FY2003 REPORT FROM THE OFFICE OF POLAR PROGRAMS COMMITTEE OF VISITORS

Office of Polar Programs
U.S. National Science Foundation
Washington, D.C.

September 2003

FY 2003 REPORT FROM THE OFFICE OF POLAR PROGRAMS
COMMITTEE OF VISITORS (COV)
17-19 SEPTEMBER 2003

Table of Contents

FY 2003 REPORT FROM THE OFFICE OF POLAR PROGRAMS

COMMITTEE OF VISITORS, 17-19 SEPTEMBER 2003

NSF Committee of Visitors (COV) Reviews

An NSF Committee of Visitors (COV) is asked to provide "a balanced assessment of ….. performance in two primary areas, the integrity and efficiency of the *processes* related to proposal review, and the quality of the *results* of investments in the form of outputs that appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future ……. It is important to recognize that reports generated by COV's are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public…." (*Committee of Visitors Reviews, NSF Manual 1, Section VII*).

COV's tasked with reviews of NSF Divisions, Directorates and Offices in 2003 are asked to respond to a set of Core Questions organized within the following major categories:

A.1. Quality and Effectiveness of Merit Review Procedures
A.2. Implementation of NSF Merit Review Criteria
A.3. Selection of Reviewers
A.4. Resulting Portfolio of Awards
A.5. Management of Program Under Review

B.1 NSF Outcome Goal for People
B.2 NSF Outcome Goal for Ideas
B.3 NSF Outcome Goal for Tools

C.1 – C.5 Other issues that the COV feels are relevant to the review

NSF Office of Polar Programs FY 2003 COV Review of the

Arctic Science Section and Antarctic Science Section

This report presents the results of the FY 2003 COV review of the Antarctic Science and Arctic Science (including logistics) sections of the Office of Polar Programs for the period FY 2000-2002, and it follows the template of major topic areas and Core

Questions set forth in the NSF COV directive cited above. It is noted that these sections were last reviewed in July of 2000 (spanning the period FY 1997-1999).

In summary, the COV finds OPP to be effectively managed, with proposal solicitation and review increasingly addressing both major review criteria by the end of the period reviewed. Importantly, the results of OPP's investments are exciting, worthwhile and of high quality, and OPP's administrative and management processes are thorough and sound, with high integrity.

The FY 2003 OPP Committee of Visitors (COV)

Dr. Karl Erb, Director of the Office of Polar Programs, appointed a Committee of Visitors (COV) comprising: Raymond Bradley (University of Massachusetts), Howard Epstein (University of Virginia), Sven Haakanson (Alutiiq Museum, Kodiak), Beverly Hartline (Argonne National Laboratory), Gonzalo Hernandez (University of Washington), Martin Jeffries (University of Alaska, Fairbanks), Molly Miller (Vanderbilt University), Marilyn Raphael (University of California, Los Angeles), James Swift (Scripps Institution of Oceanography, La Jolla), James Taranik (University of Nevada, Reno), Peter Webb (Ohio State University), and Karen Wishner (University of Rhode Island). The committee was chaired by Peter Webb, with Beverly Hartline and Martin Jeffries representing the Office of Polar Programs Office Advisory Committee (OAC). The Committee of Visitors (COV) is an *ad hoc* subcommittee of the OAC. The expertise among the FY 2003 COV group spanned most specialty areas in the OPP's science programs.

The Agenda and Work plan of the FY 2003 Committee of Visitors

The FY 2003 Committee of Visitors met at the National Science Foundation over three days from 17-19 September 2003, during Hurricane Isabel.

Dr. Erb presented the charge to the FY 2003 Committee of Visitors and clarified its duties within the framework of NSF's Core Question template. To launch the task and assist the committee, the meeting commenced with overview presentations by senior Office of Polar Program administrative staff. Dr. Karl Erb provided a comprehensive overview of the OPP mission, this including information on the current Office administrative structure and personnel, major areas of science administered by OPP in both the Arctic and Antarctic regions, the role of OPP in promoting NSF agency-wide priorities in research, education and technology, the representation of polar science to the public and society at large, proposal, budget and other information. Dr. Robert Wharton briefed the committee on Conflict of Interest issues. Then followed illustrated presentations of past, planned and proposed OPP program activities within the Arctic Science Section (Dr. Thomas Pyle, Section Head) and Antarctic Science Section (Dr. Scott Borg, Section Head).

During the following two and a half days the COV considered data from these presentations along with a range of other of documentation as it addressed NSF Core Questions and developed summary comments and recommendations. The onset of Hurricane Isabel and the consequent closing of government offices prevented the COV from discussing its conclusions with OPP program officers and managers at the end of its deliberations. However, the committee chair and one other COV member met with the OPP staff the following week for this purpose. The work of the committee was rendered more difficult by the government closing but arrangements were made for it to complete much of its activity in a local hotel. Final report editing was conducted via e-mail and phone discussions.

Sources of information and data for the period FY 2000-2002

Responses to Core Questions together with summary comments and recommendations provided below are based on the following sources of information.

1. Program officer briefings and questioning.

2. Proposal jackets (proposal, mail reviews, panel reviews, program manager statements, correspondence, award letters, annual reports, etc).

3. Office of Polar Programs and NSF Electronic Information System (EIS) spread sheet data.
   a. Dwell times for awarded and declined proposals
   b. Award dollar amounts
   c. Award duration
   d. Numbers of new principal investigators
   e. Funding (award) rates for underrepresented groups (minorities and women)
   f. Funding (award) rates for principal investigators by program specialties
   g. Funding (award) rates by geographic region
   h. Funding (award) levels by Carnegie institutional category
   i. Types of proposal review (mail and/or panel)

NSF FY 2003-2008 GPRA Strategic Plan (Draft 3.1, NSB-03-70 (June 5th 2003).

