A Report by a Panel of the

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION

for the Smithsonian Institiution, the Office of Management and Budget, and the Office of Science and Technology Policy

Scientific Research at the Smithsonian Institution

October 2002

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION

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FOREWORD

One of Washington's best-kept secrets is the role that the Smithsonian Institution plays in scientific research, the type that goes far beyond what it displays in its museums on the National Mall. In addition to research on the extensive collection at the Museum of Natural History, the Smithsonian has varied research programs at its Conservation Research Center in Front Royal, Virginia, its astrophysical observatory in Cambridge, Massachusetts, its Tropical Research Institute headquartered in Panama, its Environmental Research Center in Edgewater, Maryland, and its Center for Materials Research and Education in Suitland, Maryland.

Questions about continued funding for scientific research were raised during the Fiscal Year 2003 budget process. As a result, the National Academy of Public Administration (NAPA) and the National Research Council (NRC) of the National Academy of Sciences were asked to study numerous issues related to this issue. This report is one of two being issued by the academies.

As indicated in these reports, there is agreement that there should be continued appropriations funding for support of scientific research at the Smithsonian. The Smithsonian's role in scientific research is unique and should be preserved as an integral part of the nation's overall research efforts. At the same time, however, Smithsonian management itself can do more to improve communications with the science centers and demonstrate support for an "increase in knowledge."

This study served as a model of cooperation between the two academies. I want to thank the Panel that directed and guided the NAPA portion of this study and the Committee that carried out the NRC examination. I also extend my appreciation to the project team for its hard work, and to Smithsonian officials and staff for their excellent cooperation.

Robert J. O'Neill, Jr.
President
National Academy of Public Administration

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EXECUTIVE SUMMARY

The Smithsonian Institution is a unique organization, established in 1846 "for the increase and diffusion of knowledge among men." It has grown over the years and is now composed of 16 museums and galleries, the National Zoo, and numerous research facilities in the United States and abroad. The Smithsonian participates in the annual federal budget process to receive funding though the federal appropriations process. In Fiscal Year (FY) 2001, it received 57 percent of its funding through federal appropriation. The remainder came from government grants and contracts, contributions and private grants, business ventures, and investment earnings.

During development of the FY 2003 budget, several issues arose concerning funding of scientific research in the Smithsonian. The President's FY 2003 budget indicated that, of all the research "agencies" listed, only the Smithsonian did not subject its research to any form of competition. The budget proposed to increase competition by transferring some of the Smithsonian budget to the National Science Foundation (NSF) where it could be used to fund research for which Smithsonian and other organizations researchers could compete. The Smithsonian objected to the characterization of its research and the transfer.

The National Academy of Public Administration (NAPA) and the National Research Council (NRC) of the National Academy of Sciences were jointly commissioned to study this issue. NRC's assignment was to determine whether there are research programs at the Smithsonian where funding should be awarded through a competitive grant process open to all public and private sector researchers. NAPA's assignment focused on determining Smithsonian research program costs; examining research management models used by other academic institutions, museums, and private organizations; and identifying factors that might give the Smithsonian scientists an unfair advantage over others when competing for funds.

The studies' scope includes the six science centers that report to the Smithsonian's Under Secretary for Science:

- the National Museum of Natural History
- the Smithsonian Astrophysical Observatory
- the National Zoological Park
- the Smithsonian Tropical Research Institute
- the Smithsonian Center for Materials Research and Education
- the Smithsonian Environmental Research Center

In carrying out its assignment, the NAPA Panel looked at various topics, including the reliability of budget figures for Smithsonian research, the degree to which competition is a factor in Smithsonian research funding, and factors that may produce an uneven "playing field" in the competitive processes. Because of the organization of the study, some of NAPA's work in these areas was dependent on the NRC findings. NRC's five recommendations are referenced in this report, and the NRC report's executive summary, "Funding Smithsonian Scientific Research," is included as Appendix B.

NAPA CONCLUSIONS AND RECOMMENDATIONS

The NAPA Panel finds that:

- Data for Smithsonian scientific research, included in the budget and accompanying explanatory material, engender a low level of confidence. Data for the science centers were found to be more reliable, although there are problems at that level, as well. **The Panel recommends that funding decisions and related analyses rely on the actual cost of running the science centers, with appropriate adjustments, rather than the research estimates currently presented in the budget**.

- Appropriations provide the Smithsonian with funds for core support functions and salaries of researchers who develop proposals. Contrary to the impression given in the FY 2003 special budget analysis, Smithsonian researchers compete for (and obtain) a significant proportion of their research funds through competitive grants and contracts.

The appropriations provide a continuity of core support that makes it possible for Smithsonian scientists to maintain the requisite capacity to compete for grants and contracts. In turn, these grants and contracts provide the necessary funding for associates, post-doctoral researchers, travel, equipment, and other costs for conducting research. **The Panel recommends the continuation of core support appropriations for all Smithsonian science centers consistent with the NRC report recommendations.**

- Numerous factors may tilt a competitive process toward different organizations competing for grants and contracts, but Smithsonian researchers do not have a consistent advantage when they seek competitive funding. It is widely held that scientific merit is, and should be, the primary determinant of competitive decisions, although other factors sometimes influence the outcome. The Smithsonian has a lower overhead rate than many other institutions, but this does not appear to provide a significant advantage as grant review panels focus almost entirely on the scientific merit of proposals. Overhead only is a factor when discussing bottom line funding. In addition, some believe that the Smithsonian has an advantage because its researchers receive 12-month salaries under federal appropriations, in contrast to academic year salaries paid by some universities. The NAPA Panel found that this is only one of several compensation and resource factors that may give the Smithsonian or other competitors a theoretical advantage in a given situation. Yet, the Panel found evidence that the Smithsonian is disadvantaged when applying for NSF funds. The situation is not clear, and it appears that perceptions—both at NSF and the Smithsonian—may be creating barriers.

The Panel recommends that the Under Secretary for Science examine the perceptions and practices of the science centers' researchers and managers regarding NSF grants, and establish a mechanism for keeping them informed of changes and best practices.

The Panel recommends that the Under Secretary for Science meet with the NSF Director to clarify and explore reformulating the Smithsonian-NSF relationship concerning the eligibility of Smithsonian scientists to compete for NSF funding.

CONCLUDING COMMENTS

The NAPA Panel reviewed and concurs with the NRC Committee's findings and recommendations. Both the Panel and Committee noted some weaknesses in communications between the Smithsonian's central management and the science centers. The NRC report recommends that the Secretary and Board of Regents improve these communications and become strong advocates for the science centers goals and achievements. The NAPA Panel found that scientific staff are seriously concerned that science is no longer recognized as a critical component of the Smithsonian agenda.

The NAPA Panel believes that the Secretary has an opportunity to demonstrate support for the "increase of knowledge" by tying specific institution level fundraising initiatives to scientific endeavors as part of the strategic planning process. The Panel urges the Secretary to seek ways to demonstrate that science is an important priority of the Smithsonian—possibly by making the Smithsonian's scientific research activities and their results more public.

The NAPA and NRC studies addressed different aspects of similar issues, making joint coordination and cooperation vital. This was accomplished through joint participation in meetings and frequent staff interaction.

CHAPTER 1
INTRODUCTION

The Smithsonian Institution was established by an Act of Congress in August 1846 "for the increase and diffusion of knowledge among men," fulfilling the purposes contained in the bequest of an Englishman, James Smithson. Today, the Smithsonian is composed of 16 museums and galleries, the National Zoo, and numerous research facilities in the United States and abroad. Federal appropriations and other funding sources support scientific research activities, among others. Although the Smithsonian is unique in this regard in the United States, support of research activities is common for national museums worldwide.

During development of the FY 2003 budget, the U.S. Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) proposed an independent review of the Smithsonian science research programs that would specifically address the issue of competition. The Smithsonian, OMB and OSTP asked the National Research Council (NRC) of the National Academy of Sciences and the National Academy of Public Administration (NAPA) to conduct this review.

BACKGROUND OF PROJECT

The FY 2003 budget includes a table that categorizes how federal agencies allocate their research funds. The categories range from merit-reviewed and externally evaluated competitive awards to research performed at congressional direction (see Table 1-1). Other categories reflect more limited competition areas, and a category titled inherently unique refers to organizations that direct all research funds to intramural research. Table 1-1 places 100 percent of the Smithsonian's research in the inherently unique category. The Smithsonian previously was aggregated with other small entities in the "other" category because it has a relatively small research budget.

For FY 2003, OMB proposed reducing the Smithsonian's funding by $35.7 million and transferring the funds to the National Science Foundation (NSF). Under this arrangement, the Smithsonian and others were expected to compete for the funds. The Smithsonian strongly protested this proposal, which was designed to increase competition in the research funding process. Chapter 3 details the extent to which the Smithsonian is involved in competitive funding processes.

The ensuing discussions about the proposed funding reductions provided the impetus for this study. OMB and OSTP agreed that NRC and NAPA were best equipped to conduct it. The NRC was tasked with determining whether the Smithsonian had research programs with funding appropriately awarded through competitive grant processes open to all public and private sector researchers. NAPA's task was to focus on how the Smithsonian research budget should be revised based on the NRC's findings, and assess whether the Smithsonian enjoyed an unfair advantage given its federal appropriation support in competing for grants.

SMITHSONIAN INSTITUTION

The Smithsonian has grown in many ways in its 156 years. Historically significant events, ranging from the 1846 signing of the Act of Organization to the 1999 opening of the National Museum of the American Indian Culture Resources Center, are listed in Table 1-2.

Table 1-1
Excerpt from the President's 2003 Budget

By Agency	Research Performed at Congressional Direction		Inherently Unique Research		Merit-Reviewed Research with Limited Competitive Selection		Merit-Reviewed Research with Competitive Selection and Internal Evaluation		Merit-Reviewed Research with Competitive Selection and External Evaluation		Total	
	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002	2001	2002
Health and Human Services.....	89	142	206	230	2,392	2,718	201	216	17,777	20,126	20,665	23,432
Energy.....	134	223	1,078	1,068	2,382	2,820	305	395	821	788	4,720	5,294
Defense*.....	678	426	295	350	1,012	1,014	2,712	2,950	247	221	4,944	4,961
National Aeronautics & Space Admin.....	230	287	152	149	532	398	1,377	1,550	1,894	2,291	4,185	4,675
National Science Foundation.....	0	0	0	0	191	206	184	192	2,700	2,887	3,075	3,285
Agriculture**.....	105	122	815	893	720	676	0	0	206	157	1,846	1,848
Commerce.....	18	21	354	377	100	108	204	218	142	166	818	890
Veterans Affairs.....	1	0	0	0	2	2	349	370	381	408	733	780
Interior.....	27	48	156	154	379	392	26	31	2	3	590	628
Transportation.....	55	82	69	73	0	0	338	380	0	0	462	535
Environmental Protection Agency.....	39	60	39	38	195	192	69	68	133	130	475	488
Education.....	5	0	0	0	0	0	0	0	169	180	174	180
Smithsonian Institution.....	0	0	108	111	0	0	0	0	0	0	108	111
Other.....	385	413	11	7	17	17	76	74	6	6	495	517
Total.....	**1,766**	**1,824**	**3,283**	**3,450**	**7,922**	**8,543**	**5,841**	**6,444**	**24,478**	**27,363**	**43,290**	**47,624**

* Allocation among categories is preliminary.

** Does not include net mandatory funding for USDA Research grant programs of $120 million in FY 2001.

Particularly important are the six science centers that are this study's focus. The centers were established between 1890 and 1965 and have been widely recognized as world-class institutions throughout the scientific community.

Organization of the Smithsonian

The Smithsonian is governed by a Board of Regents, whose members act as trustees to ensure that the Institution continues to fulfill the intent of the original bequest. The Board includes members from all three branches of government along with citizen regents. The Chief Justice of the Supreme Court serves as Chancellor. The Board of Regent's primary obligation is to manage resources and provide for the care of the collections. It is solely responsible for policy and asset management oversight. For example, a Science Commission, which will receive the NAPA and NRC studies, was established by the Board at the Secretary's recommendation.
The Secretary of the Smithsonian is selected by the Board of Regents. He manages the Institution with two Under Secretaries, one for Science, and another for American Museums and National Programs. In addition, a Director for International Art Museums, a Chief Executive Officer for Business Ventures, a Chief Financial Officer, a Chief Information Officer, a Director of Facilities Engineering and Operations and several staff offices report directly to the Secretary. The Smithsonian organizational structure is shown in Chart 1-1.

Smithsonian's Science Centers

The Smithsonian's scientific research is concentrated in six research centers that report to the Under Secretary for Science. These centers are:

- **The National Museum of Natural History (NMNH),** located in Washington DC, hosts the world's largest group of scientists dedicated to the study of natural and cultural history. Much of its research is based on the Smithsonian's collection of more than 140 million specimens of plants, animals, fossils, minerals, rocks, meteorites, and human arti-facts. The museum also has a research station in Fort Pierce, Florida

- **The National Zoological Park (NZP),** located in Washington DC, carries out most of its research at the Conservation and Research Center (CRC) in Front Royal, Virginia. The Zoo's research program deals with reproductive biology, veterinary medicine, animal behavior, conservation ecology and nutrition, population management, biodiversity monitoring, and professional training in these disciplines.

- **The Smithsonian Astrophysical Observatory (SAO),** headquartered in Cambridge, Massachusetts, partners with Harvard University to form the Harvard–Smithsonian Center for Astrophysics. The center scientists are engaged in a broad research program in astronomy, astrophysics, earth and space sciences, and science education. SAO has facilities in other locations including, Massachusetts, Arizona, and Hawaii.

- **The Smithsonian Tropical Research Institute (STRI),** located in Panama, conducts research in Panama and elsewhere to understand the behavior, physiology, ecology, and evolution of life in the tropics, including human ecology, social anthropolgy and the archeology of pre-Columbian societies.

- **The Smithsonian Center for Materials Research and Education (SCMRE),** located in Suitland, Maryland, provides technical support to the Smithsonian museums in the analysis and conservation needs of their collections. It also supports other museums in the areas of conservation, preservation, technical study, and analysis of museum collections and related materials.

- **The Smithsonian Environmental Research Center (SERC),** located in Edgewater, Maryland, advances stewardship of the biosphere through interdisciplinary research and educational outreach. SERC's scientists study a variety of interconnected ecosystems at the primary research site and affiliated sites around the world.

