1995

Cedar Creek Biodiversity Workshop 1995

Long Term Ecological Research Network

SUMMARY OF SPECIES LISTS FOR THE ANDREWS FOREST

	Title	PI/Contact	Update Year	Taxonomic Categories	No. of Species	Relative Abund	Hab	Sampling Methods Document	On-line	Other Attributes
I.	**FAUNA**									
A.	**Insects/arthropods**									
1.	Insects/other arthropods	Lattin/Parsons	1991	Class - ssp	3,345	Yes	Yes	Yes	Yes	Authority, collection, references, host, feeding group
2.	Spider (addendum)	Moldenke/Halaj	1995	Class - ssp	275	Yes	Yes	No	No	Authority, collection, references, host feeding group
3.	Aphids (addendum)	Lattin/Jensen	1995	Class - ssp	90	No	No	No	No	Authority, host
4.	Lepidoptera (add)	Miller	1995	Class - sp	637	No	No	No	No	
5.	Non-leps	Miller	1995	Family - sp	7	No	No	No	No	
B.	**Aquatic insects**									
1.	EPA Emap (Mack, Lookout)	Li/Herlihy/ Gerth/Gregory	1993	Class - genus	111	Yes	No	Yes	Yes	Nsurber
2.	Invertebrate list	Gregory/Wildman	1988	Class - genus	78	No	Yes	No	Yes	Feeding group
C.	**Fish**									
1.	Aquatic vertebrates (Mack, McRae, L.Lookout)	Gregory/ Ashkenas	1995	Genus - sp	19	No	No	No	Yes	Common name
D.	**Birds**									
1.	Bird species list	McKee	1993	Class - sp	83	Yes	Yes	Yes	Yes	Common name
E.	**Herps**									
1.	Amphibians and reptiles	Beatty/McKee/ Olson/Hunter	1995	Class - sp	20	Yes	Yes	Yes	Yes	References, common name
F.	**Mammals**									
1.	Mammal species list	Anthony/McKee	1976	Order - sp	53	Yes	Yes	No	Yes	Common name

Title	PI/Contact	Update Year	Taxonomic Categories	No. of Species	Abund	Hab	Sampling Methods Document	On-line	Other Attributes
II. FLORA									
A. Vascular plants									
1. List of vascular plants	McKee/Spycher	1979	Family - sp (var)	507	Yes	Yes	Yes	Yes	Authority, veg zone, synonyms, common names
2. RNA, SIA plant list	McKee/Brainerd	1994	Genus - sp (var)	?	No	No	No	No	Common name
B. Lichens									
1. Epiphytic lichens & bryophytes	Carroll/Pike	1975	Genus - sp	107	No	Yes	Yes	Yes	Authority, form
2. Lichen abundance HJA and nearby	Neitlich	1993	Genus - sp	59	Yes	Yes	Yes	Yes	
C. Mosses/hepatics									
1. Mosses in HJA and nearby	Peck/McKee/ Acker	1994	Family - sp	30	Yes	Yes	Yes	Yes	Authority, substrate
2. Riparian bryophytes	Jonsson	1995	Genus - sp	144	Yes	Yes	Yes	Yes	Authority
D. Algae									
1. Lookout Cr. Periphyton	Gregory/ Ashkenas	1992	Family - sp	55	No	No	No	Yes	Authority
E. Fungi									
1. Fungi of the Andrews	Molina/Smith	?	Family - sp	?	No	No	No	No	Authority
2. Fleshy fungi fruiting in HJA	Rhoades	1972	Family - sp	?	No	No	No	No	Authority
3. Fungal sporocarp (decomposition study)	Harmon/Caldwell	1993	Genus - sp	?	Yes	Yes	No	No	

DRAFT - MORE COMING

October 18, 1995

LTER - BIODIVERSITY

Arthropod component- ex Jack Lattin, H.J. Andrews

Past efforts

The early work on insects and other arthropods involved the examination of different habitats and ecosystems on the HJA. The specimens encountered accumulated through the IBP years. Ultimately, they were partially documented in several IBP era reports. In 1976, Lattin was asked to join the HJA science group to organize and consolidate the accumulated specimens into what became the HJA Arthropod Collection under the management of the OSU Systematic Laboratory. Over the ensuing years, many specimens and species were added to the collections from studies on the aquatic systems, the litter and soil systems, wood decomposition studies, old-growth canopy studies, surveys of selected trees and shrubs, and more concerted efforts to examine various taxonomic groups of interest. Various working data sets were assembled pointing towards the publication of a hard copy version documenting all known species and their attributes. Over 100 individuals assisted us in the compilation of this information. In 1991, the Annotated List of Insects and other Arthropods of the HJA was published, documenting 3,454 species from this 6,400 ha site, making the HJA one of the best known sites in North America. We estimate that there are likely 7,000 species on the HJA. (We have added about 300 species since 1991). The magnitude of the job can be appreciated when you consider that most species have at least three life stages, often very different from one another. Contrast this with the 500 species of plants and 150 species of vertebrates found on the HJA. It is not surprising that the arthropods represent over 85% of the species richness on this LTER site.

