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For a more complete report, see Federal Funding of Natural Resource Research and Development, 1978-1988, Kelly Day, unpublished thesis, University of Minnesota, August 1989.

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THE DEFICIT IN NATURAL RESOURCE RESEARCH

The deterioration in the nation's environmental protection resources under the Reagan administration should be cause for great alarm to environmentalists. Not only has there been a reduction in funds for dealing with present environmental problems but fewer funds are being set aside for environmental research. The science policy of the Reagan administration brought about shifts in research priorities that resulted in a divestment in natural resource and environmental research. Given the escalating environmental problems facing this nation, it is crucial that people who are concerned with environmental quality should be equally concerned with the research deficit. In this paper, we review the trends in the research budgets of the several natural resource agencies and discuss some of the implications of these trends for resource management and policy.

Loss of Research Capacity

The capacity of the federal government to respond to the natural resource and environmental problems facing the nation has been severely eroded over the last decade. While interest groups have focused considerable criticism on the direct assault of the Reagan administration on conservation and environmental programs, the weakening of agency research programs may be the most damaging. The Reagan administration's reductions in natural resource research has been destructive not only to our ability to protect the environment but has severely weakened our capacity to evaluate and resolve the problems that we will face over the next several decades.

Natural resources research is defined by the National Science Foundation as research activities which contribute to the management, conservation, and development of natural resources and the environment and encourage education and understanding of the environment. Natural resources research underwent a sharp transition between the Carter administration and the first Reagan administration. The Carter administration attempted to develop a science policy from a broad assessment of national needs. His administration maintained that the purpose of federal research and development was to provide a base for education, to stimulate productivity within industry, to provide standards for regulation, to ensure an adequate energy supply, to improve public health and to protect the environment and natural resources. Natural resource and environmental research was managed with the conviction that the nation valued natural resources intrinsically and not solely as marketable commodities. The administration believed that research and development policies should be consistent so as to assure long-term research and stable research opportunities.

The Reagan administration founded its natural resource and environmental research policy on a much more limited assessment of national needs. It attempted to formulate a set of policy objectives for the federal natural resource and environmental agencies consistent with the objectives of reduction of regulatory standards and enforcement, greater reliance on the free market for resource management and evaluation, privatization of certain public resources, and a decline in support for research and development.

By exercising the administrative powers of the Office of Management and Budget and by appointing to key positions persons sympathetic to Reagan's priorities, the administration was able to make dramatic changes in the level

and composition of natural resource and environmental research and development funding. Natural resource and environmental funding fell by 18 percent in real dollar terms between 1980 and 1988 and declined as a percentage of total federal research and development.

During the Reagan administration, natural resources research remained approximately unchanged in nominal terms and declined sharply in real terms (Figure 1 & 2). There were, however, sharp differences among agencies (Figures 3-4 and Tables 1 and 2). In general, conservation oriented research suffered greater reductions than research applicable to industry needs.

To facilitate discussion we divide natural resource research and development into three categories: environmental and conservation research, land and water research, and mining and minerals research.

Environmental and Conservation Research

Environmental and conservation research is conducted by the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, along with the U.S. Fish and Wildlife Service and the National Park Service. The EPA suffered a decline in funding of over seventeen percent between 1980 and 1985. The reduction of funding was compounded by leadership problems in the early eighties and recurrent agency reorganization. This led to a shift in the orientation of EPA research. A growing percentage of the EPA's declining research budget has been dedicated to supporting mandated regulatory objectives. Consequently, anticipatory and long-term research has been relatively weak at EPA. Research has been short-term and crisis oriented.

The regulatory functions of the EPA have not been adequately supported by the EPA research program. The scientific basis of EPA regulations has been criticized by the National Academy of Sciences, the General Accounting

Office, the House Committee on Science and Technology, and the Science Advisory Board. The EPA has faced numerous legal contests and criticism because standards were not based on adequate research.

The ineffectiveness of EPA research is especially critical as the EPA is facing a myriad of new and more complex pollutants. The EPA Science Advisory Board stated that traditional pollution abatement methods probably cannot control these new pollutants and they create problems that are less reversible than those of the past.

