species composition was used to make wildlife management decisions. Areal coverage by habitat type was the second most common habitat variable used by DoD wildlife managers to make management decisions. Forty-five percent of installation biologists responding to this question indicated that area within each habitat type was important in the development of installation wildlife management plans. The third most common parameter measured or estimated by installation wildlife personnel was cover. Thirty-seven percent of installation biologists responding to this question indicated that measurements of cover were important in developing wildlife management plans. Other important habitat parameters measured on DoD lands and the percentage of responding installations measuring these parameters included stocking rates (27 percent), soils data (23 percent), density (21 percent), plant/tree height (20 percent), presence or absence of cavity trees and snags (19 percent), basal area (18 percent), stem diameters (15 percent), edge length and distance to critical habitat (12 percent), number of snags per acre (11 percent), and canopy area (10 percent). The remaining

parameters were incidental and were probably species-specific variables measured on certain installations.

Population data are extremely important for wildlife biologists in planning harvest strategies, habitat management, and population-damage control programs. A list of 12 population measurements was developed, and installation biologists were asked to select the parameters that they most often measured or estimated to make population management decisions. Forty-eight percent of the installation biologists indicated that data related to determining trends in population growth were most important in making population management decisions. Population size was the second most common statistic used by installation biologists for population management decisions and was used by 45 percent of the installations responding to the survey. Other commonly used population measurements and the percentage of installations using each included density (38 percent), age class (37 percent), sex ratios (36 percent), mortality (34 percent), reproductive rates (33 percent), survival rates (18 percent), fecundity (15 percent), and recruitment (14 percent). Natality (9 percent) and emigration/immigration (8 percent) were used on less than 10 percent of the installations responding to the survey.

Estimating size and density of wildlife populations is usually a difficult, time-consuming task, and the census techniques used to estimate density are often applied differently on a case-by-case basis. Census techniques were divided into two categories for the purpose of the survey: direct census techniques and indirect census techniques. Of the direct census techniques included in the survey, the most commonly used was casual observations made by field personnel. Observation counts were used on 46 percent of the installations responding to the survey. Other direct census techniques used by installation biologists and the percentage of installations using each technique included road surveys (36 percent), spotlight counts (35 percent), aerial surveys (23 percent), time-area counts (15 percent), hen-poult counts (13 percent), roost counts (8 percent), flush counts (6 percent), and float counts (3 percent).

The most common indirect census technique used by DoD biologists was the nest box survey. Thirty-six percent of the installation biologists responding to this section of the survey indicated that nest box surveys were regularly used in their wildlife management program. The second most common indirect census technique used on DoD installations was the call count. Call counts were used on 29 percent of the installations involved with the survey. Browse surveys were next on the list and were used on 22 percent of the installations responding to the survey. Other indirect census techniques and the percentage of installations using each technique included track counts (19 percent), nest counts (18 percent), and scent station surveys (15 percent). Den counts, leaf nest counts, lodge counts, scat/pellet group counts, and calling or attracting species to counting areas were used on less than 10 percent of the installations responding to this section of the survey.

Wildlife management

A list of commonly used wildlife management techniques was developed, and installation biologists were asked to select the techniques most often used on their installation. One hundred and six installations responded to this section of the survey. As expected, the most commonly used wildlife management technique on DoD installations responding to the survey included those techniques or practices aimed at managing population levels. Sixty percent of the responding installations indicated that population management was used most often in their wildlife management programs. Wetland management, vegetation control (mechanical), and habitat improvement (nesting habitat) were the next most commonly used management practices and were used on 53, 44, and 42 percent of the installations responding to the survey, respectively. Techniques aimed at enhancing or improving food supplies of resident species were the next most common wildlife management techniques in use on DoD lands. Forty percent of installation biologists indicated that they had some type of food enhancement program in place on their installation. Additional wildlife management techniques and the percentage of installations using each technique included structural improvements (32 percent), cover improvement (30 percent), water management (28 percent), and vegetation control (chemical) (24 percent).

Wildlife damage is a serious problem on some installations; however, 47 percent of the installations responding to this section of the survey indicated that wildlife encounters had little impact on their training mission. The notable exception here is on U.S. Air Force installations where wildlife collisions with aircraft often represent serious threats to military pilots. Fifty percent of all Air Force installations responding to the survey indicated that wildlife encounters had caused significant disruption of their training activities in the past. Thirty-seven percent of the installations surveyed had some type of wildlife damage control program. As expected, this number was higher on Air Force installations, with 46 percent of the Air Force biologists indicating that they had active wildlife damage control programs in place.

The most common population control technique used by installations responding to the survey appears to be trapping. Twenty-eight percent of the installations indicated that the trapping of nuisance wildlife was the most often used technique in their wildlife damage control program. Other control techniques and the percentage of installations using each technique included the following: extermination of problem/nuisance species (27 percent), habitat modification to prevent establishment and growth of nuisance populations (25 percent), hazing/scaring techniques aimed at frightening nuisance species away from critical areas (17 percent), barriers to prevent entry (15 percent), proofing/screening (13 percent), and toxicants (11 percent). Repellents, stressing agents, and other control techniques were used incidentally by a limited number of installations.

Fisheries Resources

Fifty-six installations responded to the fisheries section of the Legacy survey. As with the previous sections, a list of aquatic habitat variables was developed, and installation-level fisheries biologists were asked to select the variables that they most often measured (or estimated) to make management decisions.

Aquatic habitat inventory

Eighteen commonly measured aquatic habitat variables were chosen for inclusion in the survey. DoD fisheries biologists indicated that measurements of pH were most often used on their installations to make fisheries management decisions. Sixty-two percent of the responding installations regularly collect information on water pH. Water temperature and dissolved oxygen, water depth, substrate vegetation, turbidity, light penetrance, and water level fluctuations were the next most commonly used aquatic variables, being collected on 57, 48, 43, 41, 39, and 30 percent of the responding installations, respectively. Other commonly measured aquatic habitat variables and the percentage of installations measuring each variable included the type of riparian vegetation adjacent to the water body (21 percent), substrate characteristics (20 percent), salinity, physical attributes, and food production (14 percent), and in-stream flow (11 percent). Dissolved solids, growing season, and other incidental measurements were made on a small number of installations.

Population dynamics

Population data are critical for biologists responsible for managing fisheries resources on DoD lands. Methods for estimating fish density and relative abundance are varied and somewhat dependent on the species being censused, the geographic location, and the type of water body being censused. Biologists responsible for the management of fisheries resources on DoD lands indicated that density was used most often in making fisheries management decisions.

Forty-three percent of all installations surveyed indicated that density was regularly estimated in the fisheries management program. Weight class, age class, recruitment rates, reproductive rates, and survival rates were the next most common population parameters measured/estimated by DoD fisheries biologists with 39, 36, 23, 16, and 14 percent, respectively, of the responding installations indicating that they regularly estimated or measured each of these parameters. Mortality rates, sex ratios, and other parameters were incidental in the responses and were used on a limited number of installations.

Harvest data also provide fisheries biologists with essential data necessary to successfully manage resident fisheries populations. Length was the most commonly measured species characteristic on installations responding to the survey. Twenty-nine percent of the fisheries biologists indicated that length

was regularly measured during data collection. Additional harvest data and the percentages of installations measuring each attribute included species caught (27 percent), weight (25 percent), sex (9 percent), and age (7 percent).

Population inventory/census methods

The most common method of censusing fish populations on DoD installations responding to the survey was electrofishing. Biologists on 43 percent of the responding installations indicated that they regularly used electrofishing techniques to obtain population data. Other commonly used inventory/census on DoD installations and the percentage of installations using each technique included active netting (29 percent), passive netting (27 percent), and toxicants (9 percent).

Fisheries management

The management of fisheries populations was broken down into two categories for the purposes of the Legacy survey: (a) those practices used for managing the population, and (b) those techniques for managing aquatic habitat(s). The most commonly used population management technique on DoD installations responding to the survey was the stocking of desirable species. Sixty-four percent of the installations had some type of stocking program in their fisheries program. Creel limits were used on 48 percent of the installations responding to the survey as a means of controlling population density and structure. Size limits on managed species and bag restrictions also were used by installation biologists to manage fisheries resources under their control. Forty-six percent of the installations indicated that they regularly used size restrictions and creel limits to manage their fisheries resources. Techniques to monitor and control species composition also were fairly common in DoD fisheries management programs. Thirty-six percent of the installations surveyed indicated that species composition was controlled and monitored as part of their fisheries management program. Predator, parasite, and disease control were also practiced on a few installations, but their numbers were incidental.