Present efforts

Present efforts in arthropod biological diversity studies on the HJA focus not only on different habitats and ecosystems but also on selected taxa. To illustrate the result of having specialists work on the site, two examples will suffice: 23 species of Aphididae (plant lice) were reported in the 1991 book, a specialist in this group added 81 species from five field trips in 1995; 492 species of Lepidoptera (moths and butterflies) were cited in 1991, 165 species have been added since then from a concerted effort via black-light traps and intensive collecting of different host plants (the 1995 results have not yet been analyzed). One interesting result--77 of the 159 species of butterflies known to occur in Oregon are found on the HJA--not what one might expect from a mesic, old-growth coniferous forest! All of the butterflies and moths are herbivorous and thus tied closely with the plant species on the site.

Work on the true bugs (Hemiptera: Heteroptera) involves 210 species - both predaceous and herbivorous species are represented. While not as species rich as the Lepidoptera, the HJA still contains about one-third of the species known to occur in Oregon. Riparian beetles (Coleoptera)

are being studied to see if they can be used to define this characteristic habit on the HJA (they can). Further studies are about to be initiated. Several important riparian trees have been sampled for their fauna. So have the canopies of several dominant conifer species at different chronological stages.

The insect and other arthropod faunas occurring in the litter and soil habitats have received considerable attention on the HJA over the years. Two hundred and fifty species of arthropods per square meter of forest litter is not unusual. Not only is the soil a rich source of biological diversity, but it contains diverse arthropod taxa of great complexity whose systematic knowledge lags far behind most groups of organisms. The shortage of qualified specialists is particularly acute.

Future efforts

Future efforts with arthropods will involve greater use of specialists to examine key taxa on the site and key taxa in different functional roles. Of necessity, emphasis will be placed on taxa where systematic expertise is available. The extensive collections of the OSU Systematic Entomology Laboratory (ca 2.6 million specimens) together with the network of specialists cooperating with the SEL is a major resource to the HJA activities. Some of the future efforts with insects and other arthropods will include the following:

Draping microdistributional data on selected taxa across the HJA landscape and comparing the patterns with aspect, topography, vegetation types and associations, successional stages, including disturbance events.

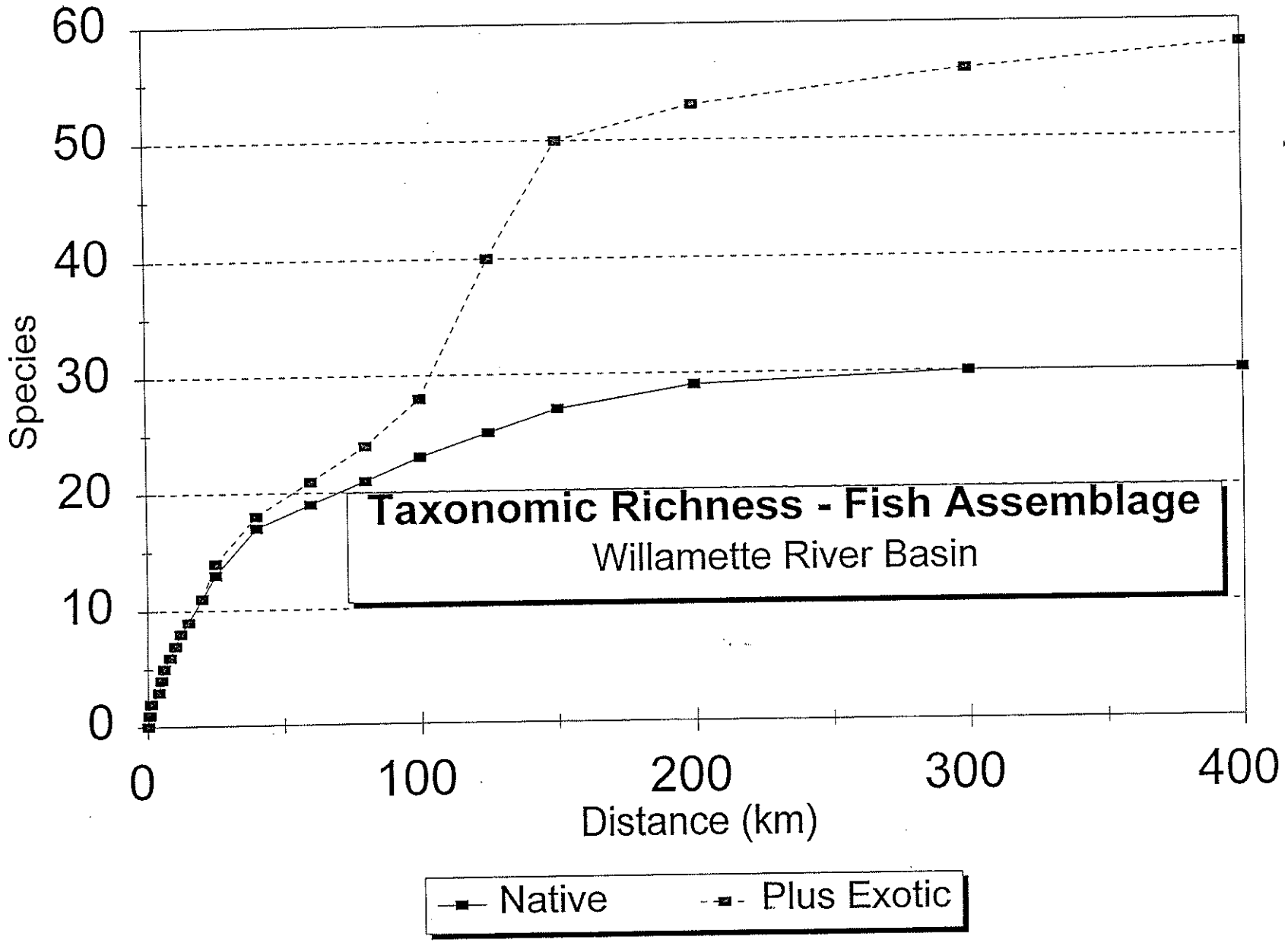
Melding appropriate insect data with appropriate plant data to examine host plant/insect relationships and the utility of this information in predicting occurrence of both groups of organisms at larger spatial scales.