One scientific research activity is not included in this review: a small research unit within the National Air and Space Museum, which reports to the Under Secretary for Museums. The studies' sponsors have agreed that this unit should

Table 1-2. Timeline of Key Historical Events
(Science Units in NAPA Study Bolded)

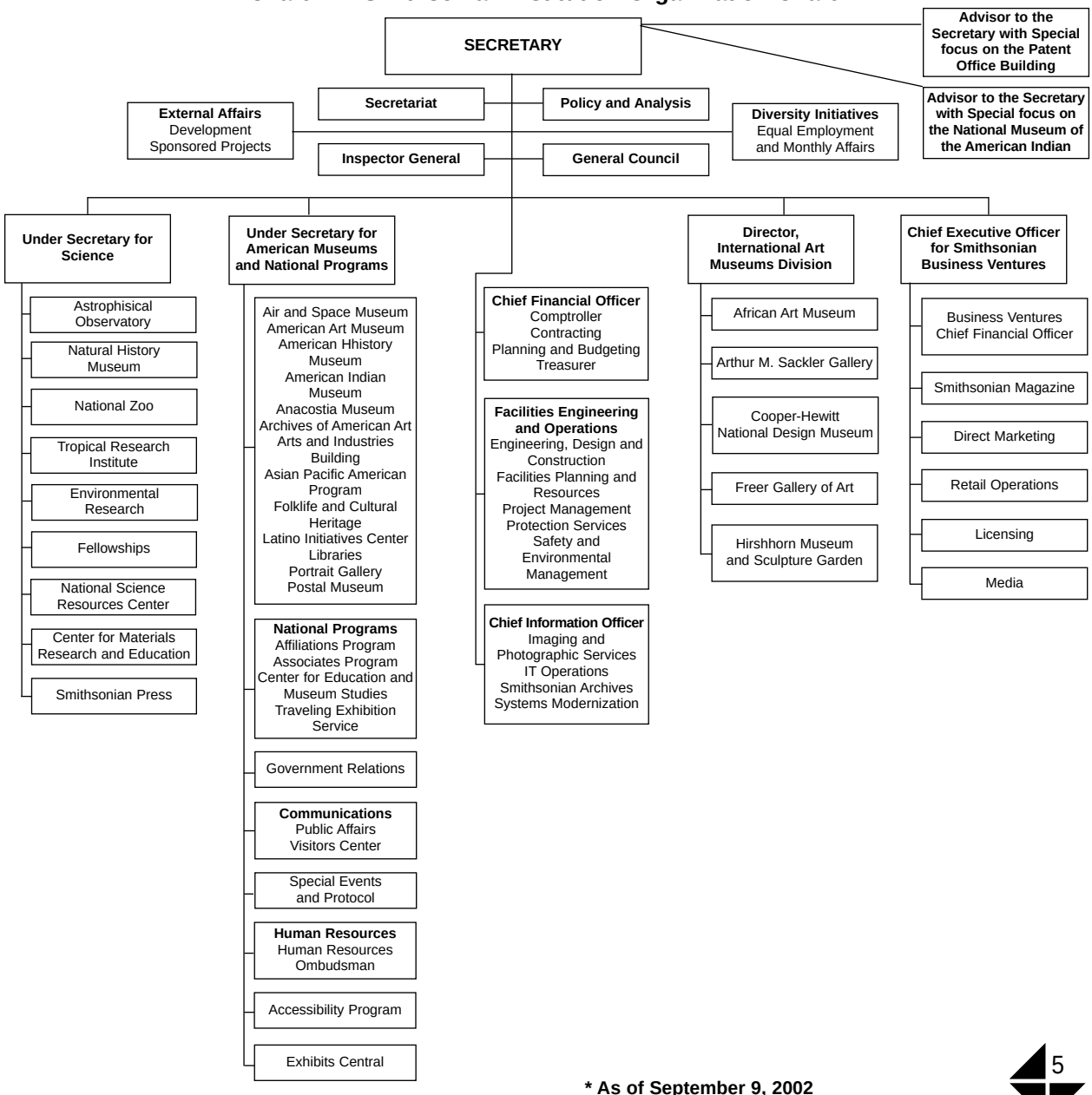
1846	Smithsonian Act of Organization passes in Congress
1846	President James K. Polk signs Smithsonian Act of Organization into law
1848	Smithsonian publishes its first book, Smithsonian Contributions to Knowledge
1849	Smithsonian initiates International Exchange Service
1855	Smithsonian Building completed
1858	Smithsonian is designated the National Museum of the United States
1879	Congress establishes the Smithsonian's Bureau of Ethnology
1881	Arts and Industries Building opens in October
1890	**Smithsonian Astrophysical Observatory is established as a separate bureau**
1891	**National Zoological Park opens in April in the Valley of Rock Creek**
1910	**National Museum of Natural History opens in March**
1943	Freer Gallery of Art opens
1946	**Smithsonian Tropical Research Institute is made part of the Smithsonian**
1963	**Conservation Analytical Laboratory (now Smithsonian Center for Materials Research and Education) established**
1964	National Museum of American History opens in January
1965	**Smithsonian Environmental Research Center established**
1967	Anacostia Museum opens in September
1968	National Museum of American Art and National Portrait Gallery open in the Old Patent Office Building
1968	Cooper-Hewitt, National Design Museum becomes part of the Smithsonian
1972	Renwick Gallery opens in January
1972	Hirshhorn Museum and Sculpture Garden opens in October
1976	National Air & Space Museum opens in its own facility in July
1978	National Museum of African Art established
1983	Museum Support Center opens in Suitland, Maryland
1987	Arthur M. Sackler Gallery opens in September
1989	National Museum of the American Indian established
1990	National Postal Museum established
1994	National Museum of the American Indian Gustav Heye Center opens in New York City
1999	National Museum of the American Indian Cultural Resources Center opens in Suitland, Maryland

not be included, but that generally applicable findings and recommendations for the science centers would be applied to it, as well.

How the Smithsonian is Financed

The Smithsonian receives its revenues from a variety of sources, including federal appropriations, grants and contracts from federal agencies, and private sources. Funds other than federal appropriations are treated as "trust funds." As shown in Chart 1-2, 57 percent of the Smithsonian's FY 2001 revenue came from a direct federal appropriation, and the remainder from trust funds. Federal grants and contracts made up more than a quarter of the trust funds and 12 percent of total Smithsonian revenue. The appropriated funds are provided in three accounts: salaries and expenses; repair, restoration, and alteration of facilities; and construction. The Smithsonian normally uses appropriated funds for collections activities, protection services, salaries and staff support, and a small portion of the research activities. The Salaries and Expenses appropriation has increased for the past 3 years as shown in Table 1-3.

Chart 1-1. Smithsonian Institution Organization Chart*



*** As of September 9, 2002**

Legal Standing of the Smithsonian

The Smithsonian describes itself as a "trust instrumentality of the federal government." However, many perceive it to be a federal agency since most of its funding comes from federal appropriations, and most of its employees are federal employees. This issue is important for several reasons, including the Smithsonian's relationship to the Executive Branch generally, and OMB specifically. Its legal status also may shape its relationship with Congress and its standing with federal agencies that fund research. The Smithsonian's relationship, with NSF is especially important and is addressed in Chapter 4.

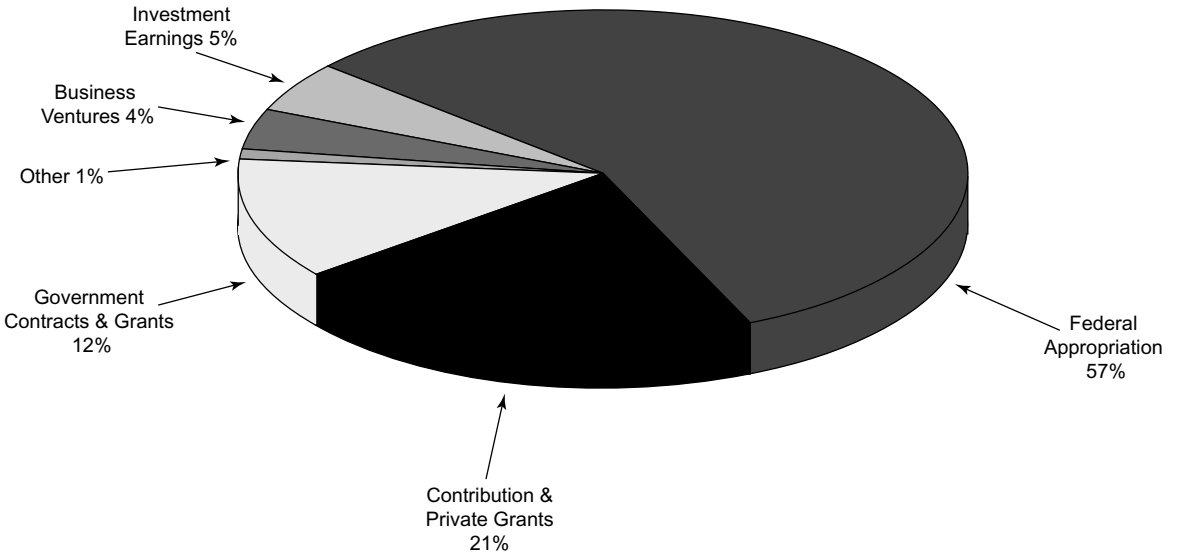
The legal standing and responsibilities of the Smithsonian, its Board of Regents, and staff have been a matter of longstanding interest and dispute. As a result, court and General Accounting Office (GAO) opinions have been issued. In each case, the underlying issue was whether the Smithsonian was subject to the same laws as federal agencies. Concerning the Smithsonian's status with respect to procurement, the U.S. Comptroller General concluded that the Board of Regents has authority to enter into lease or concession agreements without being "subject to any laws requiring advertising of government contracts" (1961 U.S. Comp. Gen. LEXIS 2585).

Table 1-3. Smithsonian Funding

FISCAL YEAR	AMOUNT
2001 Appropriation	$406 million
2002 Appropriation	$440 million
2003 Request	$455 million

In a 1963 case, The Controller General ruled that the operation of the National Zoological Park should be treated the same as a government agency when depositing revenues to the Treasury. He said that, "It is our understanding that the National Zoological Park is the property of the United States and not a part of the lands appropriated to the Smithsonian" and that the Board of Regents was subject to

Chart 1-2. FYI 2001 Sources of Revenue



Source: "Annual Report for the Smithsonian Institution, 2001"

all restrictions applicable to government administrative officials. However, he later overturned this decision stating that, "the requirements for the deposit of gross amounts of receipts from activities supported by appropriated funds into the general fund of the Treasury as miscellaneous funds need not apply to Zoo operations" (1972 U.S. Comp. Gen. LEXIS 185).

In 1997, the Smithsonian appealed a district court decision that awarded damages to an employee under the Privacy Act (5 U.S.C.S. 552a). To be an agency under the Privacy Act, the Court of Appeals reasoned that an entity (the Smithsonian) had to qualify as an authority of the U.S. government under Section 551(1) or have executive department status as defined under Section 552(f) (1997 U.S. App. LEXIS 28771). The court determined that Smithsonian authority "appears to be entirely ancillary to its cultural and educational mission," not "governmental in nature to count for Section 551(1) purposes." Furthermore, it decided, "because the Smithsonian is not an establishment in the executive branch, it cannot fall into any of the conceivably applicable Section 552(f) categories." The earlier district court judgment was reversed because neither condition was met.

Distinguishing the Smithsonian's federal appropriation from its trust funds also has been at issue. One case before the U.S. Comptroller General, concerned the Smithsonian's general authority to enter into joint contracts to purchase new acquisitions (1980 U.S. Comp. Gen. LEXIS 3152). The U.S. Comptroller General held that "the Smithsonian Institution has statutory authority to expend its private, unappropriated fund as the Regents deem 'best-suited' to promote the purposes of the trust." In a separate case, a former Smithsonian employee charged that he was entitled to civil service retirement credit under the Civil Service Retirement System (1990 U.S. App. LEXIS 11240). The court ruled that the employee was hired on to the "private roll" and paid from private trust funds, not federally appropriated funds. Thus, he was not entitled to federal retirement credit.

While these are narrow issues, the decisions point in the same direction—that the Smithsonian should not be treated as a federal agency for many purposes.

THE THREE STUDIES

The NAPA and NRC studies addressed different aspects of similar issues, making joint coordination and cooperation vital. This was accomplished through joint participation in meetings and frequent staff interaction. The specific focus of these studies is detailed below. A third related study, conducted by a Science Commission established by the Smithsonian Board of Regents, took place at the same time as the others.

The NRC Study

The NRC was asked to examined the following questions:

1. Are there portions of the Smithsonian research portfolio, which for reasons of their special contribution or uniqueness, should be exempted from being prioritized within that field via a competitive peer reviewed grants program open to all researchers in the public and private sector? Conversely, could some or all of the funds now allocated by the federal government as support for Smithsonian science programs be used more effectively for science if the funds were awarded through a competitive process open to all research performers?

2. What are the implications for Smithsonian science programs and for the relevant scientific fields if only those Smithsonian science programs determined to be unique or exempt continue to receive direct federal appropriations?

3. For those exempted Smithsonian science programs, how should the quality of this work be regularly evaluated and compared against other research in the relevant fields?

The final NRC report, "Funding Smithsonian Scientific Research," is being released concurrent with the NAPA study. So that its conclusions and recommendations could be reviewed and considered for incorporation in this report, NAPA received an advance copy of the report.

The executive summary of the NRC report is included as Appendix B.

The NRC report includes five recommendations:

1. Research is an intrinsic part of the mission of the National Museum of Natural History and National Zoological Park. These centers should continue to be exempt from open competition for research funding because of the uniqueness and special contributions conferred by association with their collections.

2. The Smithsonian Center for Materials Research and Education occupies a highly specialized research niche that is of unique and major value to museums of the Smithsonian Institution and to the museum community at large. Hence, the Committee believes that the Center should continue to be exempt from open competition for research funding because of its uniqueness and special contributions to the museum community.

3. The Committee believes that the Smithsonian Astrophysical Observatory, the Smithsonian Tropical Research Institute, and the Smithsonian Environmental Research Center should continue to receive federally appropriated research funding. Use of public funds by these facilities is already producing science of the highest quality. Much of the "research funding" (for other than salary and infrastructure costs) is already obtained via competition. Any benefits of shifting these three facilities to the jurisdiction of another organization would be greatly outweighed by the harm done to their contributions to the relevant scientific fields.

4. Regular in-depth reviews by external advisory committees are essential for maintaining the health, vitality, and scientific excellence of the Smithsonian Institution. Although details of the nature and processes of the reviews may vary to accommodate differences among the six centers, such institutional reviews should be uniformly required for all six Smithsonian science centers and for their individual departments, if warranted by their size. Retrospective external peer review is especially important for areas not routinely engaging in competition for grants and contracts. Regular cycles of review followed by strategic planning offer the best means of ensuring that the quality of Smithsonian's science is maintained.

5. The research programs at the Smithsonian Institution provide essential support to the museums and collections, make substantial contributions to the relevant scientific fields, and fulfill the broader Smithsonian mission "to increase and diffuse knowledge." The Committee urges a stronger sense of institutional stewardship for these research programs as integral components of the Smithsonian. The Secretary and the Board of Regents should improve communication with the research centers and become strong advocates for their goals and achievements in a manner that is compelling to the Executive Branch, Congress, and the public.

The NAPA Study

NAPA was asked to address the following questions:

1. How do other research institutions divide research programs between in-house and competitive programs?

2. Based on an analysis of the Smithsonian scientific research budget, the comparison with comparable research institutions, and the results of the NRC part of the study; what amount of base funding should the Smithsonian Institution apply to its unique research programs? What amount of research funds should be awarded based on a competitive process?

3. If it is determined that some portion of the Smithsonian's base scientific research funding should be subject to competition; what alternative strategies could be considered for competing such funding? What are the implications of potential changes in base support for the overhead rates that would be applicable under the competitive strategies? How do these rates compare with similar research institutions? What mechanisms should be used to help assure a level playing field for such competition?

In light of the NRC's recommendations, it was not necessary to directly address many of these

questions. However, the Panel believes that the research and analysis it did in preparing to answer them provides significant value. Thus, this work is presented along with recommendations that should aid the Smithsonian, OMB, and OSTP in the management and review of the Smithsonian science programs.

The Science Commission Study

The third study, which is being completed by the Science Commission established by the Smithsonian Board of Regents, is designed to advise the Secretary and the Board of Regents on a variety of matters related to Smithsonian scientific research activities. Congressional language directs the Smithsonian not to make any changes to its science programs until the Science Commission has reported.

Early on, the Commission made clear that it viewed the NAPA and NRC studies as important contributions to its work. A cooperative relationship was subsequently maintained between the NAPA Panel and study team and the Chair of the Science Commission.

The Science Commission is addressing the following questions:

1. How should the Smithsonian set priorities for scientific research in the years ahead and, in general, carry out its historic mission more effectively?

2. How should scientific research be organized to optimize the use of the Institution's human, physical and financial resources?
How should the performance of scientific research by individuals and research departments be evaluated?

3. How can the relationship between research and public programming be enhanced?
What suggestions, of any type might the Science Commission have to strengthen research at the Smithsonian?

4. What should be the qualifications of those chosen to lead key scientific research units of the Smithsonian?

5. What should be done to enhance public recognition of Smithsonian science?

A list of the Science Commission members is included in Appendix C.

OBSERVATIONS ON CULTURE AND INTERACTION OF SCIENTISTS

Since it is generally agreed that both the quality and quantity of the Smithsonian's research is dependent on these key players, the NAPA study team focused particular attention on principal investigators. Information was collected about the cultures of the science centers, including examples of how they differ from each other. Although data were collected from a limited sample of investigators the observations may be useful to the Science Commission and Smithsonian management as they approach their tasks. Appendix D summarizes the observations. As the study team reviewed current literature and visited research institutions, it developed an awareness of the importance that research institutions are placing on increased interaction of scientists from different disciplines. This information is contained in Appendix E.

METHODOLOGY

The views expressed in this document are those of the Panel alone. They do not necessarily reflect the view of the Academy as an institution.

The diversity of Smithsonian research, the interdependence of the NAPA and NRC studies, and the scope of the issues addressed by the NAPA Panel necessitated a multifaceted approach to data collection and analysis. The steps taken are summarized below:

- Interviews were conducted with Smithsonian officials and principal investigators in the science centers, as well as staff in the administrative offices. The principal purpose was to develop a general understanding of the Smithsonian and the nature of the scientific research conducted in the science centers. Group discussions with principal investigators allowed the NAPA study team to collect additional in-depth information.

- Interviews were conducted with officials from OMB and OSTP to determine their perspectives on the issues under review.

- "Targeting Interviews" were conducted with associations representing museums, universities, and corporations to help identify individual organizations that could provide useful insights and management models. Interviews were subsequently conducted with individual museums, universities, zoos, a botanical garden, corporations, and other private and public organizations. Appendix F lists all individuals and organizations interviewed, both inside and outside the Smithsonian.