NSF Office of Polar Programs Advisory Committee (OAC) Report on GPRA (November 2000).

NSF Office of Polar Programs Advisory Committee (OAC) Report on GPRA (November, 2001).

NSF Office of Polar Programs, Government Performance and Results Act (GPRA) FY 2002 Performance Report (2002).

NSF OPP Advisory Committee, Working Group on Implementation of Review Criterion #2 “Broader Impacts of the Proposed Study,” Merit Review Criteria (February 2001)

FY 2000 Report from the Office of Polar Programs Committee of Visitors (25-27 July 2000); and OPP Response to Recommendations of the FY 2000 OPP COV (July 25-27, 2000).

The United States in Antarctica, Report of the U.S. Antarctic Program External Panel, U.S. National Science Foundation, Washington, D.C. (April, 1997).

Polar Press Clips 2003, U.S. National Science Foundation, Washington, D.C.

List of review criteria for the solicitations and program announcements issued during the period under review (2000-2002).

Review of proposal jackets

Proposal jackets provided a major source of information used by the Committee of Visitors in addressing the NSF Core Questions. The committee examined a total of 176 proposal jackets from the period 2000-2002 during its survey.

Seventy-four (74) and one hundred and two (102) jackets fell within the "awarded" and "declined" categories respectively. Proposal jackets surveyed were randomly selected under Dr. Erb's direction using a random number generator to select 10% of the proposal actions (awards and declines) from each program under review. In the "awarded" category there was the following distribution: Arctic Science Section (36), Antarctic Science Section (36), and General instrumentation (2). In the "declined" category there was the following distribution: Arctic Science Section (60), Antarctic (38), and General Instrumentation (4). Ten SGER proposals were included in the total sample. Every jacket in the sample was reviewed by several COV members.

In its review of jackets and other material, the COV addressed the nearly 40 Core Questions provided in NSF's standard guidance to COV's. Given the consistency of the material on which we based our conclusions, we believe they are unlikely to be affected by either a more exhaustive examination of the available proposal jacket sample or by consideration of a larger jacket sample.

Responses to NSF Committee of Visitors Core Questions

The following sections present committee responses to specific Core Questions.

A.1 Quality and Effectiveness of Merit Review Procedures

1. Is the review mechanism appropriate? (panels, ad hoc reviews, site visits)

Yes. OPP uses both mail reviews and panel reviews to evaluate proposals, and obtains a minimum of three reviews for each proposal. We found no instances of site visits being

used. Absence of site visits is appropriate, since the proposals examined by the COV were not for centers or institutes.

Using their particular expertise and experience, mail reviewers provide detailed evaluations of individual proposals. Panels provide collective evaluations and comparisons among several proposals, synthesizing assessments using the collective experience and expertise of the panel members. Panel review reports appear not to contain as much detail as three or more mail reviews do together.

In both the Arctic and Antarctic sections mail reviews and panel reviews are used appropriately, in ways that reflect the nature and scope of individual programs. For example, the Arctic Natural Sciences Program, which receives more proposals than any other OPP program, uses primarily mail reviews. This is not surprising, as it would be impractical for this multidisciplinary program to assemble a panel with the necessary disciplinary depth and breadth to provide an effective review of each proposal. On the other hand, it is appropriate for the Arctic System Science program to rely exclusively on panel reviews to assess proposals submitted in response to special announcements and requests for proposals such as the "Freshwater Initiative." Given the special strengths of mail and panel reviews, we believe that OPP program managers should continue to be flexible and use their discretion to employ the most appropriate review mechanism, and consider using both types of review together, whenever doing so would be valuable.

2. Is the review process efficient and effective?

Yes. The review process and subsequent communication of decisions to principal investigators was found to be generally good. Reviews of proposals cannot be returned to PIs until a final decision is made by the Section Head. The COV stresses the importance of returning reviews as quickly as possible in cases where a proposal is declined so that a PI might re-write a proposal and re-submit in time for a subsequent submission deadline. We recognize that award notifications may be delayed by logistic and budget-related deliberations.

Recommendation: Declination letters, including access to the reviews, should proceed on as fast a track as possible, in order to allow timely submission of revised proposals.

3. Are reviews consistent with priorities and criteria stated in the program solicitations, announcements, and guidelines

Mostly. The reviews in nearly all cases seem to be consistent with the broad nature of the solicitations. With respect to the two major guidelines for NSF proposal review, Intellectual Merit and Broader Impacts, the Intellectual Merit of the proposal was in all cases addressed consistent with the priorities and criteria stated in the solicitations. The Broader Impacts appeared to be addressed more comprehensively towards the end of the 2000-2002 period, as the emphasis on this guideline and the clarity of its definition increased within NSF. Note that different reviewers often used different definitions of "broader impacts," ranging from education, to societal, to applications in other scientific

disciplines. We are impressed that OPP's work to define and communicate what "broader impacts" can entail has been adopted NSF-wide. The resulting guidance should be very helpful, and its effectiveness should be clear when the next COV review occurs in three years.

4. Do the individual reviews (either mail or panel) provide sufficient information for the principal investigator(s) to understand the basis for the reviewer's recommendation?

Yes. The overwhelming majority of individual reviews (both mail and panel) provide a considerable amount of specific, relevant, thoughtful, and insightful feedback to justify the basis for the evaluation.