At least 75 non-indigenous species of arthropods occur on the HJA. These invasive species will be examined to determine their origins and activities on the HJA. The vagility of these species will be examined and correlated with a variety of disturbance events.

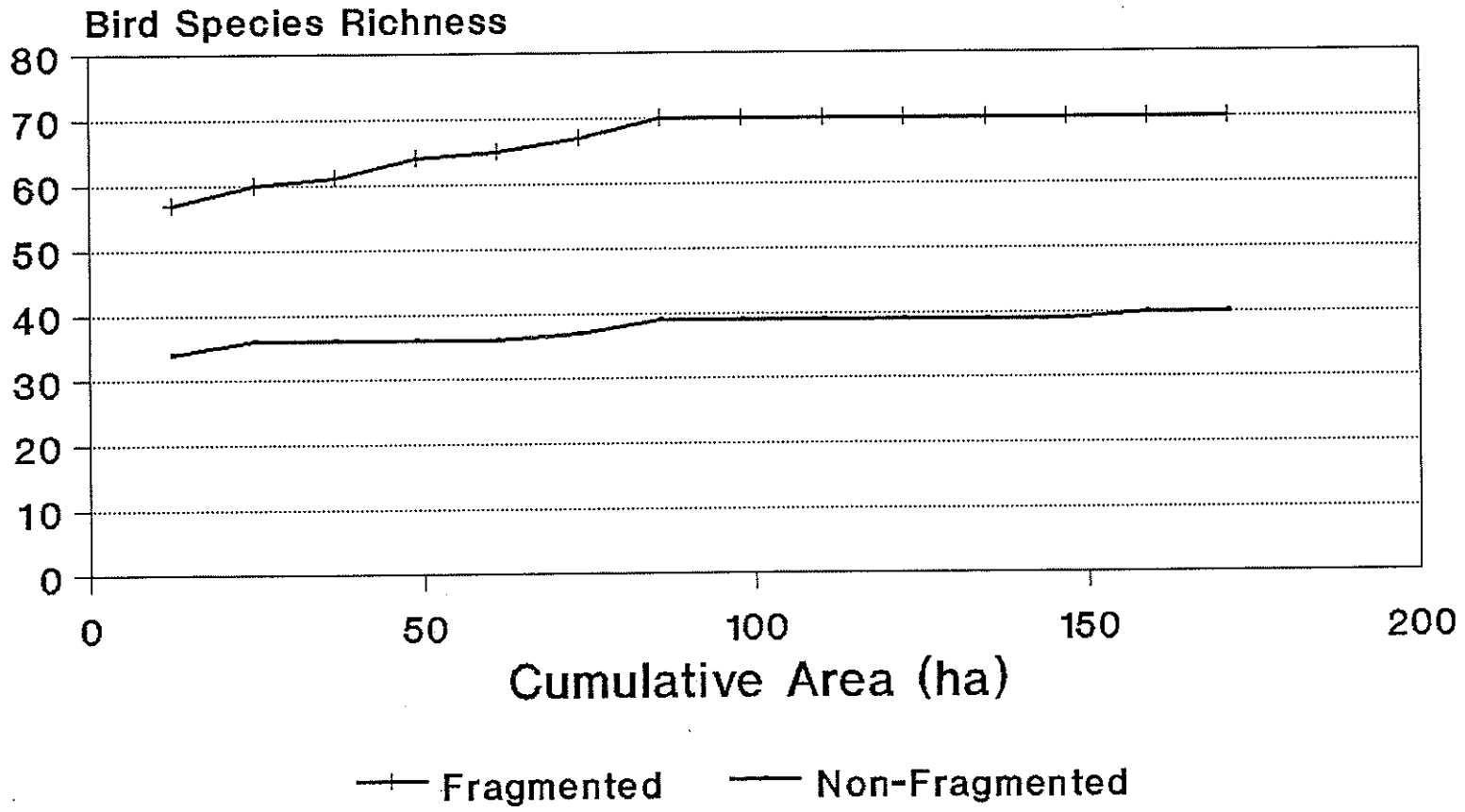
Conduct further studies of the distinct xeric component of insect and other arthropods now found on the HJA. These species are likely to be sensitive and useful indicators of climate change.