Aquatic habitat management techniques used in fisheries programs on DoD lands included plant management and control, techniques designed to improve underwater structure and cover, the regulation of water levels and discharge rates (in lakes, pools, streams, and rivers), and the fertilization and oxygenation of water resources. The most common aquatic habitat management practice used on DoD installations responding to the survey was vegetation control. Forty-four percent of the installations indicated that plant control played a major role in their fisheries management program. Other commonly used habitat management techniques and the percentage of installations using each technique included the following: improving underwater structure (39 percent), regulating water levels (26 percent), fertilizing ponds and lakes

(27 percent), improving the cover component of aquatic habitats (25 percent), and the construction and maintenance of fish ladders (7 percent).

Range Resources

The range management section of the Legacy survey was completed only by installations with large areas of open range and/or outleasements that have the potential for commercial grazing. Forty-five installations responded to the range management section of the survey. Seven installations indicated that range management was not part of their natural resources program, and nineteen installations did not have range management plans distinct from the installation's natural resource management plan. Twenty-nine percent of the responding installations had active range management programs in place, and one installation was developing a range management plan at the time of the survey. Eighty-one percent of the installations with range management programs allowed grazing, and thirteen percent did not. Cattle and horses were the only livestock utilizing DoD lands. Forty-two percent of the installations grazed cattle, and thirty-two percent grazed horses.

Range inventory

A list of seven variables commonly used by range scientists to estimate the status of range resources was included in this section of the survey. Installation-level range management specialists were asked to select the variables that they most often measured or estimated to determine the condition of range management units under their control.

Range condition was the most common parameter used to evaluate the potential of range management units. Range condition is usually determined by collecting data on several range variables describing existing vegetation and then factoring each into a weighted equation that estimates the overall ecological condition of the range. Other variables used by DoD range scientists to evaluate range condition included biomass, species composition (vegetation), density of indicator plants, frequency of indicator plants, and areal coverage by range/vegetation type.

Species composition and biomass were measured on 24 percent of the installations responding to the survey and were the second most commonly used variables to estimate range condition. Other important range parameters commonly used on DoD installations (in decreasing order of use by DoD range scientists/managers) and the percentage of responding installations using each measurement to make range management decisions included areal coverage (18 percent), frequency of indicator species (13 percent), and density of indicator species (8 percent). Sampling methods used to obtain these data included paired plots, exclosures, and quadrats. Quadrats were used on 16 percent of the installations involved in the survey, and paired plots and exclosures were each used on 14 percent of the installations.

Range management

Grazing systems currently in use on DoD lands included the continuous system, the deferred-rotation system, the rest-rotation system, the short-duration system, the seasonal suitability system, the high-intensity low-frequency system, and combinations of the above systems. The most common grazing system used by DoD range scientists was the rest-rotation system, which was used on 24 percent of the responding installations. The second most common grazing system in use on DoD lands was the continuous-grazing system, which was used on 18 percent of the installations with range management programs. The seasonal-suitability system was next on the list (16 percent of responding installations) and was closely followed by the deferred-rotation system, which was used on 11 percent of these installations. Other grazing systems currently used by DoD range scientists and the percentage of installations using each system included the short-duration system (8 percent) and the high-intensity low-frequency system (3 percent). Eleven percent of the installations used combinations of the above grazing systems.

Controlling the distribution of livestock within range management units is crucial to managers responsible for range resources. Range managers can use a variety of techniques to evenly distribute livestock use throughout range management units under their control. This ensures that the entire area will be used by resident livestock and helps to protect the vigor of range management units by prohibiting overuse of small areas.

The most common method used to control livestock distribution on DoD lands appears to be the location of watering facilities. Thirty-nine percent of the installations indicated that the placement of watering holes was regularly used to control the distribution of livestock on range management units. Location of feed lots within management units was the next most commonly used technique, with 24 percent of the respondents indicating that they regularly used this practice for controlling the distribution of livestock on lands under their control. Other commonly used techniques and the percentage of installations using each technique included herding practices (18 percent), the use of grazing systems (16 percent), the breed of livestock (foraging behavior) allowed to use management units (13 percent), range fertilization to produce more preferred forage (5 percent), and controlled burning and location of shade areas (3 percent).

Control and manipulation of range vegetation is another extremely important aspect of any range management program. Range managers must constantly manipulate range vegetation to maintain and produce nutritious, palatable forage for livestock grazed on the area. A list of control methods commonly used in range management situations was included in this section of the survey, and installation-level range scientists were asked to select the method(s) they most often used.

Grazing was the most common response to this question with 50 percent of the installations indicating that grazing pressure alone was enough to control

vegetation in range management units under their control. Other vegetation control techniques and the percentage of the responding installations included mechanical control (32 percent), controlled burning (24 percent), chemical control (21 percent), fire control/exclusion (13 percent), and biological control techniques (5 percent).

4 Biological Resources Workshop Results

Background

The second major component for Biological Resources Program Development was a workshop held in Denver, CO, in May 1992, to address the management of biological resources on DoD lands. The workshop was organized by researchers in the Natural Resources Division (Stewardship Branch) of the WES.

Participants included a variety of natural resources managers from Federal, State, and private agencies. The goal of the workshop was to gather information on the status, needs, and future direction of natural resource programs on DoD facilities. This forum offered a better opportunity to explore issues such as policy, staffing, and funding that could not adequately be addressed in the survey of installations.

Participants were from all branches of the U.S. military, BLM, USFWS, USFS, NPS, the Illinois Department of Conservation, and The Nature Conservancy (TNC). DoD participants included service, major command, and installation-level natural resource professionals, such as foresters, agronomists, ecologists, biologists, and range scientists. Initially, participation in the workshop was limited to approximately 45 individuals because of logistics, resources, and the complexity of issues chosen for discussion. Table 1 shows the matrix that was used in the initial selection process to ensure appropriate representation across all services and at all levels in the chain of command. Because of conflicts and last minute cancellations, the actual attendance was reduced to 37. Of these, nine were Army, seven were Air Force, three were Navy, four were Marine Corps, and five were from outside agencies. Nine of the attendees were facilitators/recorders from WES, other Task Area Managers, and Engineering and Housing Support Center (Headquarters (HQ) Army) staff. A complete listing of workshop organizers, speakers, and participants is provided in Appendix B.

**Table 1
Participant Matrix for Biological Resources Workshop Held in
Denver, CO, in May 1992**

	Army	Air Force	Navy	Marines
HQ	1	1	1	1
MACOM/TRADOC	1	1	-	-
Installations	10	6	5	4
NGB	1	1	-	-
WES	5	-	-	-
Totals	18	9	6	5
Outside Agencies				
USFS	- 2			
USFWS	- 2			
BLM	- 1			
NPS	- 1			
State	- 1			
TNC	- 2			
TOTAL	9			
Projected Total Attendance: 47				
Note: MACOM = Major Army Command; TRADOC = Training and Doctrine Command; NGB = National Guard Bureau.				

Methods

The Nominal Group Technique (NGT) (Brademas 1989) was modified and used during the workshop to allow participants to discuss and decide on the most important aspects and needs of DoD's natural resource program. The NGT is designed to solicit input from large heterogeneous groups of people and is especially effective for allowing the exchange of ideas and viewpoints between diverse groups familiar with the chosen topics. The technique is most often used to identify problems, explore solutions to those problems, and establish priorities for solving high priority problems (Delbecq, Van de Ven, and Gustafson 1975).

Discussion groups were organized a priori, and a facilitator and recorder were appointed for each group. Facilitators were selected based on their familiarity with the Legacy program and their experience in biological, cultural, and earth resources in military environments. They were tasked with moderating the individual group discussions and then helping to relate the information from their discussion groups in the plenary sessions. Discussion groups included natural resources personnel from all branches of the armed forces and from each of the various disciplines within the natural resources arena. The goal was to construct representative groups from various disciplines and

geographic regions to avoid bias towards any one region, discipline, or branch of the armed service. A listing of discussion groups and moderators is provided in Appendix C.

The workshop was divided into five distinct sessions, with a separate topic to be discussed in each session. Although each topic was different, they were selected and organized so that a logical progression would result. Major topics for discussion were developed prior to the workshop after extensive conversations with DoD research scientists, installation level resource managers, and other Legacy Task Area Managers. Each discussion session was preceded by a short, informal presentation by one or more of the participants in order to precipitate discussion in the individual work group sessions. Major topical areas chosen for discussion at the workshop included the following: (a) the stewardship of natural resources on DoD lands, (b) current policy and issues affecting the management of natural resources on DoD facilities, (c) the structure and organization of DoD natural resources management programs, (d) the opportunities for interagency partnerships with other Federal, State, and private agencies, and (e) the future direction and needs of DoD natural resources management programs.

Workshop participants were familiarized with the NGT, and individual group leaders were provided with discussion topics. Discussion groups then met individually and developed a list of items that they felt were most relevant to the topic under discussion. Group leaders compiled these items, and each individual in the group voted for his or her top three items of concern. These items were compiled and reported back to the plenary session for discussion. In the plenary session, the top items from individual groups were compiled by the workshop moderator, and the entire group was asked to select those they considered to be the most relevant. The workshop and group facilitators were available throughout the workshop to clarify confusing issues and keep group and plenary discussions focused on the workshop objectives.