- To help ensure effective coordination, NAPA study team members attended meetings and participated in informal discussions with members of NRC and the Smithsonian Science Commission, and attended formal NRC meetings. NRC representatives also attended NAPA Panel meetings.

- Published material was collected, catalogued, and reviewed. This material included budgets, strategic plans, annual reports, documents prepared by the Smithsonian for the Science Commission and NRC, publications from the Smithsonian and other organizations visited, and prior NAPA and NRC reports. A selected bibliography is provided in Appendix G.

- Panel meetings provided opportunities for the NAPA Panel to direct and oversee the work of the study team during the design of the work plan; data collection and analysis; identification of critical issues; and final report drafting. Three Panel meetings and one teleconference were conducted, including one in which Smithsonian and OMB officials participated. Biographical sketches of the Panel members and the study team are in Appendix A.

ORGANIZATION OF THIS REPORT

The remaining chapters are:

- Chapter 2 which focuses on the funding of Smithsonian Institution scientific research programs

- Chapter 3 which deals with questions about Smithsonian's involvement in competitive funding of research, and related core support activities

- Chapter 4 which addresses factors relevant to a level playing field in competitive research funding. These factors include facilities and administrative costs, researcher salaries and access to National Science Foundation (NSF) funding.

CHAPTER 2
SCIENTIFIC RESEARCH FUNDING AT THE SMITHSONIAN

Determining the funding strategy and budget amounts for scientific research is a key question for this study. It involves two steps. First, the NRC task was to recommend the research programs that should continue to be funded through direct appropriations, as opposed to those that should be subject to additional competition. Then the NAPA task was to determine the funds associated with these categories of programs.

This chapter is principally devoted to issues associated with accurately determining resources for Smithsonian scientific research activities. It references the relevant portions of the NRC study.

NRC RECOMMENDATIONS

As discussed in Chapter 1, the NRC Committee report made five recommendations pertaining to the Smithsonian's scientific research programs. The three which deal with the approach to funding scientific research are:

Research is an intrinsic part of the mission of the National Museum of Natural History and National Zoological Park. These centers should continue to be exempt from open competition for research funding because of the uniqueness and special contributions conferred by association with their collections.

The Smithsonian Center for Materials Research and Education occupies a highly specialized research niche that is of unique and major value to museums of the Smithsonian Institution and to the museum community at large. Hence, the Committee believes that the center should continue to be exempt from open competition for research funding because of its uniqueness and special contributions to the museum community.

The Committee believes that the Smithsonian Astrophysical Observatory, the Smithsonian Tropical Research Institute, and the Smithsonian Environmental Research Center should continue to receive federally appropriated research funding. Use of public funds by these facilities is already producing science of the highest quality. Much of the "research funding" (for other than salary and infrastructure costs) is already obtained via competition. Any benefits of shifting these three facilities to the jurisdiction of another organization would be greatly outweighed by the harm done to their contributions to the relevant scientific fields.

The NAPA Panel did not address the specific questions associated with different funding approaches because the NRC committee recommended that all six science centers continue to receive federal appropriations. However, the information developed by the Panel provides valuable insights for stakeholders wishing to understand the Smithsonian's research budget and the level of resources devoted to scientific research there.

DETERMINING SMITHSONIAN'S SCIENTIFIC RESEARCH BUDGET

This study was initiated with the presumption that the Smithsonian developed a specific budget for scientific research. During the course of the study, it became apparent that such a budget does not exist. The budget that is presented to the Congress for the Smithsonian includes line items for such operating centers as NMNH, NZP, SAO, SERC, STRI, and SCMRE. Research is discussed in each center's supporting material. There are no separate or aggregate research amounts for Congress to act upon as part of the annual budget request.

However, material supporting the President's budget includes an aggregate estimate for research—in fact, there are two estimates. A $73 million figure is shown for research in the Program and Financing Statement of the Budget Appendix.[1] This amount reflects an "estimate" of all research conducted at the Smithsonian, including art, American history, the American Indian, and other forms in addition to scientific. This research estimate has been included in the budget for only two years; it is based on a coding system that includes inconsistencies that diminish its usefulness, as explained in this chapter. In any event, this estimate is not a line item for congressional action.

There is no assurance that Smithsonian research numbers provided in the President's budget for explanatory purposes accurately reflect scientific research funding levels…Obtaining better data on scientific research activities requires a more systematic approach to coding and record keeping…

A second figure for "research" appears in the Research and Development section of the President's budget.[2] In that section, $108 million and $111 million were reported for Smithsonian research for FYs 2001 and 2002, respectively. These amounts are constructed on the same basis as the previous $73 million, but include allocated general administrative costs. Budget documents do not explain the difference between the two budget sections, nor do they reconcile the difference. This estimate, like the previous one, is included in the budget for explanatory purposes, not congressional action.

Other sets of numbers—all of which are estimates—represent the Smithsonian budget's scientific research component.

The Panel found that four factors complicate quantifying the Smithsonian's research budget. They are:

- lack of an integrated Smithsonian-wide accounting system
- inconsistent data coding practices
- presentation problems
- inconsistent treatment of facilities costs

Accounting System

In July 2001, a NAPA Panel reported that the Smithsonian did not have a comprehensive agency-wide accounting system.[3] Each science center has developed its own records to meet a variety of accounting requirements. With one exception, science center records are independent of institutional-level "official" accounting systems.[4] Data on the amount and purpose of scientific research expenditures differ between records maintained by the science centers and those kept centrally.

Aware of this inadequacy Smithsonian management has begun to implement a new accounting system under the direction of a new Chief Financial Officer (CFO). The new system is designed to meet institution-level needs and replace records now maintained in individual centers.[5] However, most center directors expressed skepticism that an effective integrated system will actually be developed. The NAPA study team was informed that center directors were consulted in the development of the new system, but not all directors recalled this consultation. Nevertheless, anecdotal information indicated that consultation had taken place with other center staff.

Assessing the new system's capacity went beyond the scope of this study. According to current plans, implementation will take place in three stages starting in FY 2003 and ending in FY 2005. The CFO advised the NAPA study team that scientific research information should be more readily available and accurate under the new system.

Inconsistent Data Coding Practices

Salaries, and salary-based costs, constitute a substantial portion of the science center

1 See Appendix to the Budget of the United States, FY 2003, page 1181.

2 See The President's Budget for FY 2003. It is reproduced in the Introduction to this report, Section 8, Table 8-5.

3 A Study of the Smithsonian Institution Repair, Restoration and Alteration of Facilities Program, National Academy of Public Administration, July 2001.

4 The exception is STRI's accounting system, which is an official sub-system of the Smithsonian accounting system.

5 Although the new accounting system was to replace the STRI sub-system, the new system so far has been unable to handle payments to Panamanian employees according to in-country rules.

budgets.[6] Consequently, keeping track of employees' time is important. For several years, a Smithsonian data system has been used to allocate time by various activities, including education, collections management, facilities management, and other functions. However, it has sought to isolate research-associated time (and resultant dollars) for only two years. Within "research," there are categories for life sciences, physical sciences, environmental science, social sciences, and other sciences, as well as research support activities. In addition, virtually every category has several subcategories.

The NAPA study team found that the data coding system is not applied consistently across the science centers. For example, some centers use a rule of "predominance"—that is, scientists are instructed to code all of their time in the category for which they spend only the majority of their time. NZP time keeping illustrates this approach. Each Zoo scientist has one code number to record all of his or her work; this code is determined on the basis of the employee's principal activity. In the Animal Programs, for example, about 10 percent of some employees' time is spent on research. Yet this will not be recorded because the employees spend more time on other activities, thus understating research done in Animal Programs. Conversely, research conducted in the Reproductive Sciences and Conservation Biology Programs is overstated because the staff, that primarily conducts research also participates in outreach and education activities.

Still other Smithsonian centers use different approaches to record time. Some have developed a one-time snapshot of an employee's time distribution at some point during the year, subsequently recording the distribution for the entire year based on the snapshot.[7] Changes during the year do not affect the reported distribution.

The NAPA study team found varied time reporting practices during its field visits to other organizations. Museums did not attempt to track specific staff time dedicated to research, but tended to use less structured systems that collect time in a single unit such as "curatorial duties" for all of the staff member's activities, including research, collection maintenance, and education. Most institutions visited maintained the minimum system needed to meet the requirements of funding organizations. Only one—the Woods Hole Oceanographic Institution—used a detailed time reporting system that recorded employee time for each pay period based on the source of funds.

No time reporting or coding changes are contemplated as a result of the new Smithsonian accounting system. Consequently, the accuracy of the numbers reported by the new system would not improve over the current estimates, unless complementary actions were taken to address the existing coding inconsistencies.

Presentation Problems

The Panel also noted several additional presentation problems. First, not all of the funds allocated to science centers are included in their budgets. For example, a central equipment pool is distributed separately, as is a pool used to support Latino programming. Second, the NAPA study team also examined whether the funds appropriated and reported for the science centers reflected the Smithsonian appropriation that was actually applied to

6 According to information provided by the Smithsonian, the following percentages represent total costs applied to salaries in each science center.

FY 2001 Science Center Funds Used for Salaries and Benefits

	Appropriations	Total
NMNH	84%	66%
SAO	63%	42%
NZP	72%	51%
STRI	74%	55%
SCMRE	80%	69%
SERC	82%	61%

7 This could be at the beginning of the year or during budget development.

those centers. Normally, all agency contract and grant funds are considered to be trust funds. In limited situations, however, the Smithsonian will accept what they term, "interagency transfers," which can be reimbursements (or advances) under the Economy Act.[8] This funding mechanism is used when a federal agency wants something done fast, and the contract or grant route would take too long. The Office of Sponsored Projects receives the paperwork and turns the project over to the CFO who decides whether to accept it. One example occurred when NMNH employees identified remains at the Pentagon following the terrorist attack of September 11, 2001.

The NAPA study team's analysis revealed that the "appropriated" figures for each science center included appropriated funds transferred from other agencies and not included in trust funds. The Panel believes that transfers from other agencies should not be included as Smithsonian appropriation funds as this practice can be misleading.

Third, science centers budgets are complicated by a concept of "overhead recovery" that is applied to SAO and SERC accounting practices. This term is used to indicate the amount of overhead that is provided by an agency or institution making grants or contract awards to the Smithsonian. Most science center budgets for grants and contracts include no amounts for "overhead recovery." However, overhead is added by the Office of Sponsored Projects (OSP), but most science centers are unaware of the amounts included in their proposals. An exception is SAO, which manages its own contracts and grants and collects overhead directly, so its budget includes "overhead recovery." SAO ultimately sends a portion of those funds to Smithsonian headquarters to defray overhead costs, and SERC has begun a similar procedure. Thus, SAO's budget and numbers (and to a limited extent, SERC's) are on a different basis than the other science centers.

It is not possible to adjust for every factor in the development of a consistent Smithsonian research budget. However, the budget office provided a best estimate of total science centers funding, separating the Smithsonian's appropriation and including all funds allocated to them. There was no way to provide an accurate estimate of employees' time since the only available data were those collected through the imprecise reporting practices described earlier.

Table 2–1 provides the best available estimates for the science centers budgets and the portion allocated to scientific research. Not included are additional "off budget" research funds, which principal investigators may receive through their association with universities.

8 Smithsonian directive No. 319, dated July 20, 1998 provides instructions for handling fund transfers under the Economy Act.

Table 2-1. Funding of Smithsonian Science Units (in millions of dollars)

	2001 Actual Expenditures					2002 Estimated Appropriation					2003 Estimated Appropriation				
	Federal Approp.	Federal Other[a]	Govt G&C	Other Trust[c]	Total	Federal Approp.	Federal Other[a]	Govt G&C	Other Trust[c]	Total	Federal Approp.	Federal Other[a]	Govt G&C	Other Trust[c]	Total
National Museum of Natural History[d]															
Scientific Research:															
Direct expenses	14.3		1.0	4.8	20.1	14.4					15.1				
Equipment—instrumentation	0.5	0.2	0.0	0	0.7	0	0.5				0	0.4			
Subtotal, Scientific Research	14.8	0.2	1	4.8	20.8	14.4	0.5				15.1	0.4			
Other Activities	31.9	1.0	0.8	11.7	45.4	32.1	1.0				32.3	1.0			
Total, NMNH	46.7	1.2	1.8	16.5	66.2	46.5	1.5	2.5	11.8	62.3	47.4	1.4	2.2	14.5	65.5
National Zoological Park[e]															
Scientific Research:															
Direct expenses	1.7		0.6	2.1	4.4	2.0					2.1				
Equipment—instrumentation	0	0.2	0	0	0.2	0	0.2				0	0.2			
Subtotal, Scientific Research	1.7	0.2	0.6	2.1	4.6	2.0	0.2				2.1	0.2			
Other Activities	19.4		0.1	3.2	22.7	24.3					22.2				
Total, NZP	21.1	0.2	0.7	5.3	27.3	26.3	0.2	0.7	5.3	32.5	24.3	0.2	0.7	3.3	28.5
Astrophysical Observatory															
Scientific Research:															
Direct expenses	17.9		54.7	3.9	76.5	17.6					18.1				
Equipment—instrumentation	7.0	0.4	0	0	7.4	6.2	0.4				5.0	0.4			
Subtotal, Scientific Research	24.9	0.4	54.7	3.9	83.9	23.8	0.4				23.1	0.4			
Other Activities	2.5		12	13.9	28.4	2.9					3.0				
Total, SAO	27.4	0.4	66.7	17.8	112.3	26.7	0.4	71.1	17.4	115.6	26.1	0.4	71.1	17.2	114.8
Center for Material Research and Education															
Scientific Research:															
Direct expenses	1.2				1.2	1. 4					1.8				
Equipment—instrumentation	0	0.2			0.2		0.1					0.1			
Subtotal, Scientific Research	1.2	0.2			1.4	1.4	0.1				1.8	0.1			
Other Activities	2.0	0.1	0	0.1	2.2	2.0	0.1				1.7				
Total, SCMRE	3.2	0.3	0	0.1	3.6	3.4	0.2	0	0.3	3.9	3.5	0.1	0	0	3.6
Environmental Research Center															
Scientific Research:															
Direct expenses	2.1		2.2	0.8	5.1	2.2					2.3				
Equipment—instrumentation	0	0.1	0	0	0.1	0	0.1				0	0.1			
Subtotal, Scientific Research	2.1	0.1	2.2	0.8	5.2	2.2	0.1				2.3	0.1			
Other Activities	1.2	0	0.5	0.4	2.1	1.2	0				1.2	0			
Total, SERC	3.3	0.1	2.7	1.2	7.3	3.4	0.1	2.7	1.0	7.2	3.5	0.1	2.7	1.0	7.3
Tropical Research Institute															
Scientific Research:															
Direct expenses															
Equipment—instrumentation	6.1		1.2	2.2	9.5	5.8					6.0				
Subtotal, Scientific Research	0	0.3	0	0	0.3	0	0.2				0.0	0.2			
Other Activities	6.1	0.3	1.2	2.2	9.8	5.8	0.2				6.0	0.2			
Total, STRI	4.9	0	0.2	1.3	6.4	4.9	0				5.0	0			
	11.0	0.3	1.4	3.5	16.2	10.7	0.2	1.5	4.8	17.2	11.0	0.2	1	2.9	15.1
Total Above Science Units															
Scientific Research:															
Direct expenses	43.3		59.7	13.8	116.8	43.4					45.4				
Equipment—instrumentation	7.5	1.4	0	0	8.9	6.2	1.5				5.0	1.4			
Subtotal, Scientific Research	50.8	1.4	59.7	13.8	125.7	49.6	1.5				50.4	1.4			
Other Activities	61.9	1.1	13.6	30.6	107.2	67.4	1.1				65.4	1.0			
Grand Total, Science Units	**112.7**	**2.5**	**73.3**	**44.4[f]**	**232.9**	**117.0**	**2.6**	**78.5**	**40.6[f]**	**238.7**	**115.8**	**2.4**	**77.7**	**38.9[f]**	**234.8**

[a]Represents appropriation transfers from federal agencies
[b]Represents government grants and contracts
[c]Portion of endowment income, business income and gifts; either raised by the center or allocated to them
[d]NMNH figures include the Museum Support Center operations and Move.
[e]Disagrees with the amount reported for 2001 in the NAS report. The Smithsonian has reclassified expenses for 2002 and 2003 and the NAPA report adjusts the 2001 NZP expenses for comparability with those years while the NAS report uses actual data reported for 2001.
[f]Other Trust expenditures are offset by directly recovered overhead as follows:

	Other Trust		
	2001	2002	2003
SAO	-9.6	-12.2	-12.2
SERC	-0.1	-0.2	-0.2
Total Directly recovered overhead	-9.7	-12.4	-12.4

Inconsistent Treatment of Some Facilities Costs

The treatment of several other cost categories has an impact on determining scientific research funding levels and quantifying science center budgets. The science centers do not treat costs consistently due to organizational and operational differences. As a result, some funds are included in other Smithsonian central accounts, but not in science centers budgets—even though they are necessary for operations. These include funds for:

- facilities operations and maintenance
- security
- utilities
- libraries
- capital programs

Some examples of inconsistent treatment of these costs across science centers are provided below:

- SAO's budget includes funds for operations, maintenance and security. However, other Smithsonian funds are used for this purpose, as well. In addition, Harvard University provides for some expenses.