Expansion of the base information on arthropods on the HJA to the Central Cascade Mountains, Oregon, and the Pacific Northwest to test the applicability of the HJA to larger spatial scales. (Some of the candidate taxa include the Lepidoptera, Coleoptera [Carabidae]; Hemiptera: Heteroptera, Hemiptera Homoptera (Alphididae and Cicadellidae), Hymenoptera (Bombidae).

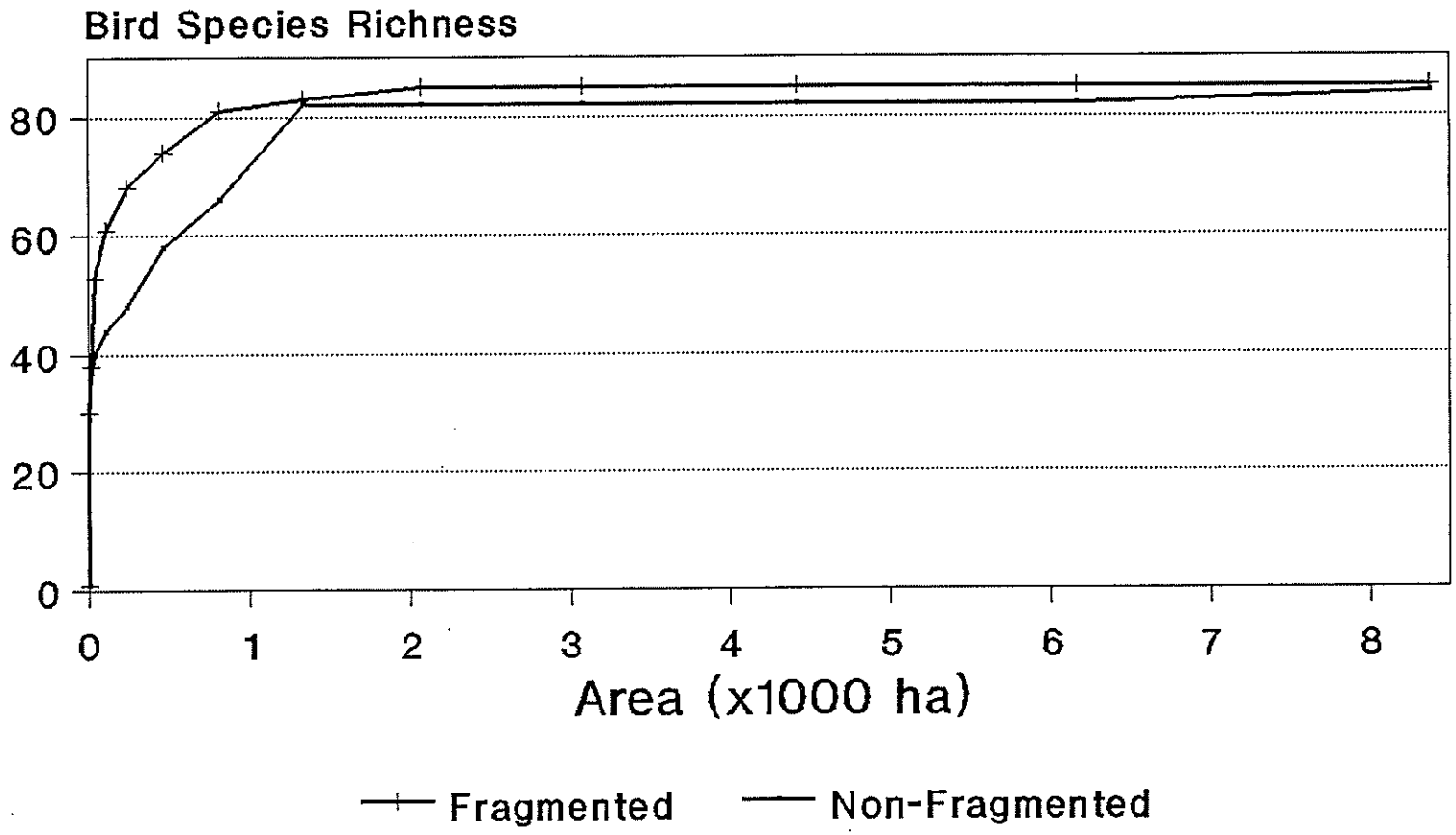
Utilization of the great species richness of the arthropods to elucidate ecological/ecosystem questions.