Session 1: Stewardship

The first topical area addressed during the workshop was stewardship and the elements necessary for good stewardship of biological resources on DoD lands. Speaker topics for this session included the concept (definition and philosophy) of good stewardship on DoD lands, the approach to long-term ecosystem management, and the integration of natural resources management plans.

Group discussions on the stewardship of natural resources on DoD lands resulted in the compilation of approximately 14 issues that DoD resource managers felt were most important for the successful completion of their missions (Appendix D). The issues voted most important by workshop participants included the following: (a) better command support at all levels for natural resources programs (to include funding for additional professional positions), (b) better definition and understanding of the resources to be managed

(additional surveys and inventories) and the interactions between them, (c) the need to integrate natural resources management plans into installation operational and training plans, and (d) the establishment and maintenance of command level support for natural resource programs (i.e., staffing and funding requirements and the necessary equipment, supplies, and facilities to carry out their mission).

Session 2: Policy issues

The second session addressed policy issues that affect the ability to manage natural resources under DoD control. Speaker topics for this session included the following: (a) the effects of compliance on good stewardship and management, (b) the key issues that cause problems with compliance (especially in situations where there are multiple compliances), and (c) whether or not compliance is synonymous with good stewardship. Group discussion of the compliance issue overwhelmingly indicated that the single most important factor in compliance was the need for a genuine command commitment to policy accountability (Appendix E). Other areas of concern included (a) the need for a formalized mechanism for accountability at all levels of DoD, (b) the lack of resources (i.e., manpower, funding, equipment, facilities, etc.) necessary for proper implementation of natural resources policy, and (c) the requirement that natural resources programs on DoD installations be financially self-sustaining.

Session 3: Structure and organization

The third issue addressed by workshop participants was the current structure and organization of DoD natural resources programs. Participants were asked if the current structure/organization of DoD natural resource programs was adequate to meet the criteria and philosophy of integrated management. Speaker topics in this session included (a) an overview of current structure/organization, (b) law enforcement, (c) support and stability of current organizational structure, and (d) the need for professional development and continuing education of DoD natural resources managers. The most important concern voiced by workshop participants was the current structure of DoD natural resource management programs (Appendix F). Participants felt that natural resources and environmental staffs should be removed from the civil engineering directorate and elevated to its own directorate or to the Deputy Chief of Staff (DCS) level. Participants also suggested that an environmental directorate be established that is staffed by trained natural resource professionals with direct access (chain of command) to the installation directorate. Other key issues included the following: (a) relief from the current hiring freeze, (b) the establishment of grade structures and staffing levels that are commensurate with other professional positions within DoD, and (c) the need for HQ/DoD natural resource specialists to provide guidance for installations and intermediate echelons.

Session 4: Opportunities

A critical element of the Legacy workshop was the discussion of opportunities available to DoD land managers for acquiring resource management expertise from other Federal, State, and private sources. Speakers in this session included representatives from Federal, State, and private natural resource management agencies, and presentations centered around the inter-agency management opportunities available to DoD land managers. Participants indicated that interagency cooperation in natural resources management could possibly supplement their understaffed natural resource departments and at the same time provide DoD additional expertise necessary to properly manage the resources under their control.

Participants were asked to list the critical requirements and potential opportunities for accomplishing their missions in an environment of reduced staffing and funding. Discussions from the plenary sessions indicated that DoD could alleviate some of their staffing problems (i.e., lack of expertise) by developing interagency, cooperative agreements and partnerships (e.g., cooperative research agreements, matching funds and cost-sharing programs with Federal, State, and private agencies, and intergovernmental personnel agreements between Federal and State agencies and universities) and volunteer programs (Appendix G). A second issue of importance was the need to develop a DoD-wide initiative designed to promote an increase in natural resources funding and staffing. Participants also felt that new manpower standards need to be developed before DoD land/natural resource managers can realistically support their natural resources mission. Another suggestion for alleviating the personnel shortage at individual installations involved the use of military personnel and equipment in the natural resources program.

Session 5: Future directions

The last session of the workshop was designed to allow participants to voice their opinions and ideas on the future direction of natural resources management on DoD facilities. Participants were asked, if given the opportunity, what elements of DoD's natural resource management program would they include, change, or restructure. Speaker topics focused on the effects of changes within the military mission (the ongoing base realignment and closure program - BRAC) on the management of natural resources. Representatives from the USFWS and DoD provided participants with a perspective on how DoD could better inform and educate the American public about its environmental decisions and land-management practices.

Two issues evolved from this section of the workshop: (a) the need for continual environmental education and training programs for DoD civilian and military employees, and (b) the need for adequate staffing, funding, and professional grade levels in DoD natural resource programs (Appendix H). Participants suggested the development of continuing environmental education

programs (entry level and refresher) for both military (officers and noncommissioned officers) and civilian employees.

5 Demonstration Program

The third critical component of the Biological Resources Task Area is the field demonstration program. The demonstration program was developed to support natural and cultural resources management in a military environment and included input from field level resource specialists from all branches of the military. Project proposals detailing installation-level natural resource issues were solicited from field personnel instructed to design projects that would address current and future installation-level natural resource problems. In fiscal year (FY) 1991 and 1992, appropriations from Legacy were used to fund demonstration projects on approximately 127 installations from all branches of the U.S. military (Appendix I).

Initially, these demonstration projects were not directly linked to the Task Area Development work. However, as the program matured, each Task Area Manager was asked to become more involved in the demonstration program by providing review and recommendations on the selection of new projects. This evaluation and selection process considered the objectives and benefits of the proposed projects, the overall approach, and the location. The following questions were used as guidelines in the evaluation process:

- a.* Does the project have wide application, or is it strictly installation specific?
- b.* Does it address multiple issues or task areas?
- c.* Does it address an urgent need?
- d.* What is the status of other work on the subject?
- e.* Can it be linked to other Legacy projects?
- f.* Is it covered under other programs?
- g.* Are costs and approach reasonable?
- h.* Is it strictly a compliance project, or a project conceived because money is suddenly available?

- i.* Is the project out of sequence—i.e., should it be funded later in the Legacy process, after some initial work has been completed in other projects?

Demonstration projects from FY91 and FY92 were grouped into broad categories so that a basic analysis of the demonstration project program could be done to determine the following: (a) how demonstration projects would lead to a better understanding of the problems encountered by natural resource managers on military installations, (b) how demonstration projects will add to the current “state-of-knowledge” concerning natural resource management on military lands, and (c) how this “new” knowledge will relate back to the Task Area and aid researchers in accomplishing the goals set by the Legacy program.

In FY91, 46 demonstration projects relating directly to biological resources were established on approximately 35 different installations. These projects were initiated on 18 U.S. Army installations, 9 U.S. Air Force bases, 4 naval installations, and 4 U.S. Marine Corps facilities. Projects addressed a wide variety of natural resource issues, were located in several geographic regions (27 states), and were grouped into the following categories for Biological Resources Program Development purposes: (a) habitat studies (creation-replacement, preservation-protection, and restoration-enhancement-improvement), (b) natural resource surveys/inventories, (c) general natural resource management studies, and (d) studies designed to evaluate the effects of military operations on natural resources. Tables 2-5 show these projects as they are grouped under each category.

In FY92, Legacy funds were used to start additional demonstration projects. A total of 142 new demonstration projects were funded in FY92 that addressed biological resources. These projects were similar to the FY91 demonstration projects, but covered a more diverse set of topics and were implemented on a much broader scale than were FY91 projects.

The 142 demonstration projects funded through Legacy in FY92 were grouped into the original categories from FY91, plus three new ones. These include the following: (a) habitat studies, (b) natural resource inventory/survey projects, (c) natural resource management projects, (d) the integration of GIS technology into DoD natural resource management programs, (e) biodiversity projects, and (f) general ecological studies/investigations of individual species and habitats. Tables 6-11 show the FY92 demonstration projects grouped by category.

FY92 demonstration projects were scheduled to be carried out on 92 installations in 46 states. Currently, demonstration projects are underway on 46 Army installations, 27 Air Force bases, 15 naval bases, and 4 U.S. Marine Corps facilities.