Most proposals were reviewed by more than three external reviewers. A very small number of reviews were cursory and had very little substantive information. The reviews are used effectively by program officers to develop their recommendations whether to make an award, to decline, or to request modifications to the scope and/or budget. Communications to PIs regarding OPP actions were consistently clear, and the reviews were routinely provided to principal investigator(s) along with or shortly after the communication about NSF's decision on the proposal. Thus, each PI was provided with sufficient information to understand the reasons for NSF action on the proposal.

A few program managers went far beyond the requirements in terms of the quality and substance of their communication to PIs, and other program officials in OPP could benefit from having these program managers share their approaches across the Office. Occasionally, a program manager would request a PI to comment on a specific reviewer's questions prior to advancing the recommendation for funding.

5. Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation?

Mostly. In most cases, the panel summaries provided sufficient information for the PIs to understand the basis for the panel recommendation. In cases where there was only a panel review, the amount of information available to PIs was less than in cases where there were multiple mail reviews, as well. Some summaries (especially a few done early in the review period, before FastLane was available to support panel documentation) were sparse in their details.

6. Is the documentation for recommendation complete and does the program officer provide sufficient information and justification for her/his recommendation?

Yes. The documentation for recommendations was complete, comprehensive, and clear in all the programs the COV reviewed. Program officers in Arctic Natural Sciences (ANS) and Antarctic Geology and Geophysics (AG&G) did particularly thorough jobs summarizing the panel and/or mail reviews and describing the rationale for the

recommended decision—including scientific merit, broader impacts, funding and logistical constraints.

Recommendation: OPP should consider sharing examples of exemplary write-ups by program officers across the Office, thereby helping everyone continuously improve the quality, thoroughness, completeness, and clarity of these documents.

7. Is the time to decision appropriate?

The COV wholeheartedly supports the NSF goal of continuing to reduce the time to decision. The dwell time for OPP proposals is somewhat longer than the NSF average, but not significantly longer, considering the need to integrate both logistical and scientific elements. Note that in the case of negative decisions, it is especially desirable to have the time to decision, including the communication of reviews to PIs, be at least one month shorter than the interval between proposal deadlines, so that the PI can revise and resubmit the proposal in time for the next deadline. Dwell time for Antarctic proposals is longer than that for the Arctic program, probably because of logistics. The COV is pleased that between FY2000 and 2002 the dwell time was reduced substantially in some OPP programs (but not in others).

Recommendation: OPP should continue to expedite decisions, strive to reduce dwell time, and notify PIs promptly. It is especially important to provide reviewer comments to PIs on declined proposals, at least one month before the next proposal deadline (typically semi-annual).

A.2. Implementation of NSF Merit Review Criteria

8. Have the panel summary reviews addressed whether the proposal contributes to both merit review criteria?

Increasingly. All panel summaries address the intellectual merit and quality of the proposals. For a sampling of proposals reviewed between 2000 and 2002, it appeared that approximately one-third of panel summaries addressed "broader impacts," usually by describing potential scientific impacts or significance beyond the immediate field. "Broader impacts" was more consistently addressed in more recent panel reviews. NSF's new requirement for "broader impacts" to be addressed in proposals in FY 2003, and the very practical guidelines NSF has adopted (based originally on the product of a working group OPP convened to follow up on a recommendation of the 2000 COV) to help define what constitutes "broader impacts," should make a difference in FY 2003 and beyond.

9. Have the review analyses (Form 7s) addressed whether the proposal contributes to both merit review criteria?

Yes for Scientific Merit; Increasingly for Broader Impacts. All review analyses addressed scientific merit and importance quite thoroughly. Fewer than half of the review analyses addressed broader impacts. The review analyses of recent proposals were much more consistent in mentioning broader impacts than those prepared early in the period the COV

reviewed. Often review analyses focused the assessment of broader impacts primarily on broader scientific significance, rather than describing educational or societal impact, for example, as well. The very practical NSF guidelines, mentioned in the COV response to Question 8, above, make clear NSF's broad definition of broader impacts, and can be expected to be reflected in future review analyses.

A.3. Selection of Reviewers

10. Did the program make use of an adequate number of reviewers for a balanced review?

Yes. The number of reviews requested ranged up to 15, and the number received ranged from 3 to 12.

11. Did the program make use of reviewers having appropriate expertise and/or qualifications?

Yes. The breadth, depth and effort apparent in written assessment indicate clearly that the program made appropriate use of reviewers with expertise and relevance to the proposals. This is particularly apparent in cases where reviewers identified and discussed such issues in proposals as original and innovative science, sound logic, clear vision, and scientific flaws. An additional indication of appropriate reviewer selection is that reviewers provided comprehensive, constructive advice to the PI.

12. Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups?

Yes. The geographic distribution of reviewers for OPP proposals was diverse, including reviewers distributed throughout the conterminous United States, Alaska, and Hawaii, and sometimes from foreign countries. Most of the reviewers were from universities, but many were employees of colleges, government, industrial, or other non-educational institutions. NSF did not provide the COV with information on the gender or ethnicity of the reviewers. Many proposals included at least one woman reviewer; there were some minority reviewers, based on gender/ethnic knowledge possessed by COV members. OPP does not wish to disqualify volunteer reviewers who choose not to disclose their gender/ethnicity.

13. Did the program recognize and resolve conflicts of interest when appropriate?

Yes. All conflicts of interest appear to have been resolved. Many jackets included correspondence from persons asking to be excused for reasons of conflict of interest.

A.4. Resulting Portfolio of Awards

14. Overall quality of the research and/or education projects supported by the program

Generally, projects receiving support were all highly rated by reviewers. We take this as evidence that the research and education projects being supported are of high quality.

