NATIONAL SCIENCE FOUNDATION
DIVISION OF INTEGRATIVE ORGANISMAL SYSTEMS
COMMITTEE OF VISITORS
PANEL ROSTER
JUNE 4-6, 2008

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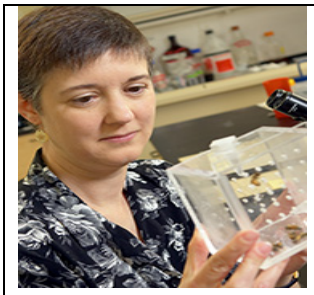
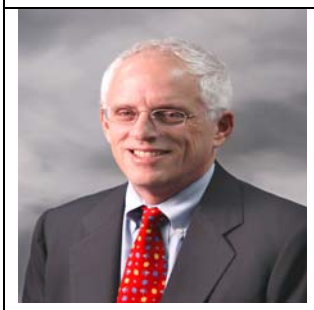
	**Susan Fahrbach** Wake Forest University Department of Biology Box 7325 Reynolds Station Winston-Salem, NC 27109 (336) 758-5980 fahrbach@wfu.edu
	**Gary Litman** Department of Pediatrics ACH/USF Children's Research Institute 830 First Street South St. Petersburg, FL 33701 (813) 259-8704 litmang@allkids.org
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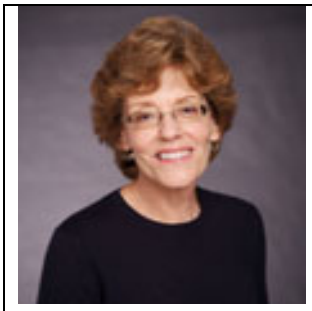	**Karen Schumaker** University of Arizona Department of Plant Sciences Marley Building, Room 441B Tucson, AZ 85721-0036 Phone: (520) 621-9635 schumake@ag.arizona.edu
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DIVERSITY DOCUMENT

Committee of Visitors for the
Division of Integrative Organismal Systems
Directorate for Biological Sciences
National Science Foundation

June 6, 2008

This document describes the diversity, independence, and balance represented by members of the COV, and the resolution of real or apparent conflicts of interest.

The 2008 Committee of Visitors for the Division of Integrative Organismal Systems (see attached list) was composed of 11 members, including 1, who represented the BIO Advisory Committee. Eight of the members are female, and 4 members are from an underrepresented minority. Members currently work in 8 different states. Ten members are from academic institutions and 1 is from the government.

All files presented to the committee were first scrutinized for possible conflicts with committee members. All conflicts were identified so that committee members would be aware of which files they could not review. Committee members were advised about confidentiality and conflicts of interest both prior to arriving at NSF and at the inception of the meeting. Conflicts issues during the meeting were considered and adjudicated by the division conflicts official.

James P. Collins
Assistant Director
Biological Sciences

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2008 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2008 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2008. Specific guidance for NSF staff describing the COV review process is described in Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) that can be obtained at <www.inside.nsf.gov/od/oia/cov>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the results generated by awardees have contributed to the attainment of NSF's mission and strategic outcome goals.

Many of the Core Questions are derived from NSF performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the subactivities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at http://budg-eis-01/eisportal/default.aspx. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the ***processes*** related to proposal review; and (B) the quality of the ***results*** of NSF's investments 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. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. The reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements, and are made available to the public. Since material from COV reports is used in NSF performance reports, the COV report may be subject to an audit.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see http://www.nsf.gov/od/oia/activities/cov/covs.jsp.

FY 2008 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: June 4-6,2008
Division: Integrative Organismal Systems
Directorate: Biological Sciences
Number of actions reviewed: 120 **Awards: 60** **Declinations: 60** **Other:**
Total number of actions within Division during period under review: **Awards: 713** **Declinations: 4,033** **Other:**
Manner in which reviewed actions were selected: For the analysis we randomly chose 40 award and decline jackets for each year of the three years, for a total sample size of 120. For qualitative measures (such as recommendation completeness), 120 will provide a sufficient sample to provide examples of styles and procedures of all of the programs and activities. For quantitative measures (such as the percentage of review analyses addressing both criteria), 120 will provide a likely standard error of approximately 3%. This random sub-sample will be available to the COV during the meeting. A list of these proposals as well as a list of all the proposals reviewed by the Division over the last three years can be found in E Jacket (EJ) within the COV Module under COV Documents. The COV can access any proposal on either list during the meeting.