The question that arises is whether the EPA can solve fundamental problems with its currently limited funds. The decline in funding and the increasing responsibilities have resulted in research focused on solving problems after they impose social costs. The concentration of research efforts on existing problems does not bode well for the early identification and treatment of emerging problems.

The National Oceanic and Atmospheric Administration, which is responsible for national oceanic, coastal, and atmospheric resources, experienced a significant loss of administrative support during the Reagan administration. Representative James Scheuer stated that the administration has maintained a policy towards the NOAA "that ranges between neglect and open antipathy". Consequently, the agency has been unable to fully achieve its mandated objectives. This is due, in part, to the steep decline in research and development funding, evidenced by the fact that 1987 NOAA research and development constant dollar funding has fallen to less than the 1980 level of appropriations.

Since the Reagan administration began, the National Sea Grant College Program, which supports academic research of ocean resources and marine

science education, has been repeatedly targeted by the administration for elimination only to be revived by Congress. According to administrative funding proposals, Living Marine Resources, Endangered Species, and Marine Mammal research budgets would have been reduced to a disabling level had Congress not intervened.

NOAA research funding has changed substantially in composition. Atmospheric programs have maintained funding while ocean programs have declined considerably as a research priority. Undersea research and ocean dumping research has been eliminated or significantly reduced.

The deterioration in NOAA research funding has significant implication for future ocean and atmospheric management. Like the EPA, the decline in NOAA funding and leadership has resulted in research which is short-term and crisis oriented and reduces the capacity of NOAA to anticipate health and environmental problems before they reach critical and costly levels.

The National Park Service, which traditionally conducts relatively less research, is the only agency within this group to sustain real increases in funding (in 1982 dollars). The Park Service is also the only agency which determines its research appropriations internally. Funding decisions were made by the Service itself, rather than being proposed by the administration and approved by Congress.

Land and Water Research

The USDA Forest Service is the largest of the land and water resource management agencies. USDA Forest Service research has sustained considerable losses in human and monetary resources since peaking in 1980, despite strong congressional support. In spite of these losses, USDA Forest Service research has fared relatively well compared to most natural resource research agencies

because of the agency's perceived ability to contribute to the economy of many communities that are dependant on the forest industries for their economic base.

In current dollar terms, USDA Forest Service research funding reached its highest level in 1981. However, when corrected for actual purchasing power, USDA Forest Service research appropriations declined 23 percent since 1977.

The significance of the declines in constant dollar funding becomes more apparent after examining the changes in research scientist years and work units. The last year of the Carter administration marked the peak of scientist years for USDA Forest Service research. From 1980 to 1988, scientist years declined by 27.2 percent and research work units by 20 percent (between 1980 and 1986), reflecting a steady and persistent cutback of research programs (Table A-1).

Research priorities also changed during the Reagan administration. The four activities most applicable to industry, Trees and Timber Management Research, Forest Products and Harvesting Research, Forest Insect and Disease Research, and Forest Inventory and Analysis Research, increased from 40.5 percent of total appropriations in 1978 to 48.9 percent of the total in 1986 (U.S. Forest Service, unpublished data).

Watershed Management and Rehabilitation, and Fire and Atmospheric Research declined in priority between 1978 and 1986 (U.S. Forest Service, unpublished data).

Mining and Mineral Research

The mineral research group consists of the Bureau of Mines, the U.S. Geological Survey, the Office of Surface Mining, and Minerals Management. While mineral research has increased slightly in nominal terms, funding has

declined significantly in real terms. Between 1979 and 1986, research funding experienced a decline of over 23 percent in real terms.

Geological Survey is one of two natural resource agencies fortunate enough to have experienced an increase in real dollar funding during the Reagan administration. Two factors account for this. First, Geological Survey has benefitted from being a predominately scientific and technical organization while those agencies with conservation, preservationist and regulatory responsibilities found themselves with significant conflicts with the Reagan agenda. Secondly, Geological Survey was designated to conduct resource assessment. The increase in Geological Survey funding was compatible with the designated goals of a strong economy and defense. This increase was a significant component of the shift towards natural resource research that could be utilized by industry.