- SAO is the only science center whose budget includes funds for its own library. Although the other centers' libraries are located at the research facilities and are necessary for their operation, the funds are included in the budget for the Under Secretary for Museums.[9]

- STRI's budget includes funds for maintenance, operations, and security. The government of Panama pays for additional security costs.

- NZP's budget, including CRC, includes funds for operation, maintenance, and security. The Friends of the National Zoo and the CRC Foundation may bear other costs.

Table 2-2 provides a best estimate of the level of Funds, which supplement the science center budgets for security, utilities, libraries, and capital programs. The cost increased from about $50 million in 2001 to an estimated $63 million in 2003. The large variation is primarily due to changes in the capital program.

These costs are associated with all of the functions at the various centers; there is no breakdown associated exclusively with "research." However, the funds reported in this table can be interpreted as principally supporting the research activities of SAO, SERC, STRI, and SCMRE research activities, since the basic rationale for their existence is research. Since the purposes of NZP and NMNH go far beyond research, a special analysis must be made. The 2002 and 2003 figures are all derived estimates. The Smithsonian does not budget for these costs by science center.

9 In at least one science center, the Director supplemented library funding from his own budget.

Table 2-2. Other Science Center Costs
FY 2001-2003 (in thousands)

SCIENCE CENTER	FY 2001 ACTUAL	FY 2002 PROJECTED	FY 2003 PROJECTED
Smithsonian Astrophysical Observatory			
Facilities Operations & Maintenance [/1]	0	0	0
Security [/1]	0	0	0
Utilities	$ 310	$ 358	$ 378
Libraries [/1]	0	0	0
Capital Program (RR&A/Construction)	456	1,219	4,969
TOTAL	766	1,577	5,347
Smithsonian Environmental Research Center			
Facilities Operations & Maintenance [/1]	197	312	234
Security	283	343	355
Utilities	199	192	210
Libraries	138	185	193
Capital Program (RR&A/Construction)	1,549	1,534	700
TOTAL	2,366	2,566	1,692
Smithsonian Tropical Research Institute			
Facilities Operations & Maintenance	0	0	0
Security	379	308	400
Utilities	886	800	850
Libraries [/2]	388	400	420
Capital Program (RR&A/Construction)	1,591	1,538	1,541
TOTAL	3,244	3,046	3,211
National Zoological Park			
Facilities Operations & Maintenance [/1]	0	0	0
Security [/1]	0	0	0
Utilities	5,616	4,085	4,195
Libraries	123	131	136
Capital Program (RR&A/Construction)	5,403	10,098	16,850
TOTAL	11,142	14,314	21,181
National Museum of Natural History			
Facilities Operations & Maintenance	3,381	2,388	2,467
Security	3,789	4,496	4,653
Utilities	3,034	3,061	3,305
Libraries [/3]	794	819	867
Capital Program (RR&A/Construction)	14,486	12,668	10,590
TOTAL	25,484	23,432	21,882
Museum Support Center [/4]			
Facilities Operations & Maintenance	1,124	543	549
Security	4,251	5,146	5,326
Utilities	1,268	1,445	1,550
Libraries	204	216	227
Capital Program (RR&A/Construction)	450	568	2,000
TOTAL	7,297	7,918	9,652
TOTAL	**$ 50,229**	**$ 52,853**	**$ 62,965**

[/1] Costs are included in unit base S&E funding.
[/2] The STRI branch library supports STRI scientists and visiting scientists in their research needs and also provides library services to students from the local university.
[/3] The Smithsonian Institution Libraries' branch libraries located in the National Museum of Natural History serve not only the resident and visiting scientists' needs, but also the research need of collections, exhibitions, public programs and education staff. In addition, it maintains a rare book room as other outreach programs.
[/4] Includes SCMRE. Separate costs for SCMRE are not available as none of the support costs are tracked by individual occupants of the Museum Support Center.
Source of Data: Office of Facilities Engineering and Operations and the Smithsonian Institution Libraries.

CONCLUSIONS AND RECOMMENDATION

Based on its review of the funding and budget activities the Panel finds that

- There is no assurance that Smithsonian research numbers provided in the President's budget for explanatory purposes accurately reflect scientific research funding levels.

- The numbers developed during the NAPA study, although the best currently available, are based on inconsistent time recording for research.

- Obtaining better data on scientific research activities requires a more systematic approach to coding and record keeping.
- The treatment of various facility-related costs among science centers is inconsistent, adversely impacting data completeness and comparability.

- NZP and NMNH aside, the science centers' total budget figures more accurately reflect scientific research funding than the "research" estimates.

Recommendation:
The Panel recommends that funding decisions and related analyses rely on the actual cost of running the science centers, with appropriate adjustments, rather than the research estimates currently presented in the budget.

Regarding SAO, STRI, SCMRE, and SERC, the rationale is that the full cost of running them is research related. If an accurate indication of NZP and NMNH research is needed, a separate analysis should be made to segregate research cost from cost for other activities. This must be done with care since research is an integral part of those organizations' operations.

The Smithsonian's core support funding must be predictable and dependable…The continuity of core support funding is critical to the researchers' ability to compete for and obtain external grants and contracts, and therefore fund the institution's research programs.

CHAPTER 3
COMPETITION AND CORE SUPPORT

NAPA's examination of competition for research funds initially encompassed two areas—the processes used to divide the conduct of research between intramural and extramural scientists, and alternative strategies for distributing funds through competitive processes. As noted in Chapter 1, the FY 2003 federal budget included an analysis that showed the Smithsonian scientists obtain funding for research without the benefit of competition. This chapter explores the degree to which competition is a factor in Smithsonian research funding.

Two general categories of expenses are typically associated with conducting research in a competitive environment: (1) core support, including administrative functions, physical infrastructure, and salaries for science center researchers; and (2) project-specific expenses, including specialized equipment and supplies, and the salaries and expenses for research assistants and associates. Analysis showed that the Smithsonian's appropriations typically support the first category of expenses but not the second. Consequently, this chapter addresses the role of appropriated funds in providing the Smithsonian's core support.

BACKGROUND

The OMB proposal precipitating this study involved redirecting the total federal appropriations for three Smithsonian science centers:

SAO—$21.3 million
SERC—$3.5 million
STRI—$10.9 million

This action would have eliminated virtually all appropriation-based core support for these centers, essentially leaving no federally funded employees to conduct research or develop proposals for obtaining research funds. If the transfer took place, only trust funds would have been available to support Smithsonian researchers' salaries in the three affected centers. NZP, NMNH, and SCMRE funds were not involved in the proposed transfer because their collection-based research was construed as "inherently unique" and exempt from competitive processes.

The NRC Committee made recommendations (see Chapter 1) addressing the Smithsonian scientific research categories that should continue to receive direct appropriations. It made no recommendations directly concerning core support, but indirectly addressed this topic and competition in two major findings:

1. Funding for research at the Smithsonian's research centers comes from a mix of sources, including a substantial fraction received through open competitive programs.

2. In general, transfer of all federal research funds (including salary and, in some cases, infrastructure support) would greatly reduce and possibly eliminate the role of the federal government in the long-term support of core

scientific research staff who provide the foundation of the Smithsonian research program. A withdrawal of federal support of this magnitude would make maintaining the staff and programs of the centers extremely difficult and would probably lead to the demise of much of the Smithsonian's scientific research program.

COMPETITION FOR RESEARCH FUNDS AT THE SMITHSONIAN

The data collected during the NAPA study show that Smithsonian researchers compete for scientific research funds on several levels. They compete for and receive external funds from the federal government, private foundations, corporations, and state universities. Within the Smithsonian, competition exists for trust funds established to sponsor fellowships and scholarships for visiting researchers.

Competition for External Funds

During interviews with Smithsonian staff and their colleagues, it became apparent that the Smithsonian does not aggressively publicize the acquisition of research funds through competitive processes. Nevertheless, funding received from external sources is substantial. As shown in Table 3-1, the six science centers were awarded more than 300 grants and contracts for research in FY 2001, totaling nearly $100 million.[1]

In addition to direct competition, Smithsonian researchers sometimes partner with university researchers to obtain funding. Some also serve as adjunct professors and can receive research funds through their respective universities. Although these practices were mentioned during several interviews, their prevalence is not known. Research funds obtained through university affiliations and partnerships will not appear in Smithsonian or science center budgets.

Science center researchers obtained grant money through competitive processes to varied degrees during the past six years, as shown in Table 3-2. This variability affects all centers with the exception of SERC, which has experienced a steady but modest increase in funding over the same period. Overall total funding for the science centers (excluding SAO) has increased less than 20 percent. One explanation involves two simultaneously occurring

Table 3-1. Smithsonian Science Centers Grants and Contracts for Research[2] Fiscal Year 2001*

FUNDING SOURCES	NUMBER AWARDED	AMOUNT AWARDED (in thousands)
Federal Agencies	259	$89,943
Private (Foundations,Corporations, NGO's, Universities)	49	$6,242
Other Public (State, Local, Foreign)	17	$1,694
Total	**325**	**$97,879**

*Includes grants and contracts awarded to researchers at NMNH, NZP, SAO, SCRME, SERC, and STRI.

1 Approximately 80 percent of the nearly $100 million was awarded by NASA to researchers at SAO.
2 For detail by granting organization, see Table 4-1 in Chapter 4.

Table 3-2. Smithsonian Science Centers
External Funding Trends
Fiscal Years 1996-2001*

		FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
NMNH	Number Awarded	32	70	55	58	64	56
	Amount Awarded (in thousands)	$2,792	$4,681	$5,330	$5,903	$2,842	$3,604
NZP	Number Awarded	23	22	30	25	35	39
	Amount Awarded (in thousands)	$1,948	$1,380	$2,045	$1,519	$3,116	$2,458
SCRME	Number Awarded	2	2	0	1	1	1
	Amount Awarded (in thousands)	$15	$11	0	$18	$64	$27
SERC	Number Awarded	13	16	19	22	26	30
	Amount Awarded (in thousands)	$1,104	$1,494	$2,437	$2,911	$3,020	$3,273
STRI	Number Awarded	12	11	16	26	10	16
	Amount Awarded (in thousands)	$3,531	$1,417	$1,131	$3,558	$490	$1,869
SUB-TOTAL	**Number Awarded**	**82**	**121**	**120**	**132**	**136**	**142**
	Amount Awarded (in thousands)	**$9,390**	**$8,983**	**$10,943**	**$13,908**	**$9,532**	**$11,204**
SAO	Number Awarded	NA**	NA	NA	NA	NA	214
	Amount Awarded (in thousands)	$56,700	$104,100	$42,300	$63,300	$73,867	$88,736
TOTAL	**Number Awarded**	**NA**	**NA**	**NA**	**NA**	**NA**	**356**
	Amount Awarded (in thousands)	**$66,090**	**$113,083**	**$53,243**	**$77,208**	**$83,399**	**$99,940**

*Includes grants and contracts for research, education, exhibitions, and collections.
**NA= Not available

situations: a decrease in the total amount of money available from foundations and government, and an increase in competition from other researchers. Although the amount of external funding awarded to most science centers has increased only modestly, the number of grants awarded has increased over 70 percent. This suggests that Smithsonian researchers have worked substantially harder to obtain these funding increases.

SAO funding obtained through grants and contracts dwarfed the combined funding of the other science centers. Over the 6-year period reported in Table 3-2, grant and contract funds received by SAO ranged from 4 to 11 times that obtained by the other five centers. Although SAO experienced a substantial reduction in FY 1998, there has been a subsequent steady upward trend in funding. Much of the funding comes from NASA to support the ongoing operation of the Chandra X-Ray observatory.

Internal Competition for Funds

The Smithsonian has limited trust fund dollars available for competition among its scientists to support research activities. These funds, distributed through competitive programs, are administered by the Office of Fellowships. The Office manages two institution-wide opportunities for Smithsonian researchers to apply for funds.

- The Scholarly Studies Program provides funds to support the research interests of Smithsonian scientists. A panel of external experts reviews the proposals developed by the scientists. Historically, about 25-30 proposals were submitted annually, of which ten to twelve were funded. In FY 2001, the program distributed $650,000 to Smithsonian researchers.[3] The maximum grant awarded is $70,000 over two years. The funding can be used for research assistants' salaries, equipment, contracts, and other necessary expenditures; it cannot be used to cover any principal investigator's salary. It also provides opportunities for postdoctoral fellows to be accepted as co-principal investigators. Smithsonian staff indicated that this program was started in part because some staff were unable to obtain NSF grants.

- The Atherton-Seidell Grant Program gives Smithsonian researchers the opportunity to re-print important out-of-print scientific research results and articles. A panel of Smithsonian scientists reviews the grant proposals. The program funds about twelve awards totaling approximately $100,000 annually. An endowment, established specifically for this purpose, funds the program.

Individual science centers also may provide limited funding opportunities for their researchers through similar internal processes. For example, the NZP competitively awards funds to its scientists for reproductive biology research, and receives funds annually from an endowment. Within NMNH, scientists compete for federal money for research start-up costs ranging from $500 to $2,000, and related travel money. SAO provides a small amount of its federally appropriated funds to its researchers to support independent research and development. It also offers them the opportunity to compete for "proposal preparation" support and research equipment funds.

Competitive Fellowship Appointments

The Smithsonian offers "in-residence appointments for research and study" related to its research interests. These appointments for graduate student fellowships, predoctoral fellowships, and postdoctoral and senior fellowships vary in duration and may include financial support. The Office of Fellowships administers the fund providing appointments through the institution-wide program. The program distributes about $1 million annually through a variety of competitive processes, and it is supported entirely by trust funds. The study team has been told that trust income reductions may force a reduction in this program. In addition, some fellowships are available from each science center, depending on

3 Preliminary indications are that reductions in unrestricted income may force a retrenchment in this program.

funding availability. For example, the SAO offers fellowships for up to three years, but it may provide funding for one year only because of funding limitations.

RESEARCH FUNDING PROCESSES IN OTHER ORGANIZATIONS

Agencies that receive funds for research disperse those funds in several ways depending on their missions and legal responsibilities. Organizations visited during this study demonstrated the institutional infrastructures needed to distribute research funds according to one or more of the following policies:

- externally through competitive processes (extramural research)
- internally with or without competitive processes (intramural research).
- through processes for both extramural and intramural research

Extramural Research Competition

Both the public and private sectors have institutions that fund extramural research. For example, NSF distributes research funds on a competitive basis to universities, museums, small businesses, and public agencies. Many other federal agencies, including the Department of Energy and the Department of Agriculture, have elements that fund extramural research through competition. Similarly, many private foundations, such as the Andrew W. Mellon Foundation, provide funds for research through similarly competitive processes.

Intramural Research Competition

Many public and private institutions, including the Smithsonian science centers, distribute funds for research through internal processes. Within the Department of Agriculture, the Agricultural Research Service conducts intramural research exclusively. Meanwhile, public and private universities primarily conduct intramural research by offering their researchers opportunities to compete for funds. In a few instances, universities distribute research funds externally when the research capability does not exist intramurally. Most non-governmental institutions conducting intramural research compete for grants and contracts offered by institutions funding extramural research.

Both Types of Competition

Relatively few organizations or agencies maintain the institutional structure needed to manage intramural and extramural research. The Department of Energy's Office of Science is one example found by the NAPA study team. It distributes funds competitively to university researchers who are capable of conducting extramural research that the Department of Energy needs. The Office of Science maintains a network of national laboratories, and the opportunity to use them generates competition among laboratory staff and outside researchers. It also provides extensive internal competition for research funds within the network to conduct intramural research.

The National Cancer Institute, part of the National Institutes of Health, distributes funds for extramural research yet maintains an intramural research function. It awards grants and enters into cooperative agreements on a competitive basis to support extramural research. On the other hand, about 17 percent of its budget goes to programs and funds set up for internal competition. These funds are competed for at the program level, not by individual principal investigators.