**Table 2
FY91 Legacy Demonstration Projects Involving Habitat
Improvement, Restoration, Replacement, and Protection**

Type of Study	Location
Habitat replacement - Least Bell's Vireo	Camp Pendleton, CA
Improve habitat for Stephen's kangaroo rat (mitigation)	Camp Pendleton, CA
Improve wetland-estuary-tidal marsh habitat for endangered species	Mare Island, CA
Restoration/revegetation of endangered species habitat	Fort Bragg, NC
Protection/monitoring of rare plant habitat	Mountain Home, ID
Protection/management of endangered plants	FE Warren AFB, WY
Propagation of endangered plants for reintroduction	Pohakuloa, HI
Restoration of bottomland hardwood wetland ecosystem	Barksdale AFB, LA
Restoration of habitat destroyed by Hurricane Hugo	Charleston NWS, SC
Improve marsh/wetland areas for migratory waterfowl	Camp LeJune, NC
Restore damaged terrestrial habitat	Quantico, VA
Create wetlands to improve biodiversity	Fort Riley, KS
Protect/rehabilitate damaged wetlands	Aberdeen Proving Ground, MD
Acquire native prairie plants for Huffman Flying Field restoration	Wright-Patterson AFB, OH
Erosion control/land reclamation	Letterkenney Army Depot, PA

**Table 3
FY91 Legacy Demonstration Projects Involving the Survey/
Inventory of Natural Resources on DoD Lands**

Type of Study	Location
Survey of rare plants/animals	Cherry Point MCAS, NJ
Inventory of rare plants and natural communities	U.S. Air Force Academy, CO
Survey of endangered/threatened species	Letterkenney Army Depot, PA
Survey of rare plants	Quantico, VA
Inventory of rare species and riparian zones	Vandenburg AFB, CA
Survey distribution of possible endangered turtle species	Fort Lewis, WA
Survey distribution and taxonomic status of rare plants	Fort Hood, TX
Survey endangered/threatened/protected plants and animals	Fort Knox, KY
Survey rare/protected cave dwelling fauna	Fort Hood, TX
Endangered species survey of areas likely to be disturbed by training	Fort Chaffee, AR
Field inventories of endangered/threatened plant and animal species	Pohakuloa, HI
Survey of Federally listed plant species	Eglin AFB, FL
Survey of rare plants and animals for development of management plans	Schofield Barracks, HI
Survey of endangered/threatened/rare plants and animals	Holston Army Ammunition Plant, TN
Inventory/management of tall-grass prairie	Wright-Patterson AFB, OH
Inventory population and distribution of seabirds of San Nicholas Island	Point Mugu, CA
Inventory/map wetlands	Fort McClellan, AL
Develop prototype inventory methodology for urban forests	Lackland AFB, TX
Survey floodplain habitats/species	Lackland AFB, TX
Survey breeding habitat of candidate bird species	Yakima TC, WA
Biological resource inventory	Loring AFB, ME
Biological resource inventory	Arnold AFB, TN

**Table 4
FY91 Legacy Demonstration Projects Investigating Natural
Resource Management on DoD Lands**

Type of Location	Location
Improve natural water supply to enhance wildlife habitat	Yuma Proving Ground, AZ
Construct sedimentation ponds to control sedimentation and provide habitat	Fort Leonard Wood, MO
Repair 14 watering facilities to divert wildlife from training areas	Utah Test Range, UT
Develop and integrate HEP models into GIS system	Quantico, VA
Develop standardized integrated natural resource management procedures/techniques	Fort Polk, LA Fort Hood, TX

**Table 5
FY91 Legacy Demonstration Projects Investigating the Effects of
Military Training on Threatened and Endangered Species**

Type of Study	Location
Evaluate effects of training on candidate plant species	Camp Pendleton, CA
Test/evaluate device for protecting manatees from ships trusters	Kings Bay Submarine Base, GA
Quantify effects of military operations on endangered plant species	Camp Pendleton, CA

**Table 6
FY92 Legacy Demonstration Projects Dealing with Habitat
Improvement, Restoration, Replacement, and Protection**

Type of Study	Location
Rare plant population/protection modeling	Presidio SF, CA
Wetland and old growth forest preservation	Jim Creek, WA
Prairie restoration	Twin Cities Army Ammunition Plant, MN
Prairie steppe rehabilitation	Fort Lewis, WA
Least tern habitat enhancement	Key West, FL
Red cockaded woodpecker habitat improvement	Charleston, SC
Endangered flora enhancement/protection	Whidbey Island, WA
Sensitive habitat protection	Goldwater AFB, AZ
Manatee habitat improvement	Roosevelt RD, PR
Wetland enhancement	Charleston, SC
Wetland restoration and habitat improvement	LeMoore, CA
Wetland rehabilitation	McClellan AFB, GA
Lake reclamation	Scott AFB, IL
Wetland rehabilitation	Columbus AFB, MS
Wetland restoration	Rangely, ME
Riparian zone restoration	USAE-WES, MS
Rehabilitation of brown trout habitat	Harry Diamond, IL
Sand prairie rehabilitation	Savanna Army Depot, IL
Cedar Glade habitat preservation	Fort Knox, KY
Vernal pool protection	Mirimar, CA
Long-term ecosystem monitoring	Camp Pendleton, CA
Restoration/rehabilitation of natural areas	Brooks AFB, TX
Wetland revegetation	March AFB, CA
Preservation of marine resources	Anderson AFB, Guam
Conservation of forest vertebrates	Quantico, VA
Native plant salvage	Yuma Proving Ground, AZ
White cedar habitat restoration	Dare Co. AFB, NC

**Table 7
FY92 Legacy Demonstration Projects Involving the Survey/
Inventory of Natural Resources on DoD Lands**

Type of Study	Location
Endangered species survey	Indiantown Gap, PA
Survey of rare/endangered plants	Fort Campbell, KY
Inventory of endangered species and enhancement of native communities	Picatiny, NJ
Endangered species survey (2)	Sunflower Army Ammunition Plant, KS
Endangered species survey	Longhorn Army Ammunition Plant, LA
Rare plant survey	Eglin AFB, FL
Endangered species survey	Anniston Army Depot, AL
Rare/endangered plant survey	Milan Army Ammunition Plant, TN
Threatened/endangered plant survey	Redstone Arsenal, AL
Endangered species survey	Tobyhanna Army Depot, PA
Inventory/mapping of endangered natural ecosystems	Fort Lewis, WA
Inventory/protection of endangered-protected species	Makua Military Reservation, HI
Survey of threatened/endangered species	Patuxent River, MD
Sensitive plant inventory	Point Mugu, CA
Monitoring populations of rare plants	Pohakuloa Training Area, HI
Habitat survey and protection	Goldwater AFB, AZ
Development of standardized methodology	DoD wide
Natural area inventory	Dugway Proving Ground, AZ
Biological survey	Volunteer Army Ammunition Plant, TN
Natural resource inventory	Various installations
Biological inventory	Badger Army Ammunition Plant, WI
Biological survey	Raveena Army Ammunition Plant, OH
Natural resource inventory	Fort Bliss, TX
Ecosystem inventory	Nellis AFB, NV
Systematics of potentially undescribed plants	Pohakuloa Training Area, HI
Exotic plant survey	Kaneohe Marine Corps Air Station, HI
Ecological inventory of Dudley's Hammock	Moody AFB, CA
Vegetation inventory	Artamus, KY
<i>(Continued)</i>	

Table 7 (Concluded)	
Type of Study	Location
Vegetation inventory	Clay City, KY
Botanical survey	Seal Beach, CA
Habitat inventory/management	Cannon AFB, NM
Natural community survey	Eglin AFB, FL
Amphibian/reptile survey	Fort McCoy, WI
Inventory of terrestrial vertebrates	Fort Belvoir, VA
Small mammal inventory	Yakima Training Center, WA
Bat survey	Yuma Proving Ground, AZ
Avifauna survey	March AFB, CA
Turtle survey	Fort Devins, MA

**Table 8
FY92 Legacy Demonstration Projects Investigating Natural
Resource Management on DoD Lands**

Type of Study	Location
History of DoD natural resource management	DoD
Fire management workshop	Fort Huachuca, AZ
Program management/Animal Welfare Workshop	CERL, IL
Monitoring the health of DoD lands	Various
Stewardship of natural/cultural resources	Point Mugu, CA
Native grassland management	Avon Park AFB, FL
Integrated natural resource management	Avon Park AFB, FL
Natural Resource Program	Various
Marine mammal monitoring/management	Vandenberg AFB, CA
Sandpiper habitat management	Pease AFB, NH
Avian nesting/perching study	Yakima TC, WA
Brown tree snake control	Guam
Wildlife watering stations	Kirtland AFB, NM
Proactive endangered/threatened species management	Fort Carson, CO
Black-footed ferret management	Pueblo Army Ammunition Depot, CO
Colorado butterfly habitat	Warren AFB, WY
DoD endangered species management plan	DoD wide
Reintroduction of burrowing owls	North Island, CA
Karner blue butterfly study/management	Fort McCoy, WI
Management of threatened/endangered species and biodiversity	DoD wide
Loggerhead shrike recovery	San Clements Island, CA
Ecology, management population, and habitat studies of the California gnatcatcher and cactus wren	Camp Pendleton, CA
Manatee sanctuary	Jacksonville, FL