The Bureau of Mines has experienced a funding decline of over 42 percent since the Reagan administration began. According to the National Science Foundation, research has declined in the areas of health and safety technology and environmental technology.

The Loss of Research Capacity: What are the Costs?

There are four major consequences of the loss of research capacity in the natural resource agencies that will affect natural resources and environmental programs well into the 1990s. First, environmental regulations are based on increasingly less adequate scientific data. Regulatory systems of federal natural resource and environmental agencies are not supported by sufficient scientific evidence. Often the data are insufficient to justify either the regulation or the basis of the regulatory standard. The most publicized example is the regulatory functions of the EPA. Insufficient research funding

has resulted in regulatory functions which are inefficient and ineffective. Toxic and hazardous waste regulation has been especially handicapped by limited scientific information. Unresolved technical controversy and insufficient scientific data have slowed or prevented the expansion of hazardous substance regulation. Research failures to detect or control toxic and hazardous substances are even more serious as potentially dangerous chemicals are not being monitored and evaluated.

Second, long-term natural resource research and development is insufficient. While natural resource and environmental research appropriations have declined, long-term research has been cut much more severely. Those research activities with immediate commercial value were more likely to maintain appropriations under the Reagan science policy criterion. A bias towards commercially applicable research developed in a number of agencies. USDA Forest Service research became focused on forestry products and disease prevention for commercial forestry, as preservation, recreation and wildlife functions received less emphasis. The Sea Grant research program of NOAA shifted efforts towards the development of marine commodities resources. Geological Survey's Conservation of Natural Lands and Minerals Research function was eliminated. EPA underwent drastic changes in orientation during the Reagan administration as research priorities emphasized the development of low cost pollution control equipment.

Research and development program cannot sustain long-term goals without consistency in leadership, policy and funding. Unfortunately, without long-term research, prevention of natural resource and environmental problems diminishes and these issues are not explored unless costs are imposed on the health and well-being of society.

Third, the costs of reversing environmental problems increase with delay. At the current levels of research appropriations, data gathering is limited and there is a tendency among environmental policy makers to delay action until conclusive evidence is available. Historically, environmental problems have been left unrecognized or untreated until dangerous levels were reached. The hazardous waste crises of the Love Canal and Times Beach were not addressed until massive contamination became apparent. The costs of delaying action became apparent. The costs of delaying corrective action on several emerging environmental issues may be enormous. The pesticide/groundwater contamination and acid rain are urgent problems as water quality, soil quality, fish, birds and other animal resources are all at risk, and reversal may be impossible.

Fourth, the pool of scientists is declining. Throughout the Reagan administration, a number of natural resource and environmental agencies have been forced to reduce their research staff, due to declining appropriations. The reductions in personnel are even greater if falling declines in funding and grants to universities are taken into account. For example, the Fish and Wildlife Service has been unable to afford needed scientists, and has expressed concerns about the possibility of insufficient scientific personnel in the future. EPA research employment began falling within the first two years of the Reagan administration. The minerals group faces a significant drop in student enrollment in mineral programs. The Forest Service's supply of new scientists is declining dramatically, according to college and university enrollment figures. Reduction in support for training will make it increasingly difficult to recruit a new generation of resource and environmental scientists.

The consequences of the Reagan administration's treatment of the natural resource and environmental research establishment are acute as we are now facing more complex environmental problems. A number of significant environmental problems have emerged in the past ten years involving new pollutants which require a substantially higher level of scientific understanding and technical expertise. Three particularly serious problems have arisen: hazardous air pollutants, the green house effect and acid rain. There is indication that future environmental problems will be more costly to solve than those of the past. The declines in long-term research have reduced anticipatory faculties at the time when they may be needed most.

The election of President Bush, who has declared himself an environmentalist, offers some hope for a reversal in the deterioration in the nation's environmental resources. He has appointed a highly regarded conservationist, William Reilly, former president of the Conservation Foundation, as head of the Environmental Protection Agency. Manuel Luhan, Jr., Secretary of the Interior, despite a consistently pro-development and anti-conservation Congressional voting record, has indicated he shares the president's commitment to the environment.