15. Are awards appropriate in size and duration for the scope of the projects?

Yes, in most cases. Generally, those projects that were selected for funding received 100% of the support for the period requested, and in some cases supplementary awards were also provided when requested. Comparing OPP award size with NSF as a whole shows mean awards are generally higher whereas median awards are generally lower. This may reflect a somewhat higher number of large awards within OPP. Award duration within OPP is similar to the Foundation as a whole.

In a few cases where project budgets were reduced at the request of NSF, there was evidence that graduate student salaries (and possibly tuition/fees) were removed from the budget. Graduate students are an important contributor to NSF's "Outcome Goal for People." Furthermore, if involvement of graduate students within a project is an integral part of its educational 'scope' then the reduction or removal of this line could be a negative, unless funding for the graduate student(s) was provided by other sources. The COV found no evidence to indicate whether the participation of graduate students was reduced or funded in other ways.

Recommendation: To provide specific measures of its contributions to NSF's Outcome Goal for People, OPP should try to develop statistics on the total number of undergraduate, graduate, and postdoctoral researchers receiving support from OPP awards, and also on the number of Masters and PhD degrees produced in the course of OPP-funded research projects. It would be useful if these data could be sorted according to specific programs in both Arctic and Antarctic science sections and reduced to percentages in order to aid comparisons. The COV recognizes that it will be difficult to collect quality data of this type, and acknowledges that the community must be involved.

Recommendation: OPP should ascertain whether the exclusion or reduction of budget line items for graduate student support has impacted the number of young scientists supported and graduated to any significant degree, and to follow up, as necessary.

16. Does the program portfolio have an appropriate balance of High Risk proposals?

Yes. It was clear from the jackets that scientific risk was not a negative factor in proposal review and that presenting a scientifically risky idea did not disadvantage proposals with respect to funding. Logistical riskiness or complications occasionally resulted in favorably reviewed proposals being delayed, modified, or declined. Some SGER projects allowed rapid, preliminary exploration of high-risk concepts.

17. Does the program portfolio have an appropriate balance of multidisciplinary proposals?

Yes. The program portfolio seems to be split rather evenly between disciplinary and multidisciplinary proposals, and this is appropriate for OPP. OPP by its very nature is a strongly multi-disciplinary program.

18. Does the program have an appropriate balance of innovative proposals?

Yes. Although reviewers are not asked to assess the innovativeness of proposals, in about 10% of cases innovativeness was so significant that reviewers noted it. There was no obvious discrimination against proposals called 'innovative.' It would be useful to a COV, if the reviewers (mail and panels) were asked for their opinion on this subject.

19. Does the program portfolio have an appropriate balance of funding for centers, groups and awards to individuals?

Yes. OPP appears to have an appropriate balance for the funding of individual and group (taken to mean an interdisciplinary or multidisciplinary project) awards. We saw no jackets that involved 'centers.' Both the funded and declined categories were almost evenly split between individual and group efforts.

20. Does the program portfolio have an appropriate balance of awards to new investigators?

Yes. A significant fraction of the awards go to new investigators, and it appears that the reviewers and program officers are alert to proposals by new investigators and somewhat tolerant of proposal presentation weaknesses caused by PI inexperience. About 22% of OPP PIs receiving awards between 2000 and 2002 were new investigators. OPP's rates of funding new PIs (32%) is close to NSF's average (34%), as is its funding rate for proposals from new PIs (OPP at 26% is slightly above the NSF average of 23%). Thus, new PIs submit an average of 1.4 proposals to get an OPP award. This compares favorably with both the NSF-wide rate of 1.6 for new PIs and the OPP overall rate for all PIs (1.7). OPP should continue to be proactive to encourage new PIs and help them learn how to develop successful proposals.

21. Does the program portfolio have an appropriate balance of geographical distribution of Principal Investigators?

Yes. During the target period, OPP received and supported proposals from a wide geographical area, although some areas were more highly represented than others. Overall, the geographic representation is broad, with grants having been awarded to institutions in 49 states during the reviewed period.

22. Does the program portfolio have an appropriate balance of institutional types?

Yes. For both Arctic and Antarctic programs the majority of successful applications came from Doctoral Research Universities (DRU), primarily DRU-Extensive. But the review process is not biased in favor of these institutions. For the Arctic Program, 74% of awards and 81% of declines are for DRU institutions. For the Antarctic Program, the portions are 81% of awards and 77% of declines. Master's Colleges and Universities I have about 5% of the portfolio, and Liberal Arts Colleges have about 2%. The remaining awards are to specialized institutions and "other."

Recommendation: OPP should continue to be creative and proactive in encouraging the participation of PUI (Predominantly Undergraduate Institutions) in the research process, including encouraging partnering between DRUE/I and other institutions and also use of RUI (Research in Undergraduate Institutions) and REU (Research Experience for Undergraduates) programs.

23. Does the program portfolio have an appropriate balance of projects that integrate research and education?

Yes. Most funded proposals are for research, and they often provide funding for graduate and undergraduate students training so they have an educational aspect. We note that the program has also funded several proposals that have strong educational (K-12) and community outreach components.

24. Does the program portfolio have an appropriate balance across disciplines and subdisciplines of the activity and of emerging opportunities?

Yes. Examination of the proposals showed a good balance across disciplines and sub-disciplines both in the Arctic and Antarctic regions. Many proposals showed good potential for exploitation of emerging opportunities in biocomplexity in the environment, information technology research, nanoscale science and engineering, and workforce needs in this century. The FY 2002 GPRA Performance Report and the OPP Office Advisory Committee Reports on the GPRA were examined by the COV and they support the above conclusions.