**Table 9
FY92 Legacy Demonstration Projects Investigating the Ecology
of Select Species on DoD Lands**

Type of Study	Location
Red cockaded woodpecker study	Fort Stewart, GA
Pitcher plant study	Fort Benning, GA
Coyote thistle study	Camp Pendleton CA
Red cockaded woodpecker study	Fort Benning, GA
Bat foraging study	Luke AFB, AZ
Red cockaded woodpecker research	Eglin AFB, FL
Reclamation of dwarf pines	Warren Grove, NJ
Endangered species protection and predator control	Midway Island
Monitoring bat roosting sites	Goldwater AFB, AZ
Desert tortoise research	Edwards AFB, CA
Endangered species study	McAlester AAP, OK
Gopher tortoise research	Fort Benning, GA
Black-footed ferret study	Pueblo AAP, CO
Ecology of the Okoloosa darter	Eglin AFB, FL
Black-footed ferret pre-release study	Warren AFB, WY
Population dynamics of the beach mouse	Tyndall AFB, FL
Ecology of the Florida scrub jay	Avon Park AFB, FL
Flat-tailed horned lizard study	Yuma, AZ
Endangered wetland and fishery habitat	China Lake, CA
Purple loosestrife study	Twin Cities AAP, MN
Exotic plant monitoring/control	Fort McCoy, WI
Post wildfire study	West Camp Rapid, SD
Neotropical bird habitat study	Fort Sill, OK
Herpetological study	Eglin AFB, FL
Bat foraging study	Luke AFB, AZ
Huffman prairie study	Wright-Patterson AFB, OH
Davis peppergrass study	Mountain Home AFB, ID
Tanana Flats wetland study	Fort Wainwright, AK
Natural area study	Fort McClellan, AL
Herpetological study	March AFB, CA
<i>(Continued)</i>	

Table 9 (Concluded)	
Type of Study	Location
Vulture distribution	Colorado
Fort McCoy barrens study	Fort McCoy, WI
Ecology of sea birds on San Nicholas Island	Point Mugu, CA
Ecology of feral cats	San Clements, CA

Table 10 FY92 Legacy Demonstration Projects Investigating the Use of GIS Technology in DoD Natural Resource Management Programs	
Type of Study	Location
GIS support center	Fort Sill, OK
Enhance GIS	Arnold AFB, TN
GIS soil mapping	Vandenberg AFB, CA

Table 11 FY92 Legacy Demonstration Projects Investigating Biodiversity on DoD Lands	
Type of Study	Location
Biodiversity management	CERL
CEQ/EPA Biodiversity Conference	Various
Affects of military operations on biodiversity	DoD wide
Preservation of biodiversity	Vandenberg AFB, CA
DoD/NSF Biodiversity Research Initiative	Multi
Mojave biodiversity and cultural resource data bank	CERL
Regional evaluation of DoD natural resources and biodiversity	DoD wide
Note: NSF = National Science Foundation; CEQ = Council on Environmental Quality.	

Figure 2 shows that the majority (68) of the demonstration project efforts during the initial 2 years of the program have been directed towards the survey/inventory of natural resources on DoD installations. This includes surveys or inventories of threatened, endangered, or sensitive species (both flora and fauna) and habitat types. Forty-four demonstration projects address habitat preservation, protection, improvement, enhancement, or restoration, and thirty-four demonstration projects are underway to provide basic ecological data on locally important species and habitats. Twenty-nine projects relate to natural resources management on DoD facilities (including the management of threatened or endangered species). Thirteen additional studies have been funded to investigate biodiversity, the integration of GIS technology into DoD natural resource management programs, and the effects of military operations on natural-biological resources.

This early emphasis on data collection will aid field-level natural resource personnel in making day-to-day natural resource management decisions. It will also serve to reinforce DoD's commitment to stewardship of the resources under its control by providing resource management personnel with the most recent, up-to-date data for use in making natural resources management decisions. The threatened/endangered species surveys and inventories will not only provide excellent baseline data on the status and distribution of threatened or endangered species and habitats, but will also demonstrate to other Federal agencies (i.e., U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, etc.) and private environmental groups that the DoD is committed to becoming a leader in natural resources management. Inventories of threatened and endangered species should also

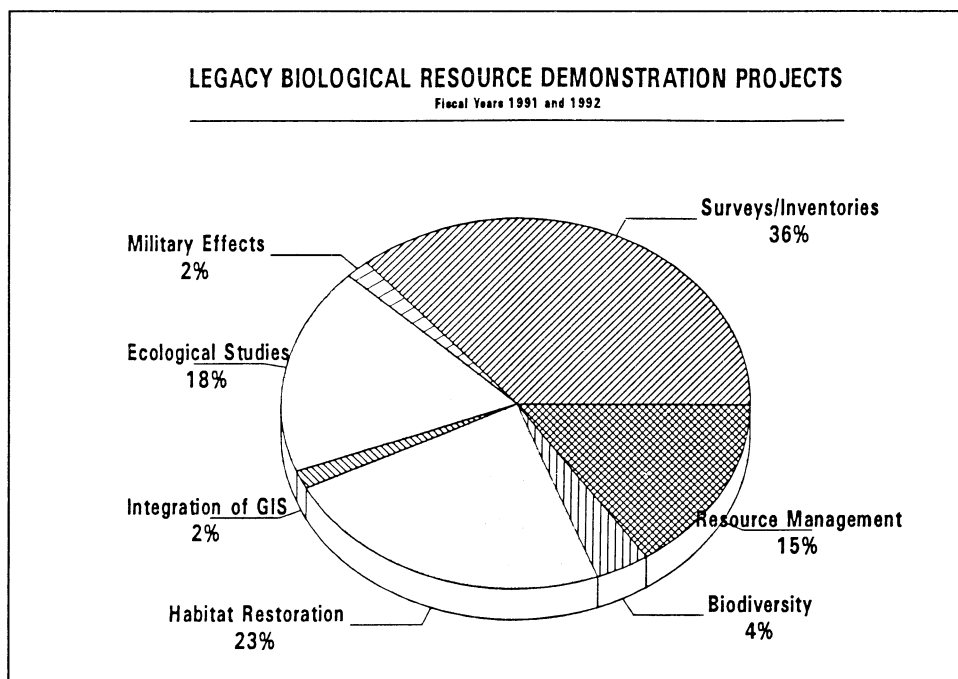


Figure 2. FY91 and FY92 Legacy demonstration projects by category

help DoD by enabling individual installations to remain in compliance with current environmental statutes that affect the management of threatened and endangered species on Federal lands. DoD installations harbor some of the largest remaining populations of threatened/endangered species, and proper management of the populations by DoD could prove crucial to the survival of these populations. Inventories of threatened and endangered species will provide some of the critical ecological data (not available in the past) on these populations and should reduce the number of compliance-related conflicts.

Projects designed to investigate natural resource management techniques on DoD installations should also provide much-needed guidance for installation-level resource managers. In the past, these personnel have had very little guidance in their efforts to integrate resource management plans with military operations and even less information on the critical interactions between military operations and natural resources. Demonstration projects at Camp Pendleton (evaluating the effects of training on candidate and endangered plant species), Quantico (development of GIS with integrated HEP capabilities), and the cooperative work being done at Fort Polk and Fort Hood (development of standardized integrated natural resource management techniques) should add greatly to the “state-of-the-knowledge” of natural resources management on military installations.

6 Conclusions and Recommendations

Conclusions

General

A preliminary evaluation of the information obtained from both the survey and the workshop indicates that current biological resources programs within DoD are generally adequate in scope. However, five main shortcomings currently exist that impede, or will impede, full implementation of DoD's intent to become the leader in stewardship of natural resources. These include the following: (a) a lack of sufficient program funding, (b) inadequate staffing at the installation level, (c) a lack of command support and accountability at all levels, (d) the need to remove natural resources programs from engineering directorates and elevate the programs to a level equal to that of other major directorates so that a direct line of communication could be established with command elements, and (e) a lack of integration between natural resource and military planning.

Concerns over funding levels and personnel shortages were voiced repeatedly throughout this study, and considerable time was spent discussing means to alleviate these items. Command support, the lack of legislative mandates dictating installation and DoD level natural resources management policy, the lack of professional positions and staffing equal to other directorates within DoD, and the lack of an organizational structure that mandates and optimizes the coordination and implementation of natural resource programs are all issues that need to be addressed before DoD can assume its role as a leader in environmental management.

An additional concern, raised very late in this study, is the future of the forestry program on Army installations. Currently, the Department of the Army is considering reducing emphasis on commercial timber operations at its

installations.¹ A more balanced, ecosystem approach to management will be used, which is definitely a step in the right direction for achieving stewardship goals.