Dividing Resources Between Intramural and Extramural Research

The NAPA Panel considered how other institutions divided research funds between intramural and extramural programs. The freedom to make these short-term decisions depends on internal and external capabilities. The freedom to make longer-term decisions depends on the rate at which capabilities can be increased.

Managers accustomed to contracting out non-research projects may imagine a portfolio of research projects that is assigned periodically on the basis of predetermined criteria. This conceptual model did not resonate well with any of the research managers interviewed. Research, particularly basic research, is not a matter of managing such a portfolio. It is about managing the capacity to do research based on the highly specialized capabilities of individual scientists. Successful research managers describe their work as recruiting the very best and supporting their work. In essence, the

managers described management practices as more akin to directing an ongoing process than managing a changing set of projects. In addition to intramural and extramural capabilities, several related factors may impact the short-term division of research:

- uncertainty concerning the ability to sustain adequate in-house capability
- availability of resources for funding extramural research
- ability to manage extramural research
- organization's reputation for supporting research based on intellectual curiosity
- influence of congressional mandates (in the case of federal agencies)
- the funding organization's planning horizon, an agency may choose not to invest scarce resources in developing in-house capacity if the duration of interest is expected to be short or unknown.
- the relative political influence of the various stakeholders (including the funding agency). One manager of a federal grant making process reported that the usual external recipients of the organization's grants became annoyed and politically active when intramural research exceeded a historic average.
- limitations on hiring and firing

The net effect is that it takes time and persistent management attention to develop a substantial capacity to conduct high quality research in a specific scientific area. Changing the focus and locus of research typically involves incremental change over long periods of time. Consequently, it is not surprising that historical precedence is the most important force shaping the balance of intramural and extramural research. Empirical evidence suggests that changes in the balance between intramural and extramural research expenditures tend to happen incrementally and very slowly.

Conclusion

- Scientists are not fungible so short-term decisions about intramural and extramural research must be based, in large part, on the organization's existing in-house capabilities.
- Additional options for long-term changes in the balance between intramural and extramural research are possible only through the gradual acquisition and support of scientists with interest and capability in the new areas, or acquisition of the capability to manage extramural research.

ROLE OF CORE SUPPORT IN COMPETITION

Core support provides the foundation for operations which an institution's staff need to compete for funding and conduct research, as well as maintain education programs and exhibitions. An institution's core support, no matter how it is funded, is fundamental to compete successfully for external funding. Necessary areas include:

- capable scientific staff
- well-maintained physical infrastructure, including facilities and equipment
- adequate administrative support, such as information technology, human resources, and accounting systems
- in the case of collection-based research centers or institutions, well-curated and comprehensive collections

Core Support Funding Models

Every research institution visited for this study that successfully competes for external funds also has core support funding. The study team found that institutions obtain this funding from a variety of sources. Funding comes from public or private sources, or a combination of the two.

The federal government can provide core support through direct appropriation to institutions, such as the Smithsonian and Howard University. Howard University is a nonprofit

institution that receives a federal appropriation as well as grants and contracts from numerous sources, including NSF and NASA. Federally-funded research and development centers, such as the National Radio Astronomy Observatory and the National Center for Atmospheric Research, receive most, if not all, of their core support through supporting federal agencies' funding lines. In addition, the government provides some funding through research contracts. One private research and development organization funds its core support through noncompetitive awards from federal agencies. This research funding mechanism is an exemption allowed under federal law.[4]

Other institutions receive core support funding from a combination of sources. State universities typically use funds from tuition, state appropriations, and endowments to cover core support costs. Private universities depend primarily on tuition and endowment funds, although they use state funds if available. The Woods Hole Oceanographic Institution, which operates like a private university but without tuition as income, receives a significant amount of funding from such federal agencies as NSF and the U.S. Navy, Office of Naval Research.[5] The NAPA study team visited many other research institutions, such as the museums and botanical garden, that fund core support through a combination of endowment, earned income, and state and local money.[6]

CONCLUSIONS AND RECOMMENDATION

The federal government, through its appropriations, provides the Smithsonian with most of its core support funds. The appropriation dollars fund the salaries of Smithsonian researchers who prepare proposals, conduct research, and contribute to educational activities, among other things. This base makes it possible for researchers to successfully compete for research funds by obtaining external grants and contracts.

The Smithsonian's core support funding must be predictable and dependable to ensure a continuing base of capable scientific staff, physical infrastructure, administrative capabilities, and comprehensive collections. The continuity of core support funding is critical to the researchers' ability to compete for and obtain external grants and contracts, and therefore fund the institution's research programs.

Recommendation
The Panel recommends the continuation of core support appropriations for all Smithsonian science centers consistent with the NRC report recommendations.

4 Under 10 USC 2304 [c] (3), the Competition in Contracting Act of 1984, the head of an agency may use procedures other than competitive procedures under specified circumstances.
5 Woods Hole Oceanographic Institution has a unique arrangement for funding of its core support functions. A major part of its infrastructure is in research vessels. Once NSF makes the decision to fund the research vessels, there is an implied commitment to fund the research programs that will utilize the vessels. For the entire national oceanographic structure—including facilities on the West Coast—there are seven large global research vessels. Of the seven vessels, five are owned by the U.S. Navy, one by NOAA, and one by NSF. Yet in any given year, there is only enough money to support six. To deal with this situation, the ocean research community rotates the one ship shortfall among them for one year out of every 4 or 5.
6 Salaries for certain positions often are endowed to ensure the continuity of core support funding.

The Panel found that there is no persuasive evidence that Smithsonian researchers enjoy a consistent … advantage over their university-based peers when competing for research funding.

CHAPTER 4
THE LEVEL PLAYING FIELD ISSUE

NRC was asked to determine whether some portion of the Smithsonian's base research budget should be subject to more open competition. This request stemmed from the perception that the institution has an advantage over its competitors, as its science centers receive funding through federal appropriations. This perceived advantage has two dimensions:

1. Given the federal appropriations, the Smithsonian's overhead costs—referred to as "Facilities and Administration" (F&A)—do not include depreciation. Consequently, the Smithsonian is seen as having a lower F&A rate than other research organizations.

2. Smithsonian scientists are paid a full 12-month salary from federal appropriations. It is believed that this provides an advantage over other institutions where researchers are typically paid for 9 or 10 months, and must include some salary costs in their proposals.

There also is the perception that the "playing field" may be tilted in the opposite direction. One important federal funding agency—NSF—restricts the Smithsonian's opportunities to compete for its grants, putting the Smithsonian at a disadvantage.

NAPA was asked to identify and examine mechanisms that could help to ensure a level playing field depending on NRC's Findings. Chapter 3 explains that competition is integral to how the Smithsonian obtains research funding. The discussion accepts the premise that the institution is engaged in competition, and addresses factors that could tilt the research funding field to the Smithsonian's advantage or disadvantage.

BACKGROUND

The NRC Committee did not make specific recommendations on a "level playing field," but it clearly considered the issue when making other recommendations. In support of one finding, the Committee stated:

"The Committee did not find the fact that the Smithsonian researchers receive full (12-month) salary support to be a substantial advantage over university-based researchers. The latter usually receive 9-month salaries and obtain funds for 2 to 3 additional months from contracts and grants. Some universities among institutions, and the need for both S1 (Smithsonian) and academic researchers to compete for resources for computing, travel and graduate student and postdoctoral researchers, any advantage of SI scientists in this regard would be small. … There also appears to be little consistent competitive advantage for federally funded scientists at the Smithsonian over federally–funded scientists at NASA centers, USDA or NSF supported or NASA supported national observatories."

It is important to assess whether Smithsonian researchers have a competitive advantage because the science centers receive substantial non-appropriation funding from contracts and grants, as shown in Table 4-1. In FY 2001, the science centers received 325 grants and contracts for research totaling nearly $98 million. SAO received the bulk of this amount.

FACILITIES AND ADMINISTRATION COSTS

F&A represents costs that are considered necessary to support research and other sponsored projects, but that cannot be easily assigned to individual projects. Research organizations

Table 4-1. Smithsonian Research Funding
(SAO, STRI, SERC, NMNH, SCMRE, NZP)
Fiscal Year 2001

SPONSOR	RESEARCH		OTHER*		TOTAL	
	NUMBER OF AWARDS	AMOUNT OF AWARDS (in thousands)	NUMBER OF AWARDS	AMOUNT OF AWARDS (in thousands)	NUMBER OF AWARDS	AMOUNT OF AWARDS (in thousands)
Federal Awards	**259**	**$89,943**	**19**	**$1,557**	**278**	**$91,500**
NASA**	195	80,298	3	280	198	80,578
NSF**	27	3,864	4	189	31	4,053
DOE**	5	2,246	-	-	5	2,246
NIH	6	1,391	-	-	6	1,391
DOI	6	452	2	612	8	1,064
DOD**	10	892	1	10	11	902
DOT	1	455	-	-	1	455
DOC	4	103	2	190	6	293
EPA	-	-	5	263	5	263
USDA	4	162	-	-	4	162
USAID	1	80	-	-	1	80
Exec. Office	-	-	1	8	1	8
Congress	-	-	1	5	1	5
Non-Federal Awards	**66**	**$7,936**	**12**	**$504**	**78**	**$8,440**
TOTAL	**325**	**$97,879**	**31**	**$2,061**	**356**	**$99,940**

*Other includes awards for Exhibitions, Education, and Collections.
**SAO is subcontracted to do research funded by the following federal agencies:
NASA (84 subcontract awards totaling $6,690,000)
NSF (3 subcontract award totaling $144,000)
DOE (1 subcontract awards totaling $576,000)
DOD (1 subcontract awards totaling $39,000)
These amounts are included in the table above.

attempt to offset F&A, which are a substantial portion of research costs.[1] The following discussion summarizes the major factors that comprise direct and F&A costs in research projects.

Direct Costs

Direct costs cover the materials and labor costs for conducting research, which can be directly assigned to a project. These include:

- salaries and wages for staff
- project material and supplies
- subcontracts
- project-specific equipment
- travel and other costs

1 These F&A costs are based on OMB's Circulars A-21 and A-122, which establish principles for determining costs of grants, contracts, and other agreements. Circular A-21 describes the principles for agreements with colleges and universities. Circular A-122 explains the costs involved in agreements with non-profit organizations.

F&A Costs

F&A costs include shared expenses that pertain to a project. Typically, they are applied as a percentage or rate to some component of direct costs. They include:

- allowances for depreciation and use of buildings and equipment
- interest on debt for buildings and equipment
- operating and maintenance costs, such as janitorial, security, utilities, repairs, and insurance
- library expenses
- general and administrative expenses, such as central office costs, financial management, legal counsel, and information systems
- departmental administration
- sponsored projects administration
- student administrative services (with some exclusions)

Several federal agencies are responsible for negotiating F&A rates with universities, museums, and other entities that receive federal grant funding. These agencies are referred to as "cognizant agencies." For example, the Office of Cost Allocation in the Department of Health and Human Services and the Office of Naval Research in the Department of Defense are responsible for negotiating F&A rates with universities and colleges. In this regard, the Office of Naval Research negotiates the Smithsonian's rates, and NSF is a cognizant agency for several museums visited. Meanwhile, OMB is responsible for establishing policy on the negotiation of F&A rates.

Smithsonian's F&A Rates Compared with Others

To answer the level playing field question, it is important to determine whether substantial differences exist between rates established for the Smithsonian and those for other research entities, and whether any differences affect the research activities funded. With respect to the first question, F&A rates for research institutions can vary depending on such factors as location, age of facilities, administrative structure, efficiency, local cost of living, state and local government subsidies, and economies of scale. For several years, average F&A rates have remained fairly constant, taking variations among institutions into account. A RAND study noted that a 1998 analysis of Department of Health and Human Services and Office of Naval Research data showed that the average F&A rate for the 145 institutions sample was 50.8 percent.[2] This was nearly identical to the 1988 rate. The range of F&A rates in 1998 was 34.9 percent to 74.5 percent, reflecting different costs associated with the items described above.

The NAPA study team collected information on F&A rates from a variety of universities, museums, and other research organizations. Public funds are a major source of funding for these institutions. The average rate and the range correspond to those reported by RAND in 1998.

Unlike other institutions, the Smithsonian does not calculate or publish a single composite indirect cost rate. However, it publishes negotiated rate components.[3] The components of indirect cost rates are applied to different bases (as shown in Table 4-2). Consequently, the rates cannot be simply added together.

The Smithsonian's rates also vary by location, as do other institutions'. SAO and SERC rates are different than other science centers, as shown in Table 4-2. This is due to their distance from Washington, DC, and their ongoing practice of providing some of their own support activities.

Without a single rate for all situations, determining one for comparison requires historical data analysis. The analysis showed that there are few, if any, instances where the derived total indirect rate was as high as 35 percent. These relatively low rates can be attributed largely to the lack of facility costs in the Smithsonian's F&A rate. The rates for most science centers include only General and Administrative (G&A) grants and contract overhead costs. Therefore, the Smithsonian's overhead rates are considerably lower than universities, museums, and

2 Goldman, Charles A. and T. Williams with David M. Adamson, and Kathy Rosenblatt. Paying for University Research Facilities and Administrative, Science and Technology Institute, RAND, Santa Monica, CA, 2000.

3 Department of the Navy, Office of Naval Research, Negotiation Agreement with the Smithsonian Institution, Washington, D.C., for 10/1/00-9/30 /02, September 25, 2000.

Table 4-2. Smithsonian Science Centers
Indirect Cost Rates[4]
As of September 30, 2002

Location	Account Name	Rate	Base
Smithsonian Onsite	General & Administrative (G&A)	4.9%	Total Cost of Onsite Direct Operating Activities
Smithsonian Onsite	Grants & Contract Overhead	21.1%	Cost of Direct Labor and Benefits
SERC*	Core Support	9.0%	Total SERC Direct Costs
SAO**	G&A	11.0%	Total Cost of SAO Direct Operating Activities
SAO**	Direct Operating Overhead	22.9%	Cost of Direct Labor and Benefits
SAO**	Material Burden	2.9%	Cost of Direct Materials and Subcontracts
SAO**	Central Engineering Overhead	20.5%	Central Engineering Direct Labor & Benefit Costs

*In addition to Smithsonian onsite costs.
**SAO rates are independent of other rates.

institutions that include facilities costs in their overhead determinations.[5]

The second question concerns how different F&A rates may impact grant awards. Grantor and grantee interviews and a review of policy manuals and prior contracts produced the following insights:

- The National Institutes of Health and NSF direct that F&A costs should not be a factor in a peer review panel's decision to award grants. However, there is conflicting anecdotal evidence concerning adherence to this instruction. The general National Institute of Health practice appears to provide full reimbursement for F&A costs and award grants exclusively on scientific merit. Regarding NSF, some of those interviewed believed that review panels only react to extremely high rates—i.e. rates over 100 percent—and that lower rates receive little or no attention. One museum executive—who had also participated in peer review panels—reported that although F&A is not supposed to be considered during peer review of NSF applications, some review groups do look at overhead to determine if they are "outrageous"

4 The Smithsonian continues to refer to these types of costs as indirect costs rather than F&A or overhead costs.
5 For most institutions the facilities costs are about equal to administrative costs.

e.g. over 100 percent. In his opinion, differences between 30-50 percent overhead rates do not impact award decisions.

- The awarding institution carries out negotiations on total grant costs after the panel decision has been made based on scientific merit. The F&A rates that a cognizant agency negotiates are considered firm unless he institution agrees to lower them; direct costs usually are the only costs subject to negotiation. Interviews indicate an unwillingness among applicant institutions to lower F&A rates unless there is some excep-tional and compelling reason. At least in theory then, institutions with higher F&A costs can be at a disadvantage during these negotiations.

- A review of NASA grants and contracts—the largest provider of such funds to the Smithsonian—indicated that F&A rates were not a factor in award decisions. SAO's experience, technical expertise, and the excellence of its scientists were.

- Interviews with representatives of two federal agencies that have major research funding programs echoed the theme that grants are awarded on the basis of scientific merit and quality. Similarly, a sponsored projects official at a major university reported that she knew of no instance where proposed research was refused solely on the basis of high F&A rates.

Conclusion

Granting agencies base funding decisions almost entirely on scientific merit, except when F&A rates are extraordinarily high (at least in the view of peer review group members). None of the rates reported by the Smithsonian or the universities and museums interviewed indicated that the playing field was appreciably tilted in the Smithsonian's favor.