60
50
40
30
20
10
0
Species
0
100
200
300
400
Distance (km)
Taxonomic Richness - Fish Assemblage
Willamette River Basin
Native
Plus Exotic

Species-Area Curves In Fragmented and Non-Fragmented Landscapes Using a Moving Analysis Window of 12 ha



Comparison of Species-Area Curves Between Fragmented and Non-Fragmented Landscapes - Expanding Window Method



The following is an ASCII text file version of the DRAFT Strategy and Implementation Plan developed by the U.S. National Science and Technology Council, Committee on Environment and Natural Resources Research (CENR), Subcommittee on Biodiversity and Ecosystem Dynamics (SBED). Comments are invited and should be sent by electronic mail to Dr. Paul Dresler, the SBED Executive Secretary, at: pdresler@ios.doi.gov

Steve Young
young.steve@epamail.epa.gov 13 February 1995

BIODIVERSITY AND ECOSYSTEM DYNAMICS: A STRATEGY AND IMPLEMENTATION PLAN

by

THE CENR SUBCOMMITTEE ON BIODIVERSITY AND ECOSYSTEM DYNAMICS

Executive Summary

Goals and Opportunities. Human pursuit of an improved quality of life has produced unintended threats to the sustainability of national and global biodiversity and ecological systems. In order to protect and manage our biological resources, we must learn how natural factors interact with human activities to determine changes in biota and the ecosystems on which they depend. However, much of the earth's diverse biota and ecological processes remain undiscovered and undescribed and for those species that have been described, we know little about the broad scale trends in their abundance and distribution. To address these deficiencies, we need national and international efforts to discover, describe, inventory, and monitor the world's organisms to provide the fundamental information base for monitoring and surveying biological diversity (Science Goal 1). Once we have a scientific and statistically reliable picture of what biotic and ecosystem trends are across large geographic areas, we can better explain observed trends. To provide a scientific basis for explaining trends in biological diversity, we must increase efforts to understand the environmental, ecological, and evolutionary processes that generate and maintain biological diversity, sustain viable populations of species and support ecosystem structure and function (Science Goal 2). These efforts will produce a clearer picture of how natural factors interact with human activities at a landscape to regional level to determine status, change, and trends in biodiversity and ecosystem function (Science Goal 3) through selected biological and ecosystem indicators. These research efforts will also help determine what role both individual species and species diversity in general play in ecosystems. In order to facilitate the incorporation of new and existing knowledge into management and policy decisions, we must provide user friendly information and

validated analytical models that can be used to explore the possible consequences of alternative management and policy decisions. An ultimate goal of all of these studies and activities will be to obtain (and improve) the scientific bases required for sound ecosystem management (Science Goal 4).

Since no organized strategy exists for either screening species for their potential value to humanity or ensuring the long-term conservation of the unknown majority, it is imperative that we develop practices and policies for responsible prospecting for and utilization of biodiversity (Science Goal 5). Recovering and maintaining vulnerable species from extinction is central to protecting the structure and function of ecosystems and maintaining biodiversity; therefore we must develop methods to conserve and restore biodiversity and ecosystem dynamics in compromised ecosystems (Science Goal 6) including improved ecological risk assessment.

Effectively applying sound ecosystem management principles will require an understanding of the human dimensions that contribute to loss of biodiversity and ecosystem integrity and that, ultimately, are critical to preserving and restoring biodiversity and ecosystems. Humans decide how resources will be used, attribute value or importance to various parts of the environment, and determine what will be conserved or destroyed. Key to controlling the loss of biodiversity is understanding how these decisions are made in the realms of social, economic and political systems. Therefore we must identify and understand the economic and social driving forces behind the loss of biodiversity and the destruction of ecosystems and develop incentives to maintain and enhance ecological goods and services (Science Goal 7).