Data/inventory needs

Resource inventories are costly and can take several years to complete, but the information they provide for installation-level resource managers is critical to the completion of their missions. In the past, DoD natural resource managers have designed their own inventories based on professional judgment, background, and local expertise. This appears to have been satisfactory in most instances; however, in certain cases, the lack of standardization and integration has hindered multiple-use, integrated management efforts on DoD lands. Ideally, DoD resource managers (e.g., biologists, foresters, land managers, and archaeologists) need to coordinate their resource inventories so that each individual's data needs are met.

The large number and diversity of habitat types and wildlife species occurring on DoD lands makes it extremely difficult to develop a standard set of variables and inventory procedures to be used in DoD biological resources programs. A mechanism needs to be developed to ensure that resource inventories on DoD lands are conducted in a truly integrated manner that will provide installation level resources managers and military planners access to sufficient natural resources data to manage DoD lands. Data collection techniques need to be standardized and optimized so that DoD natural resources personnel are obtaining the most up-to-date, high quality data available. Inventory procedures need to be coordinated with managers responsible for cultural, biological, and earth resources so that data can be collected on all installation resources and not just a select, economically important few. An integrated approach to resource inventories is not a new concept and has been considered by other large Federal land-management agencies (Heissenbuttel 1990).

Demonstration program

The demonstration project program appears to be well thought out and designed, and if implemented as scheduled, should aid DoD personnel in managing biological resources on military installations. The critical, unwritten, more difficult task for DoD resources managers will involve the integration of lessons learned through Legacy demonstration projects into their day-to-day management activities in a way that will ensure long-term, integrated, multiple benefit resource management that is compatible with the military mission.

¹ Personal Communication, 13 December 1992, Mr. Don Cole, Forester, U.S. Army Engineer Housing and Support Center, Fort Belvoir, VA.

The Legacy demonstration program has already provided considerable data acquisition for installation-level natural resource databases. Inventories have covered a wide variety of natural resource needs, including threatened, endangered, and rare species inventories (floral and faunal) and general resource inventories of nonthreatened species and habitats for management purposes. These inventories will provide the key to the future success of stewardship on DoD lands. Continued emphasis on the integration of the demonstration projects with task area development should ensure that Legacy achieves the objectives set forth in the original legislation.

Recommendations

- a. Funding levels for biological resource management should be increased in future Operations and Maintenance budgets. Programs such as Legacy should not be viewed as a substitute for direct funding. The most critical need for funding at this time appears to be baseline inventories for all installations. The development of integrated resource inventories will undoubtedly relieve many of the concerns that DoD resource managers expressed in the Legacy survey and the workshop. The use of Legacy funds for conducting inventories represents a short-term solution to a long-term problem; a more permanent mechanism needs to be established.
- b. The ability to use interagency agreements and volunteer groups may be a partial answer for stretching scarce funding. It is recommended that more streamlined methods for establishing agreements be instituted. Potential cooperators include, but are not limited to the following:

Federal

- U.S. Forest Service
- U.S. Fish and Wildlife Service
- National Park Service
- Bureau of Land Management
- Soil Conservation Service
- U.S. Army Corps of Engineers

Private

- Ruffed Grouse Society
- Wild Turkey Federation
- The Nature Conservancy
- Audubon Society
- Sierra Club
- Ducks Unlimited
- Quail Unlimited
- Trout Unlimited

Professional Societies

- Society of American Foresters
- Society of Wetland Scientists
- Society of Range Scientists
- The Ecological Society of America
- The Wildlife Society
- The Agronomy Society
- Restoration Ecological Society
- The American Fisheries Society

State

- State Resource Management Agencies
- Universities

- Cooperative Research Units
 - State Natural Heritage Program
- c. A system similar to the Natural Resource Technical Services and the Wetlands Resources Assistance Program in the Corps of Engineers Civil Works Research and Development programs should be implemented with appropriate funding. This would allow expertise in laboratories to be brought to bear on short-term, installation-specific problems.
 - d. Although the technology to integrate resource inventories may be presently lacking, an interdisciplinary advisory panel needs to be established to investigate the problem and determine technically sound procedures for developing and conducting integrated natural resources inventories. Panel members should include representatives from Federal and State agencies, academia, and private industry. Emphasis should be placed on developing and using remotely sensed data as much as possible.
 - e. Staffing levels for natural resources management activities should be increased. The current downsizing of the Nation's military and the reorganization of the Corps of Engineers will probably displace a substantial number of trained natural resource specialists (i.e., foresters, wildlife biologists, hydrologists, etc.). It is very likely that personnel with the needed expertise and skills exist within each of these groups. DoD could derive great benefits from this downsizing if a mechanism is established to incorporate this expertise into installation-level natural resource programs. These personnel have the added advantage of being familiar with military and government operations. Rather than lose these individuals to the outside, it may be more efficient and cost-effective to retain them in a different capacity and utilize their expertise at the installation level.
 - f. Elevate the natural resources organization to the directorate level, and combine all natural resources management and compliance functions into a single natural resources element. This is currently being done on a few installations, but most are still decentralized. For example, endangered species and cultural resources responsibilities are in one office, while forestry, land management, and wildlife and fisheries management are in another. Combining installation level natural resources expertise into a single element would provide better management of natural resources on DoD lands and, at the same time, help managers to better support the military mission.
 - g. Command support for natural resource management activities appears to have steadily increased over the last few years, with some installations and services more attuned than others. It is recommended that specific job performance indicators and incentives for promotion or advancement based on stewardship accomplishments be developed and included in military and civilian job descriptions and efficiency reports. Also,

mandatory natural resource training programs for civilian and military supervisors should be developed to increase their awareness of natural resource management responsibilities.

- h.* Entry level training and continuing education programs for natural resources professionals should be mandatory in DoD's natural resources management program. Additionally, natural resources managers should be encouraged (and afforded the opportunity) to participate in professional meetings in order to facilitate the exchange of ideas with other installation professionals.
- i.* The demonstration program has been very successful; it has provided much-needed funding for critical biological resources needs (especially inventories). The program should be continued with a program management structure to ensure that timing and scope of projects provide DoD with continued long-term benefits.
- j.* A future demonstration project(s) should be evaluated and funded to develop an array of standard inventory methods and multipurpose data variables. The intent of the project would be to provide a range of methods and variables that are standard across the nation, but allow for geographical differences.
- k.* Clearly defined management objectives must be developed at all levels, with realistic targets/goals. These objectives must be measurable and should be monitored over time.

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Appendix A

Glossary

Active Management - Any resource identified or listed in a management plan that receives a substantial amount of attention in day-to-day management activities.

Age Class - One of the intervals of time into which the age ranges of tree crops or stands are divided for classification or use purposes, and the trees whose age falls within such an interval.

Basal Area - The cross-sectional area of a tree at breast height (4.5 ft or 1.3 m).

Biodiversity - The variety of life and its processes; includes the variety of living organisms, the genetic differences between them, and the communities and ecosystems in which they occur.

Biological Resources - The biotic component of natural resources, including, but not limited to, wildlife, fish, and vegetation.

Buffer Strip - A relatively undisturbed forested/vegetated area adjacent to an area requiring special attention, management, or protection (i.e., lakes, streams, roads, etc.)

Candidate Species - A species being considered for listing as a Federally endangered or threatened species.

Census - A count or tally of all individuals over a specified area at a given point in time. Census techniques can be broadly grouped into three categories: direct, indirect, and ratios. The term is used loosely in this report to represent any count/enumeration of individuals made to help make management decisions.

Clear-cutting - A method of timber harvesting in which all trees (merchantable or unmerchantable) above a specified diameter (usually 2 to 4 in. or 5 to 10 cm) are cut.

Commercial Forest Land - Forested land capable of bearing merchantable timber.

Community - An integrated group of species inhabiting a given area.

Conservation - Planned management, use, and protection of natural resources to provide the best public benefits, continued productivity for present and future generations, and the prevention of exploitation, destruction, and/or neglect.

Continuous Grazing System - A grazing system that allows season-long grazing use of a particular range management unit.

Cover - Vegetation or other structural habitat components (terrestrial and aquatic) used by wildlife for shelter, escape, nesting, roosting, loafing, and refuge.

Deferred Grazing System - A grazing system in which use of a particular range management unit is delayed until the major forage species have completed their reproductive phase.

Deferred Rotation Grazing System - A grazing system that involves the rotation of deferred grazing among two or more sub-units. Used most often to restore vigor of over utilized forage species.

Density - The number of individuals per unit area (an absolute measure of the population).

Ecosystem - The organisms of a particular habitat together with the physical environment in which they live; a dynamic complex of plant and animal communities and their seasonal nonliving environment.

Edge - Brushy, vegetated transition area (ecotone) between forest stands and open lands.

Forest Resources - Any timber resource (commercial and noncommercial) occurring on DoD facilities, to include hardwoods and softwoods.

Fragile Areas - Any area having severe limitations for development and/or use because of potential irreversible environmental damage.