25. Does the program portfolio have appropriate participation of underrepresented groups?

The COV determined that the OPP had rates of participation of underrepresented groups that were close to or exceeded the rates for NSF as a whole. Neither OPP nor NSF as a whole, nor most of the fields funded by OPP has participation by PIs from underrepresented groups that approaches national demographics. There is evidence that OPP pays considerable attention to increasing the number of women and underrepresented minorities among its awardees and in its communities.

Recommendation: The COV encourages OPP to continue to be creative and proactive in this area and attempt to further increase the proportion of underrepresented groups.

26. Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports

Yes. By nearly any conceivable measure, the NSF Office of Polar Programs strongly and successfully supports the NSF Mission, and hence NSF's role in national priorities. The Office itself exists in part to assure continuous, coordinated support for the NSF Antarctic mission, and by explicitly including Arctic science assures that high latitude science issues receive focused attention within the overall NSF. Nearly every funded project examined fit strongly and clearly into the Office of Polar Program's role within the NSF. Many projects have explicit educational ties, with all levels from elementary to graduate education found in the sample. Workshops, databases, and web sites distribute and exchange information and understanding nationally and internationally. The "Augustine Report," the NSF/OPP GPRA Performance Reports for the years 2000, 2001 and 2002, and numerous press clippings, provide detailed documentation.

The special characteristics of the high latitude regions in terms of response to climate change signals, as preservers of climate change signals, as a laboratory to study unique and important processes related to climate change, and physical and biological responses to climate change are extraordinarily important to national and international scientific priorities. Other unique aspects of Arctic and Antarctic environments are represented in research related to anthropogenic effects upon the environment, in social impacts of climate and land-use change, in aesthetics via the Artist's program, in astrophysics and aeronomy, and in opportunities for international collaboration.

The long-term continuity of some OPP observations fits well with emerging priorities to obtain long-term observations in order to improve understanding of processes and projections of future change.

A.5. Management of the Program Under Review

27. Management of the program

Management of the program is quite effective overall. The jackets were well maintained, documentation was clear, the review process was run well, and there is accountability, requiring annual and final reports. Program managers use the flexibility allowed by NSF processes to good advantage, and are able to tailor the approach to fit the needs of each program. It will be important for NSF to continue to preserve this flexibility. Some programs consistently provide decision documentation that is exemplary. Reviews, both mail and panel, are used effectively by program officers to develop their recommendation on whether to make an award, to decline, or to request modifications to the scope and/or

budget. Communications to PIs regarding OPP actions were consistently clear. A few program managers went far beyond the requirements in terms of the quality and substance of their communication to PIs, and other program officials in OPP could benefit from having these program managers share their approaches across the Office.

However, the proposal pressure, success rate, dwell time, and their trends vary significantly between the Antarctic program and the Arctic program and among the subprograms. The demands on program officers vary significantly, as well, with those responsible for Antarctic field programs needing to spend extended periods in Antarctica providing oversight. In its brief review, the COV developed some questions about program management that it offers in the spirit of continuous improvement, rather than criticism.

Recommendation: OPP, perhaps assisted by its Advisory Committee (OAC), should attempt to answer the following questions, and rectify imbalances or unintended consequences, if they exist.

a) Is each program appropriately staffed to balance the workload among programs?
b) The Arctic and Antarctic programs are organized rather differently. This may be perfectly appropriate, but it raises the question of whether OPP overall is optimally structured?
c) Given the number and scientific diversity of the proposals submitted to ANS, is its current organization and approach optimized?
d) Would panels be feasible and valuable for providing a coherent ranking of proposals in ANS? Would mail reviews provide important additional information for panel use in ARCSS?
e) The proposal success rate appears to be quite variable across OPP programs. Are these differences appropriate or should program allocations be flexible to respond to variations in proposal pressure and quality?
f) In some cases, OPP requests that PIs adjust their proposals to fit within a budget below that requested. It appeared to the COV in its review of jackets, that budget reductions were disproportionately taken by reducing graduate student support. What is the impact of budget reductions on the research and on the inclusion of graduate students in the research?
g) It appeared to the COV that proposals with only three mail reviews were more likely to be declined than proposals with larger numbers of reviews and/or consideration by a panel. Is this observation accurate?

Recommendation: That OPP, assisted by its Advisory Committee (OAC), develop answers, and, as appropriate, statistics on the above questions during the next three-year period and provide these data to the next COV committee.

28. Responsiveness of the program to emerging research and education trends

The Antarctic Sciences and Arctic Sciences Programs of OPP invest in research across an extremely broad range of disciplines, including both specialized and multidisciplinary studies. There is no evidence that program decisions are biased against emerging

research trends and in favor of traditional research projects and directions. Emerging research trends tend to derive from new research directions, new discoveries, new technologies, and opportunities presented from emerging or temporal natural phenomena. The OPP programs are alert to and responsive to the occurrence of time-dependent astrophysical, oceanographic, ecological, climatologic, glaciological, etc natural phenomena. The SGER mechanism is well used to take advantage of particularly timely opportunities. OPP program officials are well networked with the disciplinary programs in NSF and with the research communities doing polar research, thus they are generally aware of emerging research trends. The Teachers Experiencing Antarctica and the Arctic (TEA) program, which is coming to an end, has been an excellent example of OPP's responsiveness to emerging education trends and alignment with education best practice. Through the TEA program, OPP provides valuable opportunities for K-12 teachers to participate in scientific research, learn first hand about the nature of scientific inquiry, and transfer the experience to their classrooms. In the new technology arena, OPP invests in a limited portfolio of innovative and novel instrumentation concepts, which promise significant benefits for future research. The Polar Instrument and Development Program, which invests in these instrument concepts, is extremely competitive, with only about one of five proposals able to be funded. This represents an extremely high threshold for funding. The COV suggests that OPP consider increasing the emphasis on new instrumentation in its future portfolio, because of the leverage on future research capabilities. In neither the jackets nor the presentations did we learn whether or how much OPP research (versus logistics) is taking advantage of emerging research trends and capabilities in computation, computational science, and information technology. This area may be one deserving of greater attention.