INFLUENCE OF FEDERAL SALARIES

Smithsonian researchers receive 12-month salaries, as opposed to university researchers (except for medical school faculty) who typically receive salaries for 9 or 10 months. Although most Smithsonian researchers receive federal salaries, some receive their salaries from the trust funds. Some observers suggest that this dynamic gives Smithsonian researchers an advantage since none of their salary is included in grant proposals. In contrast, university researchers are encouraged to pursue funded research to cover salaries for the remaining 2 or 3 months. The NAPA study team found various practices at the institutions visited that complicate direct comparison among compensation practices. For example:

- Some universities negotiate 12-month salaries for faculty, but pay them over a 9 month period. Others pay 9, 10, or 11 month salaries. Thus, two variables interact simultaneously: the amount of pay and the number of monthly payments.

- Many university-based principal investigators are permitted and/or encouraged to augment their base salaries through consulting fees and honoraria. These options are not available (or are available only under strict restrictions) to Smithsonian principal investigators.

- Some universities and other institutions provide bridge funding for researchers that have promising grant proposals.

Also complicating comparison are the variance in cost of living between the Washington DC area and other areas, and the differences in federal salaries and benefits compared to universities.

Smithsonian researchers believe that focusing exclusively on salaries neglects another important consideration. They point out that many research projects require the efforts of research assistants to collect and code data and perform tasks. Less expensive student help is widely considered to be a substantial advantage to university-based researchers but unavailable to Smithsonian researchers. On the other hand, the Smithsonian's reputation attracts volunteers who often participate in research activities.

Conclusion

There are several compensation and resource factors that may give competitors a

theoretical advantage in a particular competitive situation. The Panel found no persuasive evidence to support the hypothesis that Smithsonian researchers enjoy a consistent compensation advantage over their university-based peers when competing for research funding.

ACCESS TO NSF

In FY 2001, NSF was the government's fifth largest research funding organization.[6] It awarded $3.34 billion for research support[7] and funded 27 percent of the 31,776 proposals received. The Smithsonian science centers receive grants from NSF and other federal and non-federal institutions, as shown in Table 4-1. NSF is the Smithsonian's second largest federal grant funding agency.

Access to the NSF proposal review process brings several benefits to researchers and their institutions. First, NSF's consideration of a research proposal may lead to a grant award. Second, and less obvious, the NSF peer review process is widely viewed as one of the most effective ways to ensure a scientist's research quality. For example, one research manager stated that anything that denies Smithsonian researchers the opportunity to have their proposals evaluated by NSF panels of world-class scientists is a lost opportunity for assuring high quality research and continued personal development.

NSF Policies

As noted in Chapter 1, the Smithsonian describes itself as a "trust instrumentality of the federal government." Its legal standing and responsibilities, Board of Regents, and staff all have been a matter of long standing interest and discussion. Indeed, its ambiguous designation as a "federal agency" affects its funding relationship with NSF.

In June 1980, NSF issued Circular 108, which established policy on the eligibility of federal agencies and federally funded research and development centers to receive NSF support. The circular stated that federal agencies are not eligible for such funding unless they meet one or more exceptions, namely:

- projects that make a significant contribution to the research needs of scientists else where, or to specific NSF objectives
- activities that meet the goals of specific national and international programs for which NSF is responsible
- travel support to international conferences
- military service academies, subject to some restrictions
- proposals from scientists having joint appointments with a university, though part of the scientist's salary is provided by a federal agency

In a footnote, the policy stated, "Federal Agencies as stated here refers to all agencies of the Federal Government including the Smithsonian."

An NSF Grant Proposal Guide, issued on January 1, 2002, replaced Circular 108 yet continued the general policy. At the same time, it does not single out the Smithsonian.[8] It states:

"NSF does not normally support research or education activities by scientists, engineers, or educators employed by Federal agencies or Federally Funded Research and Development Centers (FFRDCs). A scientist, engineer, or educator, however, who has a joint appointment with a university and a federal agency (such as a Veterans Administration Hospital, or with a university and a FFRDC) may submit proposals through the university and may receive support if he/she is a bona fide faculty member of the university, although part of his/her salary may be provided by the federal agency. Under unusual circumstances, other Federal agencies and FFRDCs may submit proposals directly to NSF. Preliminary inquiry should be made to the appropriate program before preparing a proposal for submission."

6 The President's FY 2003 Budget, Analytical Perspectives, Chapter 8, Research and Development.

7 NSF's expenditures in 2001 also included $875 million for education and human resources and $119 million for equipment.

8 The NSF Proposal and Award manual, a compendium of internal policies and procedures, continues to identify the Smithsonian as a "federal agency."

A section on non-profit, non-academic organizations permits the following to compete: independent museums, observatories, research laboratories, professional societies, and similar organizations in the United States that are directly associated with educational or research activities.

Interviews with NSF and Smithsonian staff produced an ambiguous picture with respect to funding eligibility. NSF awards grants to the Smithsonian, and while current external instructions do not include the Circular 108 footnote that identified the institution as a "federal agency subject to narrow exceptions," an internal policy document continues this definition. Some NSF administrative staff stated that principal investigators paid by federal appropriation normally are precluded from direct competition for NSF funding.[9] Conversely, the same staff observed that Smithsonian researchers can obtain NSF funding in other ways.

NSF staff believed that some program managers will not consider Smithsonian proposals under any circumstances, while others will. Smithsonian researchers compete for educational activity funding that is often considered to be outside NSF restrictions. NSF grants staff indicated that Smithsonian proposals clearing peer review would not be excluded from funding. They suggested that it might be prudent for Smithsonian proposals to reference GAO opinions and federal court decisions, demonstrating that it is not a federal agency from a legal perspective.

The Smithsonian's Perspective of the NSF Issue

A substantial number of Smithsonian researchers believe that NSF policies and practices create barriers to obtaining NSF funding. They made the following observations:

- There is a generation of NSF project managers who still restrict awards to the Smithsonian. However, that generation is retiring, and incoming managers are less rigid. Nevertheless, there remains inconsistent treatment of the Smithsonian within NSF.

- NSF review panel members sometimes carry their own biases against awarding funds to Smithsonian.

- SAO officials are concerned that NSF's astronomical section will not accept proposals, other than education ones, from SAO-supported scientists. However, it will accept them from SAO scientists who are funded by trust funds, not appropriations.

- Researchers received rejection letters from NSF on the basis that the Smithsonian was a "federal agency."

Smithsonian's Record in Competing for NSF Grants

Over a four-year period, about 33 percent of Smithsonian research grant proposals submitted to NSF are awarded, as indicated in Table 4-3.

Table 4-3. Smithsonian Science Centers[10] Record of New NSF Grants for Research FY 1999-FY2002

Science Center	Award Rate and Number of New NSF Grants
NMNH	33% (11)
NZP	29% (2)
SCRME	100% (2)
SERC	46% (6)
STRI	33% (1)
SAO	29% (20)
Weighted Average	**33%**

9 Attempts to interview NSF program office staff were unsuccessful. Comments received from NSF staff interviewed do not necessarily convey NSF program policy.

10 For accuracy and consistency, the data include new awards only and do not include continuation and flow through awards and subcontracts. For all centers but SAO, partial data was included for 1999, the first year of a new data system.

Comparing success rates across the science centers is problematic as some centers submit very few proposals. Four of the six science centers submitted 7 or more proposals. Of these, the success rate ranges from 29 to 46 percent, with the majority relatively near the 33 percent average.

The Smithsonian's success rate for submitted proposals, collectively and by centers, is about the same as that for those submitted by other institutions. The reported NSF average award rates for all institutions combined ranged from 30 percent to 33 percent for FYs 1999 through 2002.

Given this comparability, it is interesting to note the degree to which the Smithsonian research centers depend on NSF. Table 4-4 shows that the six centers overall receive only 6 percent of their new research grants and contracts from NSF, ranging from a low of 3 percent at NZP to a high of 20 percent at NMNH. Determining the reasons for this diversity went beyond the scope of the study, but doing so may be important to the future research funding. The two reasons suggested most often in interviews were that some areas of scientific inquiry typically are not funded by NSF, and that some NSF program managers are reluctant to fund Smithsonian proposals.

Table 4-4. Smithsonian Science Centers Percent of Tota New Grant Awards for Research from NSF FY 1999-FY2002

Science Center	Percent of New NSF Awards and Number of New NSF Awards
NMNH	20% (11)
NZP	3 % (2)
SCMRE	67% (2)
SERC	12% (6)
STRI	4 % (1)
SAO	4 % (20)
Weighted Average	**6%***

*Excluding SAO, the figure increases to 10%.

Conclusions

Researchers at the Smithsonian science centers compete for and obtain grants and contracts from various public and private sector granting entities. Overall, their proposals to NSF are funded at about the same rate as all other researchers. However, there are substantial differences between the centers in the percentage of total awards received from NSF. Interviews indicate that some Smithsonian researchers may be reluctant to develop proposals for NSF due to the actual or perceived bias that NSF may have against Smithsonian proposals.

Recommendations

The Panel recommends that the Under Secretary for Science examine the perceptions and practices of the science centers' researchers and managers regarding NSF grants, and establish a mechanism for keeping them informed of changes and best practices.

The Panel recommends that the Under Secretary for Science meet with the NSF Director to clarify and explore reformulating the Smithsonian-NSF relationship concerning the eligibility of Smithsonian scientists to compete for NSF funding.

APPENDIX A
PANEL AND STAFF

PANEL

James E. Colvard, *Chair*—Visiting Professor, Virginia Polytechnic Institute and State University. Former Associate Director, Johns Hopkins University Applied Physics Laboratory; Deputy Director, U.S. Office of Personnel Management; Director of Civilian Personnel Policy, U.S. Navy; Deputy Chief of Naval Material; Technical Director, Naval Surface Weapons Center.

C. William Fischer—Former Senior Vice President for Business and Finance, Northwestern University; Executive Vice President, Brandeis University; Vice President for Budget and Finance, University of Colorado; Assistant Secretary for Planning and Budget, U.S. Department of Education; Deputy Administrator, Energy Information Administration, U.S. Department of Energy; Deputy Associate Director for Human Resources, and Deputy Assistant Director for Legislative Reference, U.S. Office of Management and Budget.

Adam W. Herbert, Jr.—Regents Professor and Executive Director, Florida Center for Public Policy and Leadership, and former President, University of North Florida. Former Chancellor, State University System of Florida; Dean, School of Public Affairs and Services, Florida International University; Director, Northern Virginia Programs, Center for Public Administration and Police, Virginia Polytechnic Institute; White House Fellow and Special Assistant to the Secretary of Health, Education and Welfare; Special Assistant to the Under Secretary, U.S. Department of Housing and Urban Development.

Delores Parron—Scientific Advisor, Office of the Director, National Institutes of Health. Former Deputy Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services; Associate Director for Special Populations, National Institute of Mental Health, National Institutes of Health; Associate Director, Division of Mental Health and Behavioral Medicine, Institute of Medicine, National Academy of Sciences.

Maxine Singer*—President, Carnegie Institution of Washington; Member, Board of Governors and Scientific Advisory Council, Weizmann Institute of Science; Former Chairman, Editorial Board of Proceedings, National Academy of Sciences and Commission on the Future of the Smithsonian Institution; Member, Board of Directors, Johnson & Johnson and Perlegen Sciences, Inc; Trustee, Yale (University) Corporation and Member, Board of Directors, Whitehead Institute.

Jerry R. Schubel*—President and Chief Executive Officer, Aquarium of the Pacific, Long Beach; Visiting Professor Washington College; President Emeritus, New England Aquarium. Former President and Chief Executive Officer, New England Aquarium, Boston; various positions at the State University of New York at Stony Brook, including Dean and Director of Stony Brook's Marine Sciences Research Center; University Provost; acting Vice Provost for Research and Graduate Studies. Also served as an adjunct professor, research scientist and Associate Director of The Johns Hopkins University's Chesapeake Bay Institute.

* *Not an Academy Fellow*

STAFF

J. William Gadsby, *Responsible Staff Officer*
Director, Management Studies, National Academy of Public Administration; Project Director on several recent Academy studies. Former Senior Executive Service; Director, Government Business Operations Issues, Federal Management Issues and Intergovernmental Issues, General Accounting Office.

Gerald (Jake) Barkdoll, *Project Director*
TREE (Theoretically Retired Ex-Executive); Consultant; Founder, Balanced Scorecard Interest Group. Former FDA Associate Commissioner for Planning and Evaluation; Distinguished Practitioner in Residence and Director, University of Southern California Washington Center; Senior Consultant, Public Service of New Mexico; Controller and Chief Financial Officer, The Englander Company.

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APPENDIX B
NRC EXECUTIVE SUMMARY

The Smithsonian Institution (SI) was established as an independent trust instrumentality in 1846 dedicated to "the increase and diffusion of knowledge among men" as laid out in James Smithson's bequest to the US government. To accomplish its mission, the Smithsonian throughout its history has combined high quality research conducted by its scientific research centers with public outreach through exhibitions of its collections in museums. Although the Smithsonian's science centers and their research are highly regarded by the scientific community, they are much less well known to the general public than their museums.

The Smithsonian Institution receives an annual federal appropriation toward its operating costs, which includes funds in support of research at the Smithsonian. In the FY 2003 presidential budget, the Office of Management and Budget (OMB) called for a review "to recommend how much of the funds directly appropriated to the Smithsonian for scientific research should be awarded competitively," and proposed to transfer these funds to the National Science Foundation (NSF). Specifically, OMB expressed concern about the Smithsonian's classification of its allocation of federal research funds as "inherently unique"—that is, research programs that are funded without competition.

The apparent absence of competition in the Smithsonian science centers raises concerns about a lack of quality assurance in Smithsonian research. Moreover, it is fair to ask whether the federal support given to the Smithsonian's science programs could be used more effectively for science if the funds were awarded through a competitive process open to all researchers. After the release of the budget document, the Smithsonian commissioned reviews by the National Academy of Sciences (NAS) and the National Academy of Public Administration (NAPA) to address the questions raised by the OMB. This is the report of the NAS review; the NAPA study will be the subject of a separate report.

The Committee on Smithsonian Scientific Research was charged to provide specific recommendations and a rationale with criteria on what parts of the Smithsonian's research portfolio should continue to be exempt from priority setting through competitive peer reviewed grant programs because of uniqueness or special contributions. The charge to the Committee called for a review of the scientific research centers that report to the Smithsonian's Under Secretary for Science – the National Museum of Natural History, the Smithsonian Astrophysical Observatory, the National Zoological Park, the Smithsonian Tropical Research Institute, the Smithsonian Center for Materials Research and Education, and the Smithsonian Environmental Research Center. The Committee was also charged to consider the effects on the Smithsonian, the research centers, and the relevant scientific fields of re-allocating the current federal support to a competitive process. Finally, the Committee was asked to make recommendations on how any Smithsonian science programs that continued to receive direct federal appropriations should be regularly evaluated and compared with other research in the relevant fields. The Committee was not asked to review the funding of SI research centers that report to the Smithsonian's Under Secretary for American Museums and National Programs.

To respond to its charge, the Committee examined the research programs and the funding structure at the six Smithsonian scientific research centers. It also considered possible consequences of removing direct federal appropriations to the Smithsonian science programs and reallocating the funds to open competition.

In carrying out its review, the Committee established a framework of criteria to be applied to its review of the Smithsonian research centers in the execution of its task. The Committee considered

- The nature of the Smithsonian as a scientific institution.

- How uniqueness and special contribution apply to each of the six science centers covered by the study. In the context of this study, uniqueness and special contribution may have many meanings that refer to special attributes associated with a particular research center.

- How opening some of or all the support now given to each of the centers to a competitive process would affect the science involved. How the centers might be evaluated regularly to ensure that the quality of their science is maintained if any of the six are deemed to be unique and to warrant continuation of the current system of support.

The six research centers, taken together, embody SI's research program and constitute the mechanism whereby SI carries out its charter to increase and diffuse knowledge. The Committee considered the work of each SI unit, its role and status in the scientific enterprise, and whether the terms uniqueness and special contribution should be applied to its research. In arriving at its findings, conclusions, and recommendations, the Committee drew on information received from, and interviews with, representatives of the central offices of the Smithsonian and the research centers, on the expertise and relevant knowledge of the Committee members themselves, and on informal contact with members of the wider scientific community.

FINDINGS AND CONCLUSIONS

A: The research performed by the National Museum of Natural History, the National Zoological Park, and the Smithsonian Center for Materials Research and Education is inextricable from their missions and is appropriately characterized by the terms unique and special contributions.

B: The Smithsonian Astrophysical Observatory, the Smithsonian Environmental Research Center, and the Smithsonian Tropical Research Institute are world-class scientific institutions that combine facilities, personnel, and opportunities for specialized long-term research that is enabled by the stability of federal support. These units are engaged in research that supports the mission of the Smithsonian Institution as a whole—increasing knowledge and providing supporting expertise for the activities of other SI units, including educational activities.