If we have any hope of overcoming the resource and environmental problems facing our country, we must repair the foundation of our effort. Federal research agencies must be able to place a high priority on research if efforts to protect the environment and enhance environmental services are to succeed. Unfortunately, it will not be easy to rebuild the research capacity of the federal resource agencies. The decline in research budgets has been accompanied by an erosion of the salary structure. The federal agencies are less competitive with the private sector or the states than an decade ago.

The federal resource research programs continue to lose research program leaders and scientists to both the private sector and to the state agencies. The failure of the Congress to reform the federal salary structure this past January means that Luhan, Reilly and their colleagues have had great difficulty staffing their research programs.

The deficit in natural resource research has resulted in inadequate knowledge on which to base resource policy. Unless the erosion in resource agency research budgets is soon reversed, the costs of the Reagan environmental policy will be felt well into the next century.

Figure 1

NATURAL RESOURCE R&D

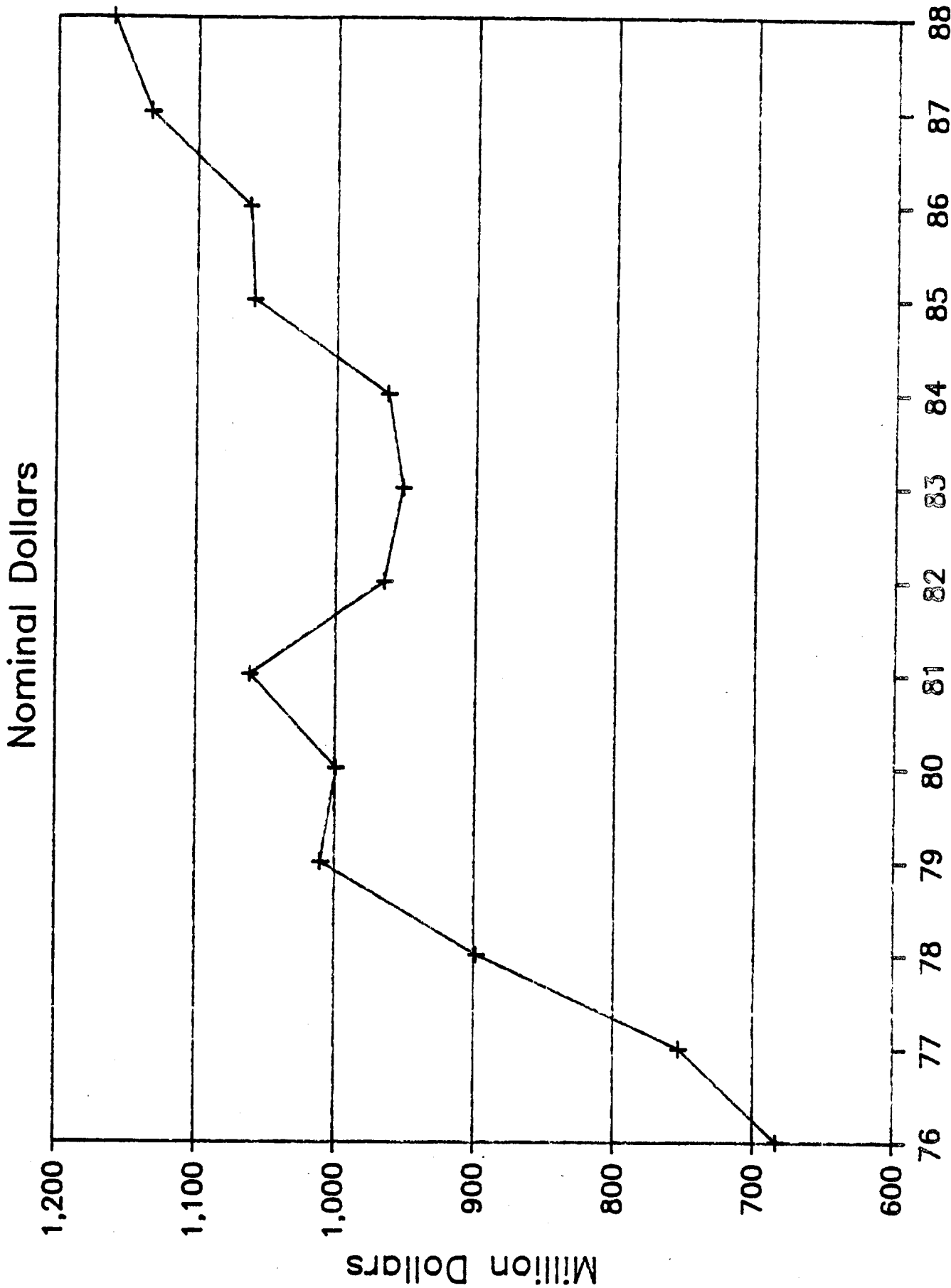


Figure 2

NATURAL RESOURCE R&D

Real 1982 Dollars

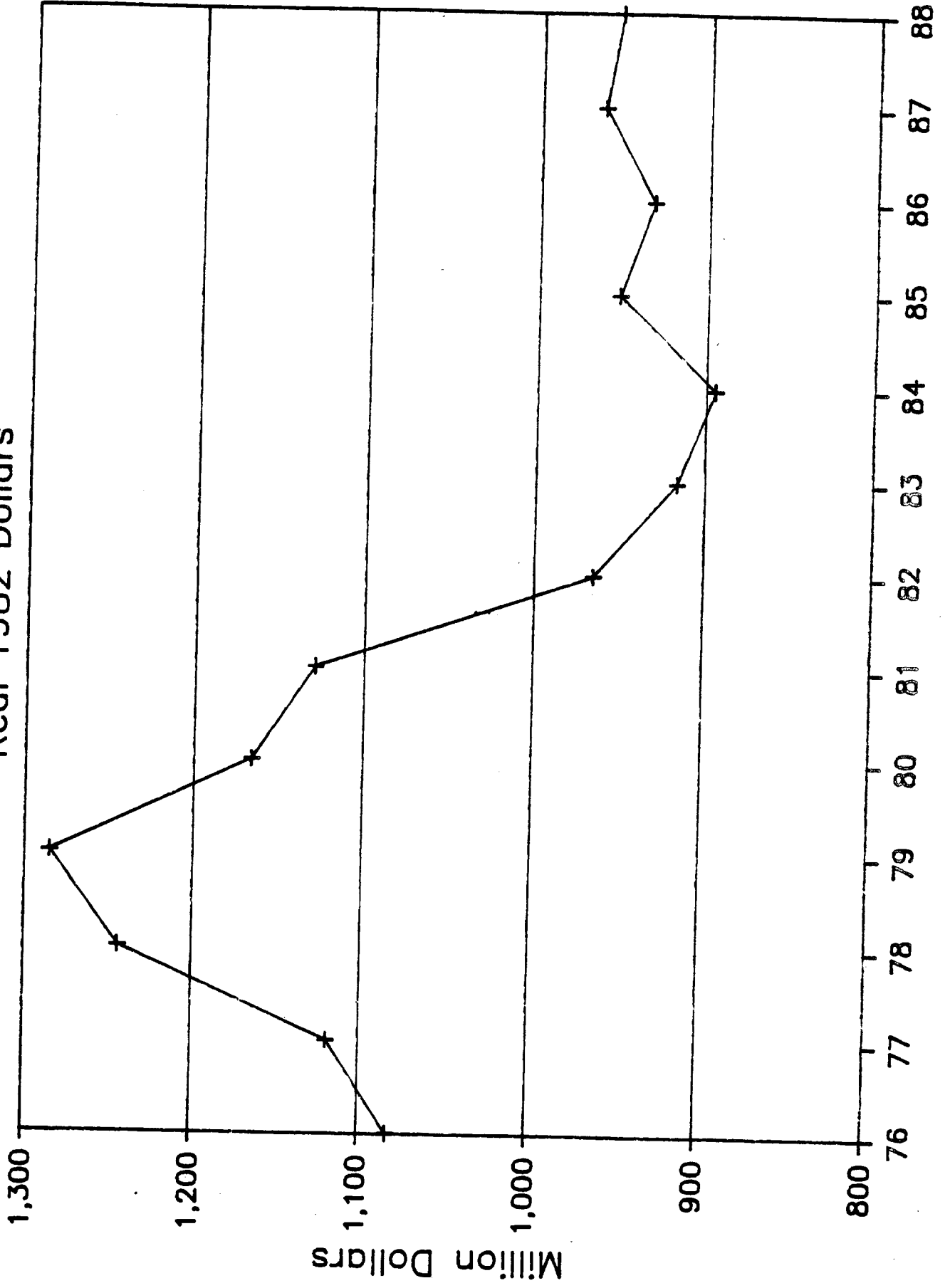


Figure 3

NATURAL RESOURCE R&D

Percent of Non-defense R&D

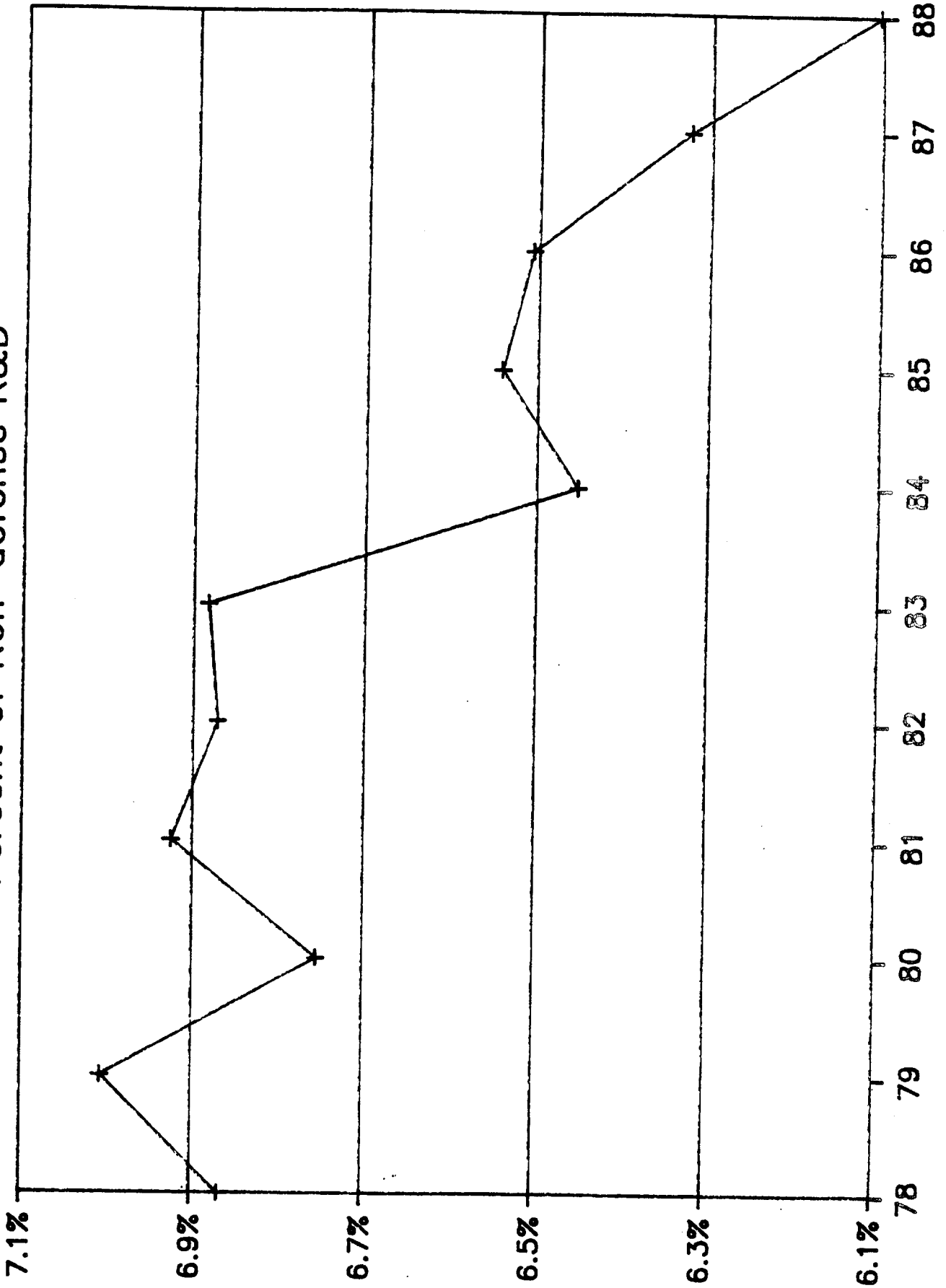


Table 1

FEDERAL FUNDING OF NATURAL RESOURCE RESEARCH AND DEVELOPMENT
Millions of Dollars

	78	79	80	81	82	83	84	85	86	87	88
Bureau of Land Management	1	1	2	2	5	7	4	3	3	3	
Bureau of Mines	117	125	106	97	92	97	91	83	79	87	92
Bureau of Reclamation	11	12	14	16	10	16	10	13	11	10	5
Corps of Engineers	27	26	39	30	29	29	28	33	34	30	33
Department of the Interior											6
EPA	249	283	239	271	222	206	223	258	268	284	300
Fish and Wildlife	30	81	89	95	99	104	60	49	46	54	59
Forest Service	107	111	112	128	112	108	109	114	114	127	136
Minerals Management						2	2	1	1		
National Park Service	9	8	9	8	12	11	14	15	16	18	19
NOAA	161	182	210	219	221	222	244	270	270	269	275
Office of the Secretary	2	3	2	1				2	1		
Office of Surface Mining	2	5	7	6	2	2	1	3	2	3	
Office of Water Research & Technology	25	28	30	18							