Data and information constitute the backbone on which science and policy decisions are supported. They must be collected in standardized protocols and formats, filed electronically, and made available and accessible to scientists, decision makers, and the public (cross-cutting all Goals).

The loss of biodiversity and the impacts of humans on ecosystems are global problems that demand global responses. Loss of biodiversity and its broad implications reach well beyond country borders and have direct impacts on our country. The U.S. thus has the opportunity and the imperative to provide leadership and partnership roles in efforts to understand and conserve the world's biodiversity and ecosystems. International dimensions to biodiversity and ecosystem programs are an integral component to this Plan.

Challenges. We believe the CENR process is working. First, it is providing the comprehensive view of environmental R&D that has been badly needed to enable interagency agreements on goals and priorities. Second, the agencies are beginning to move in the right direction by making adjustments in their budgets to place

greater emphasis on biodiversity and ecosystems. Third, we are beginning to see the agencies working together in new ways. For example, elements of Commerce, Interior, Agriculture, EPA, and the Smithsonian are working together to develop a shared, peer-reviewed database of valid organism names, synonyms, and classifications; in addition, they are collaborating with other agencies in developing a national program for monitoring and characterizing ecosystems.

Biodiversity and ecosystem dynamics research should be considered with a systems perspective, recognizing the close inter-relationships across the Science Goals and activity streams. We propose a "package" approach because the component parts are intrinsically interdependent and work together as a system greater than the sum of its parts. And the biodiversity and ecosystems package is essential to support the work of other CENR subcommittees, such as Global Change, Resource Use and Management, and Water Resources. In reviewing the agency budget information we received, we identified the following four priority gap areas where additional support is needed in FY 1996, which are highlighted below with (Ñ). A qualitative analysis by SBED Implementation Plan Programmatic Activities & Milestones shows the following challenges:

1.1 Classification and Systematics--- There is a mismatch between where existing funding is applied and where the problems are. Need to set priorities within systematics research, training and education; e.g., for which groups or regions will further research provide the most science that can be applied toward ecosystem protection, restoration, and management?

1.2 Inventory and Monitoring--- There is an imbalance between the effort in remote sensing and ground truth resources. We need to ensure that high value products are generated; a specific example of a needed product is a global ecosystem map.

2.1 National network of ecosystem sites--- A national network needs more emphasis, and we need to strengthen the "networking" between existing site networks.

2.2 Long-term and large-scale characterization of impacts on biodiversity and ecosystem patterns---This is a large category, which the agencies recognize as important, but needs more analysis and better integration. This milestone is an integrating force that ties together systematics, monitoring, and socioeconomic driving forces.

2.3 Whole ecosystem experiments--- This area links to and should key off the national site network. It requires a great deal of planning and development. The land management agencies should link their adaptive management initiatives with this milestone; with only modest modification of existing management activities, they can perform needed controlled experiments at the landscape level. The Biosphere Reserve program element and the

U.S. Man and the Biosphere program (USMAB) as a whole can make a significant contribution.

3.1 Population modeling and landscape studies--- Current research is heavy on population, light on landscapes. A possible area for reprogramming, unless there is a funding increase.

3.2 Role of species in ecosystems--- Although critical to understanding processes within ecosystems, this is a largely uninvestigated question. This milestone represents one of the worst mismatches between the need for more information and the current efforts.

3.3 Predictive understanding of consequences/effects of environmental change on biodiversity and ecosystem dynamics--- As with 2.2 above, this area is seeing substantial effort; however, we need better tying together of efforts, analysis, and integration. For example, agency modeling that is single-species, not ecosystem-based.

4.1 Adaptive management--- Closely associated with inventory and monitoring; considerable movement in this area now. Need to fill in the gaps and lay the foundation to perform adaptive management.

5.1 Biodiversity prospecting--- No methodology exists for rapidly screening the potential benefits to humanity for the bulk of the world's biodiversity. Conversely, no conservation strategies are in place to maintain options for the future use of these species.

6.1-3 Biodiversity and ecosystem restoration, including exotic species--- Current efforts do not sufficiently emphasize biodiversity and ecosystems. SBED notes the particular importance of restoration technologies, and education/outreach associated with the use of these tools.

7.1-3 Identify social and economic driving forces, quantify ecological values, and develop ecosystem policy framework--- We need a conceptual framework to help us understand the drivers; we have a better understanding of the consequences, as opposed to the causes, of biodiversity and ecosystem loss. Many sectors are involved, some unexpected, such as mortgage banking and environmental justice. Notwithstanding all the limitations, the Forum emphasized valuing the "goods and services from nature." An overall policy framework will help ecosystem managers in the public and private sectors.