Habitat - The environment in which an organism lives; an area with the combination of resources (i.e., food, cover, and water) and environmental conditions (i.e., temperature, precipitation, and presence/absence of predators and competitors) that promotes occupancy by individuals of a given species (or population) and allows those individuals to survive and reproduce.

Habitat Evaluation Procedure (HEP) - A mathematical model developed by the U.S. Fish and Wildlife Service that documents the quality and quantity of resources available for selected wildlife species. The procedure involves the calculation of Habitat Suitability Index (HSI) values based on the most representative habitat variables for the species of concern. HEPs are most often used to evaluate existing habitat quality and to predict the possible effects of alterations on future habitat quality/condition.

Habitat Type - Land units having approximately the same capacity to produce vegetation; an area or land unit that possesses similar abiotic and biotic attributes.

Hardwood - Any tree species with broadleaf characteristics, opposed to conifers or needle-leaf species.

Harvesting - The removal of products from the forest for utilization.

High-Forest System - A silvicultural system that produces stands originating from seed. Stand regeneration is a result of sexual reproduction by parent trees (includes natural seeding, artificial seeding, and planting).

High-Intensity Low-Frequency Grazing - A grazing system in which grazing is intense but infrequent. Range management units are intensively grazed for short periods of time and then allowed ample recovery time before being placed back into use.

Improvement Cutting - The elimination or suppression of less valuable trees in favor of more valuable tree growth, typically in mixed uneven-aged forests. (i.e., thinnings, salvage, cleanings, etc.).

Intermediate Cutting - Any removal of timber from a stand between its planting and final harvest.

Inventory - An assessment of the natural resources occurring on a given area; used in the report to indicate any survey of flora and/or fauna conducted on an area to provide data/information to be used for making management decisions.

Land Suitability - Evaluation of land characteristics to determine the appropriate management regimes.

Listed Species - A species that is included on the Federal endangered species list.

Low-Forest System - A silvicultural system that produces stands originating from the vegetative sprouting of harvested trees (i.e., stump sprouts, root suckers, etc.). Often times referred to as a coppice regeneration.

Mast - Seeds of trees used as food by wildlife or domestic stock.

Multiple Use - The management of lands and their various resource values so they are utilized in the combination that best meets the present and future needs of the American people; the integrated, coordinated, and compatible use of natural resources that achieves a sustained yield of a mix of desired goods, services, and direct/indirect benefits while protecting the primary purpose of supporting and enhancing the military mission and observing stewardship responsibilities.

Natural Resources - All products of nature and their environments of soil, air, and water. Natural resources are usually broken down into two categories:

- a. Abiotic or nonliving, nonrenewable resources such as minerals and soil components.
- b. Biotic or living, renewable resources such as plants and animals.

Nongame Species - Fish and wildlife species not harvested for recreation, subsistence, or economic gain.

Nuisance Species - Any wildlife/fishery/plant species that causes significant damage/disruption to training, forest, fisheries, soils, and agricultural or water resources/management. Can include such species as gophers, voles, beaver, feral cattle/horses/pigs, starlings, blackbirds, gulls, pigeons, sparrows, grass carp, sunfish, bowfin/grinnel, Kudzu, Arrundo, and Dodder.

Pasturelands - Distinguished from rangelands by the fact that periodic cultivation is necessary to maintain introduced (non-native forage) species, and agronomic practices (irrigation and fertilization) are applied at regular intervals to perpetuate the vegetative community.

Population - All of the individuals of a species or group of species that occupy a given area; the functional unit used by wildlife managers.

Rangeland Resources - Uncultivated lands that provide all of the life requisites for grazing and browsing animals (domestic and wild). Includes natural grasslands and deserts (nonbarren) and forests.

Regeneration - (a) Reproduction: The renewal of a tree crop, whether by natural or artificial means. Natural: Renewal by self-sown seed or by vegetative means (regrowth). Artificial: Renewal by direct seeding or planting (reforestation). (b) Also the young tree crop itself.

Rotation Grazing System - A grazing system that involves subdividing the range into units and regularly rotating livestock from one unit to another before substantial damage occurs on any one unit.

Rotation - The period of time to establish, grow, and harvest a crop of trees to a specified condition of maturity.

Sample - A subset of measurements selected from a population.

Seed Tree System - The removal in one cut of the mature timber from an area saved for a small number of seed bearers left singly or in small groups.

Selection System - An uneven-aged silvicultural system in which mature trees are removed individually or in small groups from a given tract of forested land over regular intervals of time.

Sensitive Species - A species not formally listed as endangered or threatened, but thought to be at risk.

Shelterwood - A method of even-aged silviculture in which older crop trees are removed in two or more successive cuttings.

Short Duration Grazing System - A grazing system in which individual range management units are small and grazing pressure is intense. This system is most often used to manage ranges where vegetation is composed of fast-growing, rank, herbaceous species.

Significant Biological Resources - A term used to describe any unique, irreplaceable, biological resource, especially native flora and fauna. Can include resources that are endemic to specific geographic areas, resources that are important to a threatened/endangered species for food, cover or habitat, or irreplaceable resources that are in threat of being irreversibly lost or damaged. Includes any forest, wildlife, range, and watershed resources.

Silviculture - The theory and practice of controlling the establishment, composition, constitution, and growth of trees.

Silvicultural System - A process, following accepted silvicultural principles, whereby the tree species constituting forests are tended, harvested, and replaced.

Site Index - A numerical measure of the productive capacity of a given site based on the heights of the dominant trees at a given age.

Stand - A community of trees possessing sufficient uniformity of species composition, age, spatial arrangement, or condition to be distinguishable from adjacent tree communities.

Stocking Level - A measure of the number of trees growing in a stand relative to the number of trees desirable to obtain optimum growth.

Snag - A standing dead tree from which the leaves or needles and most of the branches have fallen.

Softwood - The wood of any coniferous or evergreen tree species. As opposed to hardwood, the wood from a deciduous tree.

Species - A population or series of populations that are capable of interbreeding freely with each other but not with members of other species.

Stewardship - The moral responsibility to manage resources entrusted to one's care in a way that respects the intrinsic value of those resources, and respects as well the needs of present and future generations of people who depend on those resources.

Threatened/Endangered Species - Species formally listed by the Federal government as being in danger of extinction or endangerment.

Watershed - The area drained by streams and their tributaries.

Wildlife Resources - Any mammal, bird, fish, reptile, or amphibian occurring on Department of Defense facilities. Broken down into four broad categories for discussion purposes: game, nongame, threatened/endangered, and nuisance species. Includes common game species (e.g., elk, white-tailed deer, quail, turkey, trout, bass, alligator, and bullfrog), nongame species (e.g., rodents, bats, songbirds, raptors, carp, gar, snakes, and lizards), threatened/endangered (e.g., Florida manatee, swift fox, red cockaded woodpecker, spotted owl, sturgeon, snail darter, indigo snake, and gopher tortoise), and nuisance species (e.g., beavers, nutria, prairie dogs, blackbirds, starlings, and snakes).

Appendix B

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Appendix D

Plenary Session 1 (Stewardship) Results

The following ideas are shown with the total number of votes for each idea indicated in parentheses. Those ideas that are similar are marked with the same symbol and were validated by participants in the plenary session.

*(40) Command support at all levels for natural resource (NR) programs to include funding for professional positions.

+(28) Define and understand the natural resources to be managed (survey and inventory) and the interactions among them.

\$(27) Integrate and optimize NR management plans and installation operations/training mission.

*(20) Obtain and maintain command support for programs, i.e., manpower, funds, facilities, and equipment/supplies.

(9) Ensure professional NR staff at Deputy Chief of Staff/Directorate level (or equivalent).

(9) Communication/education to public and user.

+ (0) Know the full range of resources.

(8) Learn programming and budgeting; obtain spending authority.

(6) Appreciation for installation-wide environmental ethic.

* (6) Professional workforce.

(5) Clear statement of Department of Defense policy and management objectives.

(0) Good planning to establish priorities and objectives.

- (3) Report directly to command element.
- \$ (0) Integrate NR management into military mission.

Appendix E

Plenary Session 2 (Policy) Results

The following ideas are shown with the total number of votes for each idea indicated in parentheses. Those ideas that are similar are marked with the same symbol and were validated by participants in the plenary session.

- * (58) Commitment by command to policy accountability and followup.
- * (27) Policies lack teeth; therefore, we need formalized means of accountability at all levels.
- + (23) Resources for implementation of policy must accompany policy.
- + (23) Natural resource (NR) programs should not have to be financially self-supporting.
- (15) National Environmental Policy Act as a planning tool.
- \$ (7) Legislative mandates have not been adequately formulated as installation policy.
- (6) Environmental defense is an integral part of national defense.
- \$ (4) Policy must be clear and understood at all levels.
- (4) Lack of policy for considering cumulative impacts.
- (2) Conflicting interpretations of laws, regulations, directives, etc.
- (1) Stewardship surpasses compliance.
- (0) Conflicting NR management policies versus missions.