C: Funding for research at the Smithsonian's research centers comes from a mix of sources, including a substantial fraction received through open competitive programs.

D: The Smithsonian Institution plays an important role in the overall US research enterprise and contributes to the healthy diversity of the nation's scientific enterprise.

E: Mechanisms at the Smithsonian scientific research centers for evaluating overall scientific productivity and for evaluating the productivity of individual scientists are variable and inconsistent.

F: Communication between the research centers and the central management of the Smithsonian Institution appears to be weak.

Consequences of transferring federally appropriated research funds from the Smithsonian

The following findings and conclusions stem from the Committee's consideration of the consequences of reallocating the federal funds appropriated currently to the Smithsonian to a competitively peer-reviewed program at NSF.

G: In general, transfer of all federal research funds (including salary and, in some cases, infrastructure support) would greatly reduce and possibly eliminate the role of the federal government in the long-term support of the core scientific research staff who provide the foundation of the Smithsonian research program. A withdrawal of federal support of this magnitude would make maintaining the staff and programs of the centers extremely difficult and would very likely lead to the demise of much of the Smithsonian's scientific research program.

H: Transferring the federally appropriated research funds for the National Museum of Natural History and the National Zoological Park to competitive programs at the National Science Foundation is likely to jeopardize their standing in the museum and zoo communities and could seriously damage aspects of their non-research roles. If the fund transfer were large and included salary support, the positions of critical museum and zoo personnel could be threat-ened. Loss of core funds

could also lead to the closure of the Smithsonian Center for Materials Research and Education.

I: Transferring directly appropriated funds from the Smithsonian Astrophysical Observatory, the Smithsonian Environmental Research Center, and the Smithsonian Tropical Research Institute to a competitive mechanism while trying to maintain the centers in the Smithsonian could produce consequences ranging from moderately or seriously deleterious to termnation of their operations.

J: The Committee could not identify any substantial advantages with respect to organization, management, or quality assurance that would accrue from changing the current system of federally appropriated research funding for the Smithsonian Astrophysical Observatory, the Smithsonian Environmental Research Center, and the Smithsonian Tropical Research Institute.

K: The Committee identified little or no scientific benefit of transferring federal funds away from the Smithsonian. The implications for the relevant scientific fields are likely to be adverse.

L: The broad mission of the Smithsonian Institution would be compromised if the links between the Smithsonian and its research centers were broken by transferring sponsorship of the centers to the National Science Foundation.

RECOMMENDATIONS

Research is an intrinsic part of the mission of the National Museum of Natural History and the National Zoological Park. These centers should continue to be exempt from open competition for research funding because of the uniqueness and special contributions conferred by association with their collections.

The Smithsonian Center for Materials Research and Education occupies a highly specialized research niche that is of unique and major value to museums of the Smithsonian Institution and to the museum community at large. Hence, the Committee believes that the center should continue to be exempt from open competition for research funding because of its uniqueness and special contributions to the museum community.

The Committee believes that the Smithsonian Astrophysical Observatory, the Smithsonian Tropical Research Institute, and the Smithsonian Environmental Research Center should continue to receive federally appropriated research funding. Use of public funds by these facilities is already producing science of the highest quality. Much of the "research funding" (for other than salary and infrastructure costs) is already obtained via competition. Any benefits of shifting these three facilities to the jurisdiction of another organization would be greatly outweighed by the harm done to their contributions to the relevant scientific fields.

Regular in-depth reviews by external advisory committees are essential for maintaining the health, vitality, and scientific excellence of the Smithsonian Institution. Although details of the nature and processes of the reviews may vary to accommodate differences among the six centers, such institutional reviews should be uniformly required for all six Smithsonian science centers and for their individual departments, if warranted by their size. Retrospective external peer review is especially important for areas not routinely engaging in competition for grants and contracts. Regular cycles of review followed by strategic planning offer the best means of ensuring that the quality of SI's science is maintained.

The research programs at the Smithsonian Institution provide essential support to the museums and collections, make substantial contributions to the relevant scientific fields, and fulfill the broader Smithsonian mission to "increase and diffuse knowledge." The Committee urges a stronger sense of institutional stewardship for these research programs as integral components of the Smithsonian. The Secretary and the Board of Regents should improve communication with the research centers and become strong advocates for their goals and achievements in a manner that is compelling to the Executive Branch, Congress, and the public.

APPENDIX C
SCIENCE COMMISSION MEMBERS

Dr. Jeremy A. Sabloff, Chairman, The Williams Director, University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia, PA

Dr. Alice Alldredge, Professor, Ecology, Evolution and Marine Biology, Biological Sciences University of California, Santa Barbara, CA

Dr. Francisco Ayala, Donald Bren Professor of Biological Sciences and Professor of Philosophy Ecology and Evolutionary Biology, University of California at Irvine, Irvine, CA

Dr. D. James Baker, President and CEO, The Academy of Natural Sciences, Philadelphia, PA

Dr. Bruce Campbell, Geophysicist and Department Chair, Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, DC

Professor Peter R. Crane, Director, Royal Botanical Gardens, Kew, England, Richmond, Surrey, United Kingdom

Dr. Douglas H. Erwin, Research Paleobiologist and Curator, Department of Paleobiology, National Museum of Natural History, Washington, DC

Dr. Ilka Feller, Animal Ecologist, Smithsonian Environmental Research Center, Edgewater, MD

Dr. William Fitzhugh, Director, Smithsonian Arctic Studies Center and Curator, Department of Anthropology, National Museum of Natural History, Washington, DC

Dr. Stephen P. Hubbell, Professor of Botany, University of Georgia, Athens, GA

Dr. Jeremy B.C. Jackson, William and Mary B. Ritter Memorial Professor of Oceanography and Director, Geosciences Research Division, Scripps Institution of Oceanography, University of California at San Diego, La Jolla, CA

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Dr. Simon Levin, George M. Moffett Professor of Biology, Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ

Dr. Yolanda T. Moses, President, American Association for Higher Education, Washington, DC

Dr. Peter H. Raven, Director, Missouri Botanical Garden and Professor, Washington University at St. Louis, Missouri Botanical Garden, St. Louis, MO

Dr. Beryl B. Simpson, C. L. Lundell Professor and Director, Plant Resources Center, Department of Botany, The University of Texas at Austin, Austin, TX

Dr. Warren L. Wagner, Curator of Pacific Botany, Department of Systematic Biology, National Museum of Nature History, Washington, DC

Dr. Marvaleen H. Wake, Professor of Biology and Chair, Department of Integrative Biology, University of California at Berkeley, Berkeley, CA

APPENDIX D
OBSERVATIONS ON THE CULTURE OF SMITHSONIAN PRINCIPAL INVESTIGATORS

"How we do things around here" is a phrase frequently used to describe culture, although descriptions of an organization's culture can also include organizational values, the physical attributes of a workplace, and other distinguishing characteristics. Culture is an important consideration for this study and for actions that may be taken as a result. There are several reasons:

- Culture encompasses the shared values of an organization and is frequently used to describe a source of conflict within or between them. Although this study focuses primarily on research centers, institution-wide cultural issues impact their functioning.[1]

- Having groups of scientists from different disciplines and organizations work together involves cultural and interdisciplinary science issues.

- Strategic and operational management of research involves a balancing act between management's influence and scientific freedom.

- Changes contemplated by the Under Secretary for Science may impact, or be impacted by, the existing culture.

THE ROLE OF PRINCIPAL INVESTIGATORS

Principal investigators play a unique and critical role in the Smithsonian's research activities. Its research units are frequently compared to universities since they obtain so much of their funding through grants. Researchers and research managers commented on the movement of scientists between academia and the Smithsonian (as well as other museums). In both settings, the scientists serve as principal investigator's conducting research, directing others, and obtaining resources that fund the whole research enterprise.

THEORIES ABOUT CULTURE

Organizational culture is not a new topic,[2] but one of growing interest as organizations increasingly change. In a recent book on organizational culture Joanne Martin[3] notes the complexities of the topic:

"I believe that only a small part of an organization's culture consists of issues and perceptions that people see clearly and agree on. The rest is characterized by incompletely understood conflicts between groups; inconsistencies between, for example, what people say they value and what they do; ambiguities about what frequently used phrases and goal statements actually mean; and irreconcilable paradoxes and contradictions. An oversimplified theory, however comforting and appealing, is not likely to be useful if it ignores important complexities in the world it attempts, imperfectly, to represent."

Despite this potentially discouraging introduction, the author subsequently describes several theories of culture, one of which is particularly useful when exploring the principal investigator culture.

The "differentiation" perspective is based on the premise that cultural consensus exists only at a sub-cultural level, not consistently throughout an organization. Applying this concept to the Smithsonian, one can define the sub-cultures at the science center level or even at the principal investigator level. Resource and time constraints limited the focus of the analysis to the principal investigator level, but it is likely that other sub-cultures exist within the science centers.

An operationally useful theory of culture was presented in the November-December 1996 Harvard Business Review.[4] A construct was

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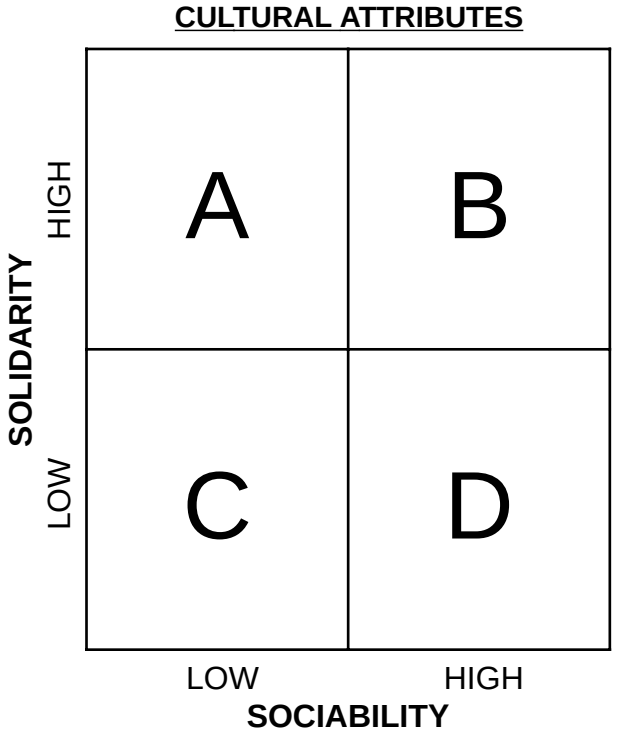
1 The March 2002 issue of the Washingtonian gives an account of Lawrence Small's first three years as Secretary. It reported in part "He has not encountered the cultural warfare that engulfed the institution during the 1990s. But his handling of other issues has left behind a wake of bad press, curatorial revolt, congressional resistance, and donor alienation…"

2 Thirteen years ago Peter Vaill wrote about the notion of culture. "For the past few years–and less visibly for the past fifty years–the subject of culture, and especially the culture of large organizations, has attracted more and more theorists and researchers. Organizational Culture: Mapping The Terrain, Sage 2002, Thousand Oaks, CA.

3 Organizational Culture: Mapping The Terrain, Sage 2002, Thousand Oaks, CA.

4 Rob Goffee and Gareth Jones What Holds the Modern Company Together? Harvard Business Review November-December 1996.

Chart D-1.
Cultural Attributes of Organizations



based on two types of distinct human relations, which the authors suggest were used by sociologists for 150 years.

The authors have created a 2-by-2 matrix that divides two dimensions into "high" and "low" ranges, as shown below. The dimensions are:

Sociability: The measure of emotional, non-official relations among individuals who regard one another as friends. In its pure form, sociability represents a type of social interaction valued for its own sake. We talk, share, laugh and cry together—with no strings attached.

Solidarity: Based more in the mind than in the heart. Its relationships are based on common tasks, mutual interests, or shared goals that will benefit all involved parties. Solidarity generates a high degree of strategic focus, swift response to threats, and intolerance for poor performance and can result in a degree of ruthlessness.

Organizations operating with the various combinations identified in the matrix as A, B, C, and D demonstrate remarkably different characteristics.[5] For example:

- Cell A includes organizations that are characterized by the ability to (in corporate terms) respond quickly to threats and marketplace opportunities. There tends to be a clear delieation in these "mercenary" organizations between work and social activities.

- Cell B includes organizations high in both dimensions, which are sometimes titled "communal" organizations. Start up, "go-go" companies frequently exhibit these characteristics as do some older organizations where employees have had time to develop personal relationships and shared organizational objectives. One inherent tension involves the conflict between friendship and firing an individual who is not contributing to the organization.

- Cell C includes organizations where individuals tend to work for themselves of by themselves. When asked what they do, few employees of a "fragmented" organization mention the organization. They are more apt to mention that they are an engineer, pathologist, or accountant.

- Cell D includes organizations with little hierarchy. Since organization priorities are less important than relationships, it usually is very difficult for managers to employ performance measures, procedures, or systems.

DATA FROM THE PRINCIPAL INVESTIGATORS

Data were collected from five groups of principal investigators representing CRC, NMNH, SAO, SERC, and STRI. The information was gathered during group discussions lasting from 1½ to 2½ hours. A senior level manager recruited participating principal investigators at each location. The NAPA study team thought that most or all of the principal investigators invited who were available at the time of the meeting actually attended it.

5 Ibid.

Two members of the study team attended the group discussions, and one took primary responsibility for facilitating to ensure a consistent process. Each discussion followed a similar format.

- The purpose of the NAPA study and the group discussion were explained.
- The study team and participants introduced themselves.
- Participants addressed the question, "What do you say when people ask you what is it like to work here?" Responses were recorded.
- Once the sociability and solidarity dimensions of culture were introduced, participants reflected on their own organizations and estimated the amount of time spent in each of the four cells.

Thirty-one principal investigators participated in the group discussions, with the following representation:[6]

CRC: 5
NMNH: 7
SAO: 7
SERC: 5
STRI: 7

INSIGHTS AND OBSERVATIONS FROM THE GROUP DISCUSSIONS

The observations and insights listed below include relevant characteristics of the principal investigator participants and a summary of what they said.

- The participants were employed by the Smithsonian as federal employees from 2 to 27 years with the average being 13 years. Nearly every principal investigator was involved long enough to develop an informed opinion of his or her center's culture.
- Almost every participant conducted research through grants and/or contracts from a variety of sources.
- Each discussion group included representatives from diverse scientific backgrounds.
- The apparent familiarity among members of four groups—CRC, SAO, SERC, and STRI—was greater than that among members of the NMNH group. There were frequent references to joint projects, grant proposals, and publications during the CRC, SAO, and SERC discussions.
- Many participants indicated that they were most likely to interact with researchers outside the Smithsonian. Joint projects with university-based researchers were frequently mentioned. NMNH participants indicated that researchers in their disciplines were most likely to be found at other institutions
- SERC and STRI principal investigators frequently mentioned that the unique physical attributes of their facilities attracted many researchers and students.
- "What is it like to work here" precipitated a wide variety of positive responses, including:
  - academic freedom and the ability to work on subjects of interest
  - unique Smithsonian resources, includes collections and research sites
  - the Smithsonian's reputation provides opportunities and access
  - relevance of research to important societal issues
  - twelve-month federal salaries
  - a stimulating intellectual environment
- "What is it like to work here" also precipitated some negative responses, including:
  - decreasing resources, including decreased opportunities for fellowships
  - increasing pressure to quantify research productivity and the corresponding loss of independence
  - apparent lack of interest and support (including financial support) from "the Mall"
  - a recent substantial increase in uncertainty

6 31 principal investigators participated in the portion of the group discussions addressing "what is it like to work here?" Only 28 principal investigators participated in the discussion of solidarity/sociability discussion due to previous engagements. The solidarity/sociability discussion was conducted by phone for the SERC principal investigators.

- Responses to the "what is it like to work here" question were consistent with anecdotal comments made during the 36 interviews involving 81 Smithsonian and non-Smithsonian individuals.

- A center's physical proximity to "the Mall" was frequently mentioned as an important factor (only NMNH principal investigators are located there). Proximity was seen as having positive and negative consequences.

- Asked to estimate the time their organization functioned within each cell of the solidarity-sociability matrix, the principal investigators responded, as shown in the chart below. The values are averages for all responses from each center.