8.1 Data and information management--- Much effort underway, but largely fragmented and in need of integration. More emphasis may be needed in some agencies. We need better integration across the agencies and with the various programs. Information is an empowerment tool; it can build capacity and help managers work within a comprehensive framework; investments in information

can have high multiplier effects.

NATIONAL BIODIVERSITY INFORMATION CENTER
[a one-page description of the NBIC concept]

WHAT IS IT?

NBIC will be a clearinghouse to provide knowledge of, enable access to, facilitate the use and exchange of, and foster collaborative discussions about the available biodiversity data and information of known quality. It will provide objective data.

WHAT IS IT NOT?

NBIC will not have any regulatory or management responsibilities. It will not be a single massive database.

WHOM WILL IT BENEFIT?

Everyone who uses, studies, or is affected by biodiversity information including:

Private individuals or companies whose activities are regulated by Federal or state agencies will benefit because both the private sector and the agencies will have better information, and will be less likely to make regulatory or management errors because of inadequate information.

Firms (e.g., agriculture, forest products, or pharmaceuticals) that use or manufacture biological products because the NBIC will give them better and more efficient access to existing scientific information, allowing them to operate more efficiently and expedite economic growth and scientific progress.

Academic and other research organizations will benefit because the NBIC will make existing knowledge more accessible, thereby reducing duplication of effort, and allowing researchers to more efficiently apply their time and expertise.

State and local governments will benefit because the NBIC will make it easier for them to access scientific information that would otherwise be very expensive and time-consuming for these agencies to collect directly.

HOW WILL IT OPERATE?

NBIC will seek to integrate, complement, and strengthen existing efforts, rather than to duplicate them.

NBIC will serve as the hub for numerous biodiversity nodes, pointing users to sources for data and information.

NBIC will participate in the development of standards for data and quality control and communication formats.

NBIC will identify biodiversity data and information needs.

NBIC will identify incentives for and encourage the building of partnerships among data-generating organizations.

Date sent: **Mon, 25 Sep 1995 11:22:41 -0700 (PDT)**
From: **Stephanie Martin <smartin@lternet.washington.edu>**
Subject: **NBS, FWIE DEVELOP ELECTRONIC DIRECTORY (fwd)**
To: **pi@lternet.washington.edu, dman@lternet.washington.edu**

For Release: September 21, 1995
Contact: Anne Frondorf (202) 482-3980
or Jamise Liddell (202) 482-3048

National Biological Service, Fish and Wildlife Information Exchange to Develop Electronic Directory of State Databases

National Biological Service Director Ron Pulliam today announced a cooperative agreement with the Fish and Wildlife Information Exchange (FWIE) to develop a directory of state biodiversity databases and information sources. Developed in cooperation with the Organization of Fish and Wildlife Information Managers (OFWIM), a national consortium of state and federal fish and wildlife data managers, the directory will be accessible over the Internet, through the National Biological Information Infrastructure (NBII), at http://www.nbs.gov/nbii/

"This agreement with the Fish and Wildlife Information Exchange is a key step in our efforts to work closely with states as partners in developing, sharing, and applying good biological data and information," noted Dr. Pulliam. "State agencies have significant and extensive biological databases, often developed over many years."

Through the agreement, the Fish and Wildlife Information Exchange and OFWIM will compile information about biological databases and information maintained by state fish, wildlife, natural resources and environmental agencies. The resulting directory will provide valuable information on the contents and subject matter of each database or information product, institutional and contact information about the source agency, and the status of the electronic accessibility of the data or information. The directory will be available on-line over the Internet and will include direct "hot links" to agencies or organizations which already have data and information products through the Internet.

An important objective of this effort is for FWIE and NBS to identify further measures needed to provide increased electronic access to biological data and information products of state natural resources agencies.

The National Biological Service of the U.S. Department of the Interior works with others to provide the scientific understanding and technologies needed to support the sound management and conservation of the nation's biological resources. The National Biological Information Infrastructure is an NBS initiative to foster the development of a distributed electronic network of biological data and information maintained by a variety of federal and state government agencies, universities, museums, libraries, and private organizations.

The Fish and Wildlife Information Exchange, which is a unit within the Fisheries and Wildlife Sciences Department at Virginia Polytechnic Institute and State University, works to make state fish and wildlife data and information products more available to the public and to assist state natural resources agencies in managing and using their biological databases.