U.S. Geological Survey	158	146	150	170	149	147	177	215	219	227	236
	898	1010	999	1060	965	952	963	1059	1062	1133	1160

Source: National Science Foundation, Federal R&D Funding by Budget Function, 1978-1989.

Table 2.

FEDERAL FUNDING OF NATURAL RESOURCE RESEARCH AND DEVELOPMENT
Millions of 1982 Dollars

	78	79	80	81	82	83	84	85	86	87	88
Bureau of Land Management	1	1	2	2	5	7	4	3	3	3	
Bureau of Mines	162	159	124	103	92	93	84	75	69	76	76
Bureau of Reclamation	15	15	16	17	10	15	9	12	10	8	4
Corps of Engineers	37	33	45	32	29	28	26	30	30	25	27
Department of the Interior											5
EPA	345	360	270	287	222	200	207	232	234	241	247
Fish and Wildlife	42	103	104	101	99	100	56	44	40	46	48
Forest Service	148	141	131	136	112	104	101	103	100	108	112
Minerals Management						2	2	1	1		
National Park Service	12	10	11	9	12	11	13	13	14	15	16
NOAA	223	232	245	232	221	214	227	242	236	246	226
Office of the Secretary	3	4	2	1				2	1		
Office of Surface Mining	3	6	8	6	2	2	1	3	2	3	
Office of Water Research & Technology	35	36	35	19							
U.S. Geological Survey	219	186	175	181	149	141	164	193	191	193	192
	1244	1285	1166	1127	965	916	894	952	930	962	953

Source: National Science Foundation, Federal R&D Funding by Budget Function, 1978-1989.

Appendix 1. USDA Forest Service Research

Forestry research has sustained considerable reductions in research resources since 1981. Measures of scientist years, research locations, and research work units confirm the decline measures in constant dollars in Table 2. The USDA Forest Service was the only natural resource agency that was able (or willing) to provide time series data on scientist years devoted to research.

Table A-1. USDA Forest Service scientist years, research locations and work units

	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1989</u>
Scientist years	949	962	972	986	958	908	838	813	799	747	710	718
Research locations	86	86	86	86	85	83	80	76	76	76	76	74
Work units	253	247	245	248	242	235	219	217	200	199		

Source 1977-1986 data: Geise, Ronald. "Forestry Research: An Imperiled System," Journal Of Forestry (vol. 86, no. 6, p. 17.)

Source 1987 data: USDA Forest Service. Report of the Forest Service, FY 1987.

Source 1988 data: USDA Forest Service. Report of the Forest Service, FY 1988.