Recommendation: OPP should find some way to enable teacher participation in polar research to continue into the future, even as TEA comes to an end. There should also be a mechanism found to continue follow-up support of the existing cadre of TEA teachers.

29. Program planning and prioritization (internal and external) that guided the development of the portfolio under review

OPP's program is planned and prioritized in a variety of ways, which include workshops sponsored by NSF, NSF/OPP, U.S. National Academy of Science studies, international workshops, and leadership provided by Groups of Specialists and Working Groups of SCAR (Scientific Committee on Antarctic Research), for example. Furthermore, OPP can point to a long and successful history in the promotion of activities that brought or bring communities together to promote the planning, execution and follow-up of innovative polar science. Examples of successful initiatives from the Arctic include SHEBA (Surface Heat Budget of the Arctic), and from the Antarctic include, WAIS (West Antarctic Ice Sheet Project), CRP (Cape Roberts Project), and ANDRILL (Antarctic Drilling Program).

These synergistic programs advanced science within and between major disciplines and have guided the development of the portfolio. OPP also participates in some of the large multidisciplinary NSF programs (JGOFS, GLOBEC) and agency-wide initiatives, such as

Biocomplexity, Nanoscience, and the others. OPP should evaluate whether or not to promote the initiation of more multidisciplinary programs.

B.1 NSF Outcome Goal for People: Developing "a diverse internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."

The COV concluded that OPP has performed at the highest level in the strategic area of *Outcome Goal for People*, and that the investment has resulted in many tangible and valuable results. We note the many and varied people-related activities and results portrayed in the *GPRA FY 2002 Performance Report, pages 4-17.* The wide spectrum of program activities in both the Arctic and Antarctic include the training of undergraduate and graduate scientists in polar settings, via on-land and at-sea field experiences, courses, internships, workshops and conferences. OPP investments have contributed to the development of a well-educated, very experienced and productive workforce of scientists and engineers. The Teachers Experiencing Antarctica and the Arctic (TEA) program has allowed K-12 teachers to bring the relevance of scientific exploration and investigation and the scientific method into schools across the nation in an exciting and innovative fashion. OPP has been successful in its attempts to attract the participation of underrepresented groups in the polar science enterprise. The significance of science in general, and polar science in particular, to a wide range of societal issues, has been clearly and successfully made available to a large and interested public via documentary film, web sites, radio, television, and the popular press, etc. The Antarctic Artists and Writers program brings artists and writers to Antarctica, and their art and writings stimulate and engage the large numbers of people reached by their work.

B.2 NSF Outcome Goal for Ideas: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

The COV concluded that OPP has performed at the highest level in the strategic area of *Outcome Goal for Ideas* and that the investment via grant awards has been extremely well founded. We note the many Idea-related results documented in the GPRA FY 2002 Performance Report, pages 17-40, and also in the scientific publications that communicate new ideas, discoveries and data to the scientific community, as well as the popular science press which conveys this information to the public at large. Scientific research in both the Arctic and Antarctic regions spans the complete spectrum of the Geosphere, Atmosphere, Cryosphere, Hydrosphere and Biosphere, and beyond into space. While all results contribute to the essential polar knowledge base, we note the significant contributions being made to a wide variety of global research initiatives, and confirm the crucial role that polar science plays in understanding planet Earth. A few examples of frontier science and contributions to global issues include: deciphering the record of Antarctic glacial cycles millions of years back in time and their relationship to global sea level oscillations and global deep sea climate cycles, implications for methane formation during climate change in Alaska, discovery of the number and extent of large freshwater lakes thousands of meters below the East Antarctic Ice sheet and the potential

impact of these sources of water on the global hydrosphere, archeology revealed at sites associated with retreating Alaskan glaciers and snowfields, and understanding of origins of North American populations through DNA studies of human remains in the Aleutian Islands, etc.

B.3 NSF Outcome Goal for Tools: Providing "broadly accessible, state-of-the-art and shared research and education tools."

The COV concluded that OPP has performed at the highest level in the strategic area of *Outcome Goal for Tools* and that the investment was both responsible and successfully applied. These outcomes are more fully documented in the GPRA FY 2002 Performance Report, pages 40-49. The scientific objectives of the Arctic and Antarctic research programs, and the personnel involved in achieving these outcome objectives, will only succeed if supported by modern and well-equipped facilities, efficient and functioning equipment and instruments, state-of-the art communications, adequate ground and air transport, and the highest level of safety. OPP has continued to develop and modernize the logistic support system for scientists and staff who work in both the Arctic and Antarctic regions. Important items in connection with infrastructure, logistics and environment include: building and refurbishing of bases (including South Polar Station), logistic and service contractors, aircraft for long-haul cargo and personnel transport operations, fixed-wing and helicopter services for science parties, ships for transport and use as science platforms, deep drilling rigs and camps for use in support of glaciological and geological programs, repositories for geological and glaciological materials, and environmental monitoring and stewardship, etc.