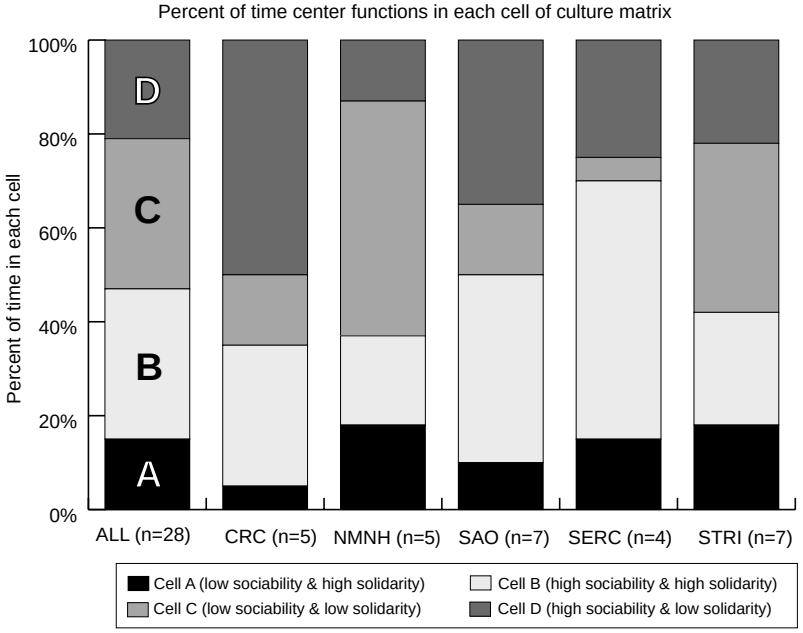
- The participants' combined perceptions were that the centers functioned in all four cells of the solidarity–sociability matrix. Although responses indicate that the centers functioned in the low sociability-high solidarity cell less than the other three cells, any difference must be viewed with caution given the relatively small sample (N=28).

- The chart indicates that principal investigators perceive that some centers function a substantial amount of time in a particular cell including:

  - CRC: 51 percent in the high sociability–low solidarity cell
  - NMNH: 47 percent in the low sociability–low solidarity cell
  - SERC: 59 percent in the high sociability–high solidarity cell.

- This chart does not address what may be the most important insight: the principal investigators' responses within individual centers and across them were remarkably diverse. For example, one participant believed that his center functioned 80 percent of the time in cell C (low-solidarity and low-sociability) while another in the same center reported that it functioned only 10 percent. In fact, nine participants estimated that their centers spent no time functioning in a particular cell while their fellow principal investigators reported percentages ranging from 10 to 80 percent for the same cells.

Chart D-2.
Principal Investigator Perceptions of Organizational Culture



APPENDIX E
OBSERVATIONS ON THE INTERACTIONS OF SCIENTISTS FROM DIFFERENT DISCIPLINES

Research managers interviewed believed that there should be a growing interest in increased interaction among scientists from different disciplines. This growing interest is precipitated by several factors:

- the emergence of complex societal issues—such as improving water quality, understanding global warming, and protecting endangered species—that require the application of a variety of disciplines

- the synergistic effect of exposing scientists in one discipline to the tools and techniques used in others

- avoiding stove-piped organizations that isolate scientific efforts and lead to overly narrow perspectives

Notwithstanding these advantages, several barriers make increased interaction a challenging task at the Smithsonian and other organizations. Interviewees identified some of these challenges.

- Management turnover: Without management continuity, there is limited opportunity for individual researchers to develop trust in the organization and become comfortable moving beyond their established areas of expertise.

- Sequential development: When different departments are established at different times, a competitive environment may develop for resources, space, and recognition. Both established and emerging departments may perceive that they are at a disadvantage. One observer noted that this was the case at the Smithsonian.

- Physical separation: Interviewees cited physical separation, ranging from building layouts and separation of collections from research laboratories, to "satellite" units separated by hundreds or thousands of miles.

- Specialization: Productivity in highly specialized areas often requires uninterrupted concentration that limits the time available for interaction and exploration of other disciplines.

COMMUNITIES OF PRACTICE

An approach used by corporations for integrating research and other functions may provide an interesting model for increasing scientist-to-scientist coordination and cooperation at the Smithsonian. In the corporate world, product and service program designs that once required years must now be completed in months or weeks. Furthermore, the product model life cycle has been dramatically shortened. Activities that once supported sequential decision-making now require collective decision-making. It is generally accepted that no single department (including a research department) has the full knowledge needed to successfully pursue innovation. Innovation and the knowledge development require the involvement of an entire organization, suppliers, customers, and other external partners.

The new relationships between research and program components have led to a new term, "communities of practice."[1] These communities include researchers and program staff at a minimum, and additional stakeholders as required. Viewing the participating organizations as a community, rather than individual organizations working together, requires each participant to focus on relationships, not transactions. Ideally, such activities as annual research planning are replaced by ongoing communication and collaboration among community members who are collectively interested in developing data, turning them into information, and combining them with experience and theory to produce new programs and policies and other actions. Communities of practice could extend to relationships between Smithsonian researchers and research centers, and among the research, education, and exhibit function.

1 Communities of practice are the "social and intellectual context in which learning occurs because it is here that information, theory, and experience are actively integrated in the continual process of doing, of getting work done through practice." For more on this concept see, Miller and Morris, *Fourth Generation R & D: Managing Knowledge, Technology, and Innovation.*

Communities of practice typically exhibit three characteristics. They share the same experiences, hold the same theories, and use the same information. Although many communities occur naturally, it may be possible to create or enhance them through overt action and leadership.

Effective Initiatives

Without specifically referring to communities of practice, several researchers and research managers reported using strategies to increase the interaction among different disciplines. Specific activities mentioned include:

- Conducting lecture series with topics of diverse interest: This brings scientists into physical proximity and demonstrates topics of common interest and value.

- Establishing ad hoc teams to address specific issues or projects: One organization brought together researchers from various disciplines to help it create a "coffee table" book arraying its diverse activities. The book was made available to the public, giving researchers an opportunity to present their work in a very public way.

- Creating special positions for interdisciplinary activities: One museum has established two principal investigator positions that continue to be funded so long as the incumbents work on cross-organizational projects.

- Providing seed money for interdisciplinary proposals: A museum sought to open a new area of inquiry requiring input from several disciplines. It allocated "start-up" incentive funds to the new endeavor.

- Co-locating offices to increase informal interaction: One corporation combined its research units under a single management structure, and built a new research campus to house all research activities in close proximity.

- Supporting non-work events that bring scientists together: One research center hosts noontime volleyball games and summer picnics.

- Assigning scientists from different organizations to shared laboratories: One museum fosters collaboration by providing shared space to scientists studying fungi and those studying insects.

- Establishing "virtual" organizations: Some organizations identify ongoing themes or long-term initiatives that attract researchers from various disciplines.

Based on group interviews with Smithsonian principle investigators, an effective way to increase this type of interaction is to align such efforts with a common goal or mission. Support for increased funding and other benefits also may accrue if the common mission has widespread public appreciation and support. The Smithsonian's research units all have done this to some extent, including NMNH's demonstrated work in biodiversity and global warming. Much of SAO's mission and many of its resulting activities are in sync with the public's ongoing interest in outer space. NASA activities keep this topic in the public eye. Three research centers—SERC, CRC and STRI—are positioned to take full advantage of widespread public interest in protecting the environment and conserving and protecting endangered species in the United States and around the world.

APPENDIX F
INTERVIEWS CONDUCTED

SMITHSONIAN INSTITUTION

Administrative Offices

Bruce A. Dauer, Director, Office of Planning, Management and Budget
James D. Douglas, Deputy General Counsel
Ardelle G. Foss, Director, Office of Sponsored Projects
Mildred Glover, Associate General Counsel
Catherine F. Harris, Acting Director, Office of Fellowships
Frederic A. Heim, Indirect Cost/Audit Analyst, Office of Sponsored Projects
Pamela M. Henson, Director, Institutional History Division
Pamela E. Hudson, Program Manager, Office of Fellowships
Michael A. Lang, Executive Officer for Scientific Programs, Office of the Under Secretary for Science
Alice C. Maroni, Chief Financial Officer
Bruce Morrison, Program Manager, Office of Fellowships
Carole Neves, Director, Office of Policy and Analysis
J. Scott Robinson, Assistant Director, Office of Sponsored Projects
Mary Rodriguez, Associate Director, Office of Planning, Management and Budget
Mary R. Tanner, Senior Executive Officer, Office of the Under Secretary for Science

SMITHSONIAN SCIENCE CENTERS

National Museum of Natural History

Carole C. Baldwin, Research Zoologist, Division of Fishes, Department of Systematic Biology
Martin A. Buzas, Senior Geologist, Curator of Minerals, Department of Paleobiology
Douglas H. Erwin, Interim Director
Terry Erwin, Research Entomologist
Rafael Lemaitre, Curator/Research Zoologist, Invertebrate Zoology Section, Department of Systematic Biology
Timothy J. McCoy, Curator-in-Charge, Division of Meteorites, Department of Mineral Sciences
Scott E. Miller, Acting Chair, Department of Systematic Biology
Paul M. Peterson, Curator of Grasses, Botany Section, Department of Systematic Biology
Bruce D. Smith, Curator of North American Archaeology, Director, Archaeobiology Program, Department of Anthropology
Wendy Wiswall, Scientific Program Administrator, Office of the Associate Director for Research and Collections

National Zoological Park

Daryl Boness, Head of Biological Conservation Program
Janine L. Brown, Reproductive Physiologist
James A. Comiskey, Associate Director, Research, Management and Assessment of Biodiversity Program
Scott R. Derrickson, Assistant Director, Collection and Facilities
JoGayle Howard, Theriogenologist
McKinley Hudson, Deputy Director
Olav T. Oftedal, Research Nutritionist

Smithsonian Astrophysical Observatory

William J. Ford, Contract Specialist
Lincoln Greenhill, Radio Astronomer
John G. Harris, Manager of Contracts, Grants, and Property Management
Matthew Holman, Astrophysicist
Charles Lada, Senior Astrophysicist
Michael C. McCarthy, Physicist
Jeffrey McClintock, Senior Astrophysicist
Philip C. Myers, Senior Astrophysicist
Robert Palleschi, Manager, Financial Management Branch
John Raymond, Physicist
Judith Ryan, Systems Accountant
Irwin Shapiro, Director

Smithsonian Center for Materials Research and Education

Ronald Bishop, Coordinator for Research, Senior Archaeologist
Lambertus Van Zelst, Director

Smithsonian Environmental Research Center

Charles L. Gallegos, Phytoplankton Ecologist
Anson H. Hines, Assistant Director
J. Patrick Megonigal, Biogeochemist
Patrick J. Neale, Photobiologist
Donald Weller, Quantitative Ecologist

Smithsonian Tropical Research Institute

Lisa Barnett, Director of Development
Richard Condit, Staff Scientist
William Laurance, Staff Scientist
Leopoldo Leon, Controller
Harilaos Lessios, Staff Scientist
Dolores Piperno, Staff Scientist
Ira Rubinoff, Director
William Wcislo, Staff Scientist
Donald Windsor, Staff Scientist
Klaus Winter, Staff Scientist
S. Joseph Wright, Staff Scientist

SMITHSONIAN SCIENCE COMMISSION

Jeremy A. Sabloff, Chairman, University of Pennsylvania Museum of Archaeology and Anthropology

ASSOCIATIONS

American Association of Museums

Kim Igoe, Vice President, Policy and Programs
Elizabeth E. Merritt, Director, Museum Advancement and Excellence

Council on Governmental Relations

Carol J. Blum, Associate Director
Anthony DeCrappeo, Associate Director
Robert Hardy, Associate Director
Katharina A. Phillips, President

Pharmaceutical Research and Manufacturers of America

Bert Spilker, Senior Vice President, Scientific and Regulatory Affairs

FEDERAL AGENCIES

Department of Energy

William J. Valdez, Director, Office of Planning and Analysis

National Insitutes of Health

Leo F. Buscher Jr., Grants Management Officer, Office of Management, National Cancer Institute

National Science Foundation

Brian J. Mannion, Senior Advisor for Workforce Planning, Operations, and Risk Management, Division of Contracts and Agreements
Joanna Rom, Deputy Director, Planning, Coordination, and Analysis
Mary F. Santonastasso, Director, Division of Contracts and Agreements

National Aeronautics and Space Administration

Devin Barnett, Contract Specialist, Goddard Space Flight Center
Elaine Hamner, Contract Specialist, Marshall Space Flight Center
Veronica Stubbs, Contract Specialist, Goddard Space Flight Center
Carl Thomas Weih, Contracting Officer, Langley Research Center

Office of Management and Budget

Sarah Horrigan, Acting Branch Chief, Science and Space Programs
David Radzanowski, Program Examiner, Science and Space Programs Branch

Office of Science and Technology Policy

Cliff Gabriel, Deputy to the Associate Director for Science

Office of Senator Pete V. Domenici, New Mexico

Peter Lyons, Science and Technology Advisor

U.S. Department of Agriculture

Edward Knipling, Acting Administrator, Agricultural Research Service

PUBLIC INSTITUTIONS

American Museum of Natural History

Darrel Frost, Associate Dean of Science for Collections, Curator, Herpetology
Michael Novacek, Senior Vice President and Provost of Science, Curator, Vertebrate Paleontology
Merrily Sterns, Director, Federal Programs

Field Museum of Natural History
Deborah Bakken, Sponsored Programs Coordinator
Gregory Mueller, Chair, Department of Botany
Olivier Rieppel, Chair, Department of Geology

Los Angeles County Museum of Natural History
John E. Heyning, Deputy Director, Research and Collections and Curator of Mammals

New York Botanical Garden
Michael Miceli, Controller
Dennis Stevenson, Vice President for Botanic Science

Wildlife Conservation Society/Bronx Zoo
John Robinson, Senior Vice President and Director of International Conservation

UNIVERSITIES

Cornell University
Robert Richardson, Vice Provost for Research, Physics Professor

SUNY-Stony Brook
Gail Habicht, Vice President for Research, Research Foundation Operations Manager and Professor of Pathology

University of California, Los Angeles
Linda Lee, Manager, Public and Non-Profit Sector, Office of Contract and Grant Administration

University of Virginia
David Hudson, Associate Vice President for Research and Public Service

PRIVATE COMPANIES

Abbott International Division
Melissa Brotz, Director, Public Affairs
Charles Fisher, Divisional Vice President, Global Pharmaceuticals R&D
Keith Hendricks, Director, New Product Planning and Marketing Research
Jeff Leiden, Executive Vice President, Global Pharmaceuticals R&D
Perry Nisen, Divisional Vice President, Global Oncology Development
Daniel Norbeck, Vice President for Pharmaceutical Discovery
Doug Sporn, Divisional Vice President, Corporate Regulatory Affairs
Eugene Sun, Divisional Vice President, Infectious Diseases and Virology Development, Global Pharmaceutical R&D

Biogen, Inc.
James D. Green, Vice President, Preclinical and Clinical Sciences Division

The Charles Stark Draper Laboratory, Inc.
James D. Shields, Vice President, Programs
Vincent Vitto, President and Chief Executive Officer
Joseph M. Wolfe, Vice President and Treasurer

OTHER INSTITUTIONS AND ORGANIZATIONS

National Radio Astronomy Observatory
Ken Kellermann, Chief Scientist

Friends of the National Zoo
Miguel Vilar, Foundation and Grants Coordinator

The John H. Heinz III Center for Science, Economics, and the Environment
Thomas E. Lovejoy, President

Space Telescope Science Institute
Ray Beaser, Chief, Grants and Contracts Branch

Woods Hole Oceanographic Institution
James Luyten, Executive Vice President and Director of Research
Maurice Tavares, Manager of Grant and Contract Services

CONSULTANTS
William E. Lilly, Senior Consultant and Director of NASA Programs, National Academy of Public Administration
Herb McLure, Senior Consultant, Smithsonian Institution

APPENDIX G
BIBLIOGRAPHY

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APPENDIX H
ACRONYMS

CFO Chief Financial Officer

CRC Conservation and Research Center

F&A Facilities and Administration (Overhead)

FFRDC Federally Funded Research and Development Center

FY Fiscal Year

GAO General Accounting Office

NASA National Aeronautics and Space Administration

NMNH National Museum of Natural History

NRC National Research Council of the National Academy of Sciences

NSF National Science Foundation

NZP National Zoological Park

OMB Office of Management and Budget

OSTP Office of Science and Technology Policy

SAO Smithsonian Astrophysical Observatory

SCMRE Smithsonian Center for Materials Research and Education

SERC Smithsonian Environmental Research Center

STRI Smithsonian Tropical Research Institute

Smithsonian Photo Credits

(clockwise from top right):

Triceratops and Display Hall: Chip Clark

La Mano Poderosa—The Powerful Hand: Pike Collection, National Museum of American History, Smithsonian Institution

Smithsonian Tropical Research Institute: Marcos Guerra

CO2 Forest Chamber: Richard Strauss, Smithsonian Institution

Antennas atop Mauna Kea: Antony Schinckel, SMA Operations Director

Giraffe: Jessie Cohen

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