Appendix F

Plenary Session 3 (Structure/ Organization) Results

The following ideas are shown with the total number of votes for each idea indicated in parentheses. Those ideas that are similar are marked with the same symbol and were validated by participants in the plenary session.

*(34) Remove natural resources (NR) and environment from civil engineering and elevate to a combined function at the Directorate/Deputy Chief of Staff level.

(25) Establish a “purple suit” Department of Defense (DoD) Directorate staffed by trained NR professionals with chain of command to installation directorate.

(17) Relief from personnel ceiling and hiring freeze. +(16) Establish grade structures and staffing commensurate with other professionals within DoD according to resource needs.

(12) Staff DoD and services headquarters with appropriate specialist as guidance for installations and intermediate echelons.

* (9) Natural resources as an equal partner with environment as a Directorate/Department/Assistant Chief of Staff.

\$ (9) Develop minimum NR staffing standards and educational requirements for all DoD levels.

(2) Establish installation requirement for unit representatives to serve as point of contact for all environmental/natural resources issues (e.g., training, violations, and planning).

\$ (2) Professional recognition on par with engineers.

- (2) Installation Natural Resource Management Plan must include implementation chapter.
- + (0) Salaries must reflect responsibilities comparable to other professionals.

Appendix G

Plenary Session 4

(Opportunities) Results

The following ideas are shown with the total number of votes for each idea indicated in parentheses. Those ideas that are similar are marked with the same symbol and were validated by participants in the plenary session.

*(36) Better use of partnerships of government and nongovernment entities through cooperative agreements, matching grants, cost shares, intergovernmental personnel agreements, cooperative education units, etc.

+(31) Develop an organized effort at all levels to promote an increase in natural resources funding and staff (e.g., public relations, lobbying, and marketing).

+(18) Develop a case for increasing staffing and funding. \$(16) Use military equipment and personnel to support natural resources while training. +(11) New personnel standards to realistically support the natural resources mission.

(11) Develop user responsibility program to include cost of rehabilitation/restoration (“you play, you pay”).

(6) Prioritize activities, eliminate everything except what is mandated by law (i.e., compliance); identify cost of reduction.

* (4) More effective use of outside organizations, partnerships, volunteers, and funding sources.

\$ (4) Utilize appropriate military personnel to supplement personnel shortages.

(2) Implement Department of Defense Volunteer Program.

* (0) Cooperative personnel agreements (including universities).

* (0) Interagency task agreements, including cooperative research.

Appendix H

Plenary Session 5 (Future Directions) Results

The following ideas are shown with the total number of votes for each idea indicated in parentheses. Those ideas that are similar are marked with the same symbol and were validated by participants in the plenary session.

+ (23) Ensure adequate staff, funding, and grade levels.

* (20) Provide natural resource (NR) and environmental training for officers and noncommissioned officers in schools.

(17) Goal = 100 percent of Department of Defense personnel aware of stewardship responsibilities and are sincerely dedicated to the concept (NOTE: This relates to answer directly above; however, it is a goal and was therefore not lumped with any other answer).

(15) An organizational structure that mandates and optimizes NR coordination and implementation.

(12) Establish natural resource review board within each service.

* (11) Directly involved in natural resources training for both military and civilian personnel.

(10) Use partnerships and cross-installation exchange as a foundation for establishing natural resources training network.

(7) Facilitate more effective information and education through personal contacts, public affairs offices (use and education), and multimedia resources.

* (4) Develop education program at entry level.

(3) Move Natural Resources/Environment up in the command chain.

* (2) Mandatory initial and refresher environmental training of military personnel at the installation level.

(1) Environmental management an element of performance standards.

Appendix I

Demonstration Program Sites

U.S. Army Installations

Alabama

Anniston Army Depot
Redstone Arsenal
Ft. McClellan

Alaska

Ft. Wainwright

Arizona

Yuma Proving Ground
Ft. Huachuca

Arkansas

Ft. Chaffee

California

Presidio-San Francisco

Colorado

Ft. Carson
Pueblo Army Ammunition
Plant

Georgia

Ft. Stewart
Ft. Benning

Hawaii

Kanaio TA
Pohakuloa TA
Makula Military Reservation
Scofield Barracks

Idaho

Orchard Training Area

Illinois

Harry Diamond
Savanna Army Depot
USAE-Construction Engineering
Research Laboratory

Kansas

Sunflower Army Ammunition
Plant

Kentucky

Ft. Campbell
Artamus
Ft. Knox
Clay City

Louisiana

Longhorn Army Ammunition
Plant
Ft. Polk

Maryland

Patuxent River
Aberdeen Proving Ground

Massachusetts

Ft. Devens

U.S. Army Installations

Minnesota

Twin Cities Army Ammunition
Plant

Mississippi

USAE-WES

Missouri

Ft. Leonard Wood

New Jersey

Picatinny Depot

North Carolina

Ft. Bragg

Ohio

Ravena Army Ammunition
Plant

Oklahoma

Ft. Sill
McAllister Army Ammunition
Plant

Pennsylvania

Indiantown Gap
Tobyhanna Army Depot
Letterkenny Army Depot

South Dakota

West Camp Rapid

US Air Force Installations

Arizona

Goldwater AFB
Luke AFB

California

Travis AFB
Vandenberg AFB
Moody AFB
March AFB
Miramar
McClellan AFB
Edwards AFB

Tennessee

Volunteer Army
Ammunition Plant
Milan Army
Ammunition Plant
Holston Army
Ammunition Plant

Texas

Ft. Bliss
Ft. Hood

Utah

Dugway Proving Ground
Utah Test Range

Virginia

Ft. Belvoir

Washington

Ft. Lewis
Yakima Training Center

Wisconsin

Badger Army Ammunition
Plant
Ft. McCoy

Guam

Colorado

U.S. Air Force Academy

Florida

Eglin AFB
Avon Park AFB
Tyndall AFB

Idaho

Mountain Home AFB

U.S. Air Force Installations

Illinois

Scott AFB

Louisiana

Barksdale AFB

Mississippi

Columbus AFB

Nevada

Nellis AFB

New Hampshire

Pease AFB

New Jersey

Warren Grove AFB

New Mexico

Cannon AFB

Kirtland AFB

North Carolina

Dare County AFB

Ohio

Wright-Patterson AFB

Tennessee

Arnold AFB

Texas

Brooks AFB

Lackland AFB

Virginia

Langley AFB

Wyoming

F.E. Warren AFB

Guam

Anderson AFB

U.S. Navy Installations

California

Point Mugu Pacific
Missile Test Center
San Clemente Island
Seal Beach
LeMoore Naval Air
Station
North Island
China Lake Naval
Weapons Center
Mare Island

Florida

Key West Naval
Air Station
Jacksonville Naval Air
Station

Georgia

Kings Bay Submarine
Base

Indiana

Crane

Maine

Rangely

South Carolina

Charleston Naval Weapons
Station

Washington

Jim Creek
Whidbey Island Naval
Air Station

Puerto Rico

Roosevelt RD

Midway Island

U.S. Marine Corps Installations

Arizona

Yuma MCAS

California

Camp Pendleton

Hawaii

Kaneohe MCAS

New Jersey

Cherry Point MCAS

North Carolina

Camp Lejeune

Virginia

Quantico

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13. ABSTRACT (Maximum 200 words) Objectives of the Legacy Biological Resources Task Area Study were to (a) evaluate the capability of existing Department of Defense (DoD) resource management programs and (b) address shortfalls by recommending modifications to existing programs. Interviews with natural resource management experts, literature reviews, surveys, and a workshop were used to gather data. The workshop addressed the management of biological resources on DoD lands. Major areas of discussion included the following: (a) stewardship of natural resources, (b) current policy and issues, (c) the structure and organization of DoD natural resource programs, (d) opportunities for interagency partnerships, and (e) the future direction of natural resource management. Critical issues identified by workshop participants included the following: (a) better command support for natural resource management programs at all levels, (b) command commitment to policy accountability, (c) current structure of DoD natural resource management programs, (d) interagency cooperative agreements to supplement installation staffs, and (e) the need for adequate staffing, funding, and professional grade levels. <div style="text-align: right;">(Continued)</div>

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The survey identified the status of natural resource management on DoD facilities. Key issues were personnel qualifications, limitations, and needs; the type(s) of data collected on natural resources; data collection techniques; and resource management techniques. Common concerns included the lack of trained natural resource professionals and a lack of funding for resource inventories.

Major recommendations included the following: (a) increase funding at the installation level for natural resource inventories, (b) improve inventory technology so that natural resource inventories are more integrated, (c) increase natural resource staffs, and (d) elevate installation natural resources management to the directorate level, and combine resource management and compliance functions into a single, centralized natural resource element.