C.1 Program areas in need of improvements or gaps within program areas

1. Interdisciplinary, multidisciplinary, bipolar, and international science ventures

While the committee applauds OPP's extremely robust and long-running record in the promotion of interdisciplinary, multidisciplinary and international science, and leadership demonstrated by the United States Antarctic Program over several decades, we believe there are compelling reasons to continue augmenting such efforts, particularly with regard to the preparations for the upcoming International Polar Year-4 program (2007-08) that is to offer increased opportunities to do so.

Recommendation: The Arctic and Antarctic science sections should consider engaging with the community to conduct a series of 'future workshops' or 'think tank meetings' which focus on the coupling of bipolar science, the integration of polar-derived data with global programs, the elucidation of new cutting edge opportunities between disciplines, involvement with agency-wide initiatives, etc.

2. Technology and logistics in support of science

The COV focused on Arctic and Antarctic Science, Arctic Research Support and Logistics (ARSL), and Major Research Instrumentation. It did not review the Polar Research Support System (PRSS) for Antarctica. The development of technology to support science is often done through ARSL and PRSS. During the 2000-2002 period reviewed by the COV, OPP issued one focused and highly oversubscribed solicitation for polar research instrumentation development (Polar Instrumentation and Technology Development Program). As polar science grows in scope and complexity the need for improved research instrumentation will increase. This need would be best met by offering more frequent announcements of opportunity and/or requests for proposals for polar research instrumentation that are coordinated by the Arctic and Antarctic Science Sections.

Recommendation: OPP should seek adequate budgets to support the development of new polar research instrumentation, link polar research instrumentation development opportunities directly to research needs in the Arctic and Antarctic, issue regular solicitations in this area, and increase the number of awards for technological innovation and development.

C.2 Program performance in meeting program-specific goals and objectives not covered by Core Questions A1-29 and B1-3

Not applicable or covered elsewhere in C1 to C5.

C.3 Agency wide issues that should be addressed by NSF to improve the program's performance

1. Agency-wide data bases

Accurate and well organized numerical data are a critical element in meaningful assessment of a program's performance over the three year time frame encompassed by the COV review process. They are also essential should an Office, Directorate or Division, or NSF at large, mandate a survey which links a succession of COV reviews.

Recommendation: The NSF should standardize its data collecting and reporting procedures at all administrative levels and across all Directorates, Divisions and Offices; ensure that non-sensitive data be available on-line; provide complete indexing and cross-linking for these data; and enable effective graphical formats for such data. Also, NSF should ensure that it collects and makes readily available to the COVs in advance whatever data are needed to answer the questions it sets for COV reviews of Directorates and Offices.

C.4 Other relevant issues

1. Intellectual property rights with regard to indigenous people and local communities

This issue centers on problems arising when researchers study the long-held cultural traditions, a specific type of expertise, and/or environmental knowledge held by indigenous people or by particular local groups. Whereas the academic/research community and general public may benefit by getting access to such knowledge, we pose the question as to the benefits that are accrued by the communities in which such expertise, knowledge, and traditions originate. The OPP/COV suggests that NSF ensure that interactions with Arctic communities be conducted in ways that facilitate future research; and seek information from institutions and groups (such as the Alaska Native Knowledge Network, Nunavut Research Institution, American Association for the Advancement of Science, etc) on their approach to respecting and dealing with this type of intellectual property rights.

Recommendation: The relevant programs within NSF should examine the issue in depth and develop policies and guidelines for dealing with intellectual property rights associated with indigenous people and local communities.

2. Strengthening assessment of and accountability for Broader Impacts

OPP programs send proposals primarily to scientific/engineering peers of the principal investigator, and request their evaluation of the proposal with respect to its intellectual merit and quality and broader impacts. The requirement for researchers to include broader impacts in their proposals helps get both investigators and reviewers to think about them and to be proactive in achieving them. However, these individuals may not be qualified to develop or assess certain aspects of broader impacts, without getting input from individuals expert in a broader-impact area, such as education, policy, international relations, economics, or other fields. Such collaboration can be very useful in the development of a proposal, in the review of a proposal, and in the conduct of the work. Over the past few years, NSF has continuously strengthened and clarified its expectations with respect to broader impacts. Most recently it implemented a requirement in FY2003 that proposals not addressing broader impacts be returned to the PI without review. In a similar way, NSF could phase in an expectation that the PI's and research team's previous accomplishments in "broader impacts" be mentioned in the proposal section that summarizes the results of prior work, so that reviewers can judge the PI's and team's track record in this arena, as well as on their scientific track record.

Recommendation: OPP should consider requiring PIs to summarize their track record in "broader impacts," in the section of the proposal describing prior results. In addition, where it would be beneficial, OPP should seek to ensure that the mail or panel reviewers include individuals with strong qualifications to assess and provide feedback on the broader impacts of a proposal.

3. Ensuring that information essential for accountability is obtained from the most appropriate source at the most appropriate time

The COV plays an important role in NSF's process of assuring accountability for getting high value from its taxpayer funds. Yet the COV is not the only mechanism available for

assuring accountability, and many of the assessments the COV is requested to make cannot be made effectively during the 3-day COV review. Such assessments include judging the innovativeness, riskiness, and other aspects of the portfolio, when to do so, etc. To achieve this we would have to read and judge the innovativeness, riskiness, etc of each of nearly 200 proposals comprising the random sample of jackets. At the risk of adding more check boxes (and other bureaucracy) to the review process, we make the following recommendation.