###-nbs-###

Interagency Taxonomic Information System (August 3, 1995)

Background Information

The White House Subcommittee on Biodiversity and Ecosystem Dynamics has identified systematics as a research priority that is fundamental to ecosystem management and biodiversity conservation. This primary need identified by the Subcommittee requires improvements in the organization of, and the access to, standardized taxonomic nomenclature. Agencies have joined efforts and resources to build the Interagency Taxonomic Information System (ITIS) to fulfill these requirements. In the future the ITIS will not only provide taxonomic data but also a directory of taxonomic expertise that will support the system.

The ITIS is a result of a partnership of federal agencies formed to satisfy their mutual needs for scientifically credible taxonomic information. The goal is to create an easily accessible database with reliable information on species names and their hierarchical classification. This database will be periodically reviewed to ensure high quality with valid classifications, revisions, and additions of newly described species. The ITIS will include documented taxonomic information of flora and fauna from both aquatic and terrestrial habitats.

The partners in this interagency effort include:

* National Oceanic and Atmospheric Administration
  - o National Oceanographic Data Center (NODC)
  - o National Marine Fisheries Service (NMFS)
* Department of Interior
  - o National Biological Service (NBS)
  - o U.S. Geological Survey (USGS)
* Environmental Protection Agency (EPA)
* U.S. Department of Agriculture
  - o Agriculture Research Service (ARS)
  - o Natural Resources Conservation Service (NRCS)
* Smithsonian Institution

o National Museum of Natural History (NMNH)

These agencies have formed a Steering Committee and two technical work groups - the Database Work Group and the Taxonomy Work Group. The Database Work Group (DWG) is responsible for documenting requirements and overseeing development of the system. The DWG has designed a relational database model to meet the requirements of the interagency partners. The ITIS is being built by NBS and NRCS and is scheduled for implementation in 1996. NBS will maintain the system, which will be accessible to the public via the World Wide Web on the Internet.

The National Biological Service
Exhibit Booth 14 and 15

The 46th Annual Meeting of the
American Institute of Biological Sciences
August 6-10, 1995
Towm and Country Hotel and Convention Center
San Diego, California

The mission of the National Biological Service of the U.S. Department of the Interior is to work with others to provide the scientific understanding and technologies needed to support sound management of our nation's biological resources. The NBS has 16 science centers, 60 Cooperative Research Units, and 88 field stations across the United States that provide biological expertise and scientific data to state and federal agencies, community planners, developers, universities, and the public.

The NBS Exhibit will feature the agency's recently released major publication. "Our Living Resources," which will be widely used by the public as well as within educational and scientific circles. It is available in print, on CD-ROM, and through the Internet's World Wide Web (GPO Order Forms available and http://164.159.188.82). The NBS Exhibit will also feature the Interagency Taxonomic Information System (ITIS) which is the result of a partnership of federal agencies formed to satisfy their mutual needs for scientifically credible taxonomic information. Additional information on the ITIS and NBS's role in it may be found at http://trident.ftc.nrcs.usda.gov/itis/ and http://164.159.188.82.

The NBS Exhibit will also include the NBS World Wide Web Home Page Version 2 which uses exciting new Web technology that is fast and user-friendly. Accessing NBS infobases from home or field sites is now possible with only a low band-width requirement. The NBS Web Home Page Version 2 contains the latest NBS Fact Sheets, Funding Announcements and Press Releases, NBS Information Kiosk, Science Stories and K-12 Educational Materials, NBS's new premier scientific publication "Our Living Resources", Biology and Biodiversity Information and Databases, Other NBS Web Home Pages, Electronically Hosted Home Pages for NBS Programs and Partners, and Guides to Data and Information in the U.S. Government.

The NBS Exhibit also includes information on the Gap Analysis and NatureMapping Programs, the Man and the Biosphere Program and MABFauna, the MAB Biological Information System, the Wildlife Review/Fisheries Review CD-ROM, and the Success with Species at Risk in California Program.

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Michael Mac, Our Living Resources Status and Trends Report Manager, NBS, 202-482-2929 (Michael_Mac@nbs.gov).
Brand Niemann, NBS, NBS Home Page Version 2, 202-482-3989 (Brand_Niemann@nbs.gov).

SOURCES OF INFORMATION ON BIODIVERSITY

Interagency Taxonomic Information System (ITIS)

National Biodiversity Information Center (NBIC)

Electronic Directory of State Databases (NBS and FWIE)

SOURCES OF INFORMATION ON BIODIVERSITY

Interagency Taxonomic Information System (ITIS)

National Biodiversity Information Center (NBIC)

Electronic Directory of State Databases (NBS and FWIE)

SOFTWARE TOOLS

Expert-center for Taxonomic identification
- **World Biodiversity Database**
- **Linnaeus II**

MABFauna - metadata standard for Biosphere Reserve faunal databases

Biota - specimen-based biodiversity data

BIOMON - MAB/SI permanent plot software

Specialty software
- **Lanius**