Recommendation: NSF should make final reports from grants available to the public through its Web page. In addition, NSF should study its "core questions for COVs" and determine how to acquire the best information on each question and make this information available for COV use. For example, perhaps each proposal reviewer (mail and panel) should be asked to assess and indicate the innovativeness, riskiness, multidisciplinarity of each proposal, and this information could be captured in the statistical data maintained by the agency.

C.5 Improving the COV review process, format and report template

1. The COV process overall

The COV consists of a group of scientists and engineers with expertise generally spanning the disciplines and research areas covered by OPP programs, who spend three days at NSF reviewing the management, proposal "jackets," and outcomes of OPP's investments. The work of the COV is guided by "NSF FY2003 Core Questions for COVs." Most of these questions each focus closely on one specific aspect of the process for reviewing and investing in proposals and the demographics of people engaged in the program. Some of the questions request an assessment of matters the COV is well qualified to judge. Others request assessments, for which the COV possesses no special qualifications. Finally, it is easy given the large number of very specific questions, the requirement to address each one for NSF's GPRA accountability, and the small amount of time for the COV to "miss the forest for the leaves."

Recommendation: NSF should reduce the number of specific questions it asks of COVs, and emphasize those that are most important to its performance and accountability that are of a type appropriate for COV assessment. In addition, OPP should identify a few areas in which the COV could provide advice and assessment that would be most important and helpful to OPP's management and outcomes, and pose questions/issues in those areas for the COV consideration, along with the standard NSF direction to COVs.

2. Agency-wide software-based COV template

The review of information and data, and writing of a comprehensive report within the span of a three day meeting is no simple task. The development of a standard agency-wide COV software package, such as is used by NSF panels, and in which the template

categories or headings are set out in the format of a final report, might make the process more efficient.

3. Technical facilities

Ideally, the COV report is prepared in three days. For the FY 2003 review OPP provided net-worked laptop computers for all committee members. While we made ample use of the computers we did not have time to make full and efficient use of these facilities. Partly due to the intervention of 'Hurricane Isabel' we ended up preparing text and transferring this via floppy disks to a master template on a separate laptop.

Recommendation: The next COV chairperson should work with OPP staff to prepare a final report template based on the Core Questions in advance of the meeting, and have this template pre-loaded onto the laptop network before the meeting. It would also be useful to have appendices entered into the template ahead of the meeting.

4. Assembly, availability, review and presentation of the OPP data

The 2003 COV examined two large sets of material. The first set consists of the randomly selected proposal jackets representing awarded and declined proposals, in all the major disciplines within the Arctic and Antarctic science sections. This material is strictly protected by confidentiality law and could not have been examined before the COV meeting. The second category of material includes large amounts of statistical information and reports, which are publicly available.

Recommendation: OPP should provide the COV approximately 8 weeks in advance of the meeting with the list of solicitations, a bulleted summary of the evaluation criteria for each solicitation, along the materials routinely sent in advance to COVs and all of the publicly available statistical information related to NSF's core questions for COVs. The COV chairperson should consider delegating reviewing tasks to individual committee members at that time.

Recommendation: OPP should prepare a list of 'non-sensitive' data topics that are deemed central to the COV process, compile and present data and source information for each topic, and organize these as a series of numbered appendices for the COV report.

Recommendation: OPP should collect and maintain data on the total number and diversity of undergraduate, graduate, and postdoctoral researchers receiving support from OPP awards, and also on the number of Master's and PhD degrees produced in the course of OPP-funded research projects each year. The COV recognizes that it will be difficult to obtain such data, and that the community will need to provide it. It would be useful if these data were able to be sorted according to specific programs in both Arctic and Antarctic science sections, reduced to percentages to aid comparisons, and provided to the COV in advance of the review.(See A.4.15)

5. The long term view

Although the FY2003 COV considered aspects of the 2000-2002 time frame in considerable detail, we did not concern ourselves with pre-2000 records. This was not included in our charge and would probably be made difficult because NSF Core Questions tend to change and evolve over time.

Recommendation: NSF should consider the strategic value of standardizing some aspects of basic data collection and the COV assessment, so that the next COV could evaluate selected long term trends within OPP. In fact, assessing trends might be more meaningful than the absolute judgment of "appropriateness," or "appropriate level" required for some of the core questions.

6. Devising the COV work plan

In choosing the most effective and efficient work plan we considered; (1) having each member address all core questions, (2) separating proposals into Arctic and Antarctic groups before review, (3) separating proposals into science program specialties (e.g. marine and terrestrial biology) with Arctic and Antarctic proposals combined, and (4) assigning a limited number of core questions to a pair of committee members who would then examine all proposals without geographic or discipline distinctions being made. We opted for (4). This allowed for a much more in-depth assessment, the tallying of quantitative data, more objective detection of patterns and trends, and very lively presentation of the assessment with respect to each question to the entire COV during the wrap up and writing phases of the COV meeting.

7. Committee of Visitors and Office of Polar Program staff interaction

Despite the chaos wrought by Hurricane Isabel during the meeting, the FY2003 COV process was a cheerful, positive and very productive experience. The COV found great value in the well illustrated presentations by Drs. Karl Erb, Thomas Pyle, and Scott Borg. It was also helpful to meet OPP program managers during this introductory session. This part of the meeting provided useful syntheses on OPP history, staffing, budget and performance data, past and planned initiatives, and interactions with other parts of NSF. These presentations and the opportunity to pose questions allowed the committee to become acquainted with the task ahead, and also become acquainted with each other. We also note that Dr. Erb and staff were most helpful in answering questions and providing additional information as the meeting progressed. Ms. Brenda Williams very effectively provided administrative and logistical support for the COV, which allowed its work to be accomplished despite the hurricane