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

A.1 Questions about the quality and effectiveness of the program's use of merit review process. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	**YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE[1]**
1. Are the review methods (for example, panel, ad hoc, site visits) appropriate? Comments: PI proposals are reviewed by a combination of ad hoc reviewers and panelists in a very thorough and fair manner. Because there is no triage, every proposal submitted is given a complete review. The activities of the panels are well documented. By contrast, the internal review process (subsequent to the panel) that leads to the final funding decision is less transparent, but conversations with the Program Officers suggested a fair and effective process. Proposals submitted by current panel members are reviewed by ad hoc reviewers and Program Officers. The COV did not review the results of submissions by current panel members, but this circumstance is rare. The only example that occurred during the time frame that the COV reviewed was handled well. Source: Jackets and the EIS. Select the "Type of Review" module.	Yes
2. Are both merit review criteria addressed a) In individual reviews? Are Program Officers instructing ad hoc reviewers to evaluate and comment on Broader Impacts? b) In panel summaries? Are Program Officers instructing panels to discuss	a) No b) Yes c) Yes

[1] If "Not Applicable" please explain why in the "Comments" section.

and comment on Broader Impacts? What are science assistants looking for as adequate Broader Impacts? c) In Program Officer review analyses? Comments: a) The Intellectual Merit criterion is typically very carefully addressed by individual reviewers, although the quality of individual reviews is variable. Individual COV members reviewed ad hoc reviews from 78 proposals. On the basis of this informal survey, the COV concluded that the Broader Impact criterion is typically not as well addressed as the Intellectual Merit criterion, particularly in ad hoc reviews. Discussions with Program Officers, however, indicated that they provide appropriate instructions to reviewers. b) A review of a sample of panel summaries by individual COV members indicated that panel summaries typically include a statement on the Broader Impact criterion. These statements varied in their depth and detail. In some cases, the proposed Broader Impact activities were simply described without evaluation. The COV feels that this is unacceptable. A trend was noted that the more recent panel summaries (from 2007) were more balanced in their use of both criteria. This presumably reflects the instructions given by the Program Officers, the use of a panel summary template, and review by the Science Assistants. However, the quality of the panel summaries is still not uniformly excellent, suggesting that the process by which the panel summaries are produced requires additional refinement. c) A review of a sample of Program Officer review analyses by individual COV members indicated that the review analyses are typically more thorough than the panel summaries in that both criteria are carefully addressed in depth. The review analyses could be used as a model for the panel summaries. Source: Jackets	

3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals? Comments: The COV felt that the majority of reviewers provide substantive and useful comments that explain their assessment of the proposals. Our conclusion is based on review of the eJackets provided by IOS and the considerable experience of COV members on panels. Source: Jackets	Yes.
4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)? Comments: The COV examined more than 80 eJackets to determine the quality and	Yes

thoroughness of the panel summaries. The COV finds that the vast majority of panel reviews stated clearly the rationale for the priority ratings. At the current funding rate (only 59% of proposals receiving the highest ranking by the panel), it is difficult to determine the criteria that are used to distinguish among the most meritorious proposals. Source: Jackets	
5. Does the documentation in the jacket provide the rationale for the award/decline decision? (Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.) Comments: The review analyses written by the Program Officers clearly describe the rationale for the award/decline decision. Source: Jackets	Yes

6. Does the documentation to PI provide the rationale for the award/decline decision? (Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.) Comments: The COV felt that the answer to this question is generally yes, but that the quality of the panel summaries often did not match the quality of the review analyses prepared by the Program Officers. Because the panel summary is a critical part of the documentation provided to the PI, PIs (and future panels reviewing resubmissions) are poorly served by a cursory panel summary. Source: Jackets	Yes
7. Is the time to decision appropriate? Note: Time to Decision --NSF Annual Performance Goal: **For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later**. The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to decision is appropriately greater than six months for some programs or some individual proposals. Comments: Time to decision was well-documented in the self study. Source: Jackets and EIS-Web COV module. Select "Report View", then select "Average Dwell Time," and select any combination of programs or program solicitations that apply.	Yes
8. Additional comments on the quality and effectiveness of the program's use of merit review process: The COV was unanimous in its opinion that panels are dynamic and are doing an exceptional job. The IOS should consider the possible benefits of holding some panel meetings on the west coast, similar to recent procedural changes at NIH.	

A.2 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	**YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE[2]**
1. Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: Based on our review of the packets and extensive COV member panel experience, the COV felt that reviewers are top tier and geographically well distributed. The COV thought that the use of international reviewers was appropriate and beneficial. Source: Jackets	Yes
2. Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups? Note: Demographic data is self reported, with only about 25% of reviewers reporting this information. Comments: The COV noted that significant attention is paid to racial, ethnic, and gender diversity in recruiting reviewers. However, the COV found it surprisingly difficult to obtain appropriate descriptive data on reviewers. Source: Jackets and EIS-Web COV module. The "Report View" has reviewers by state, institution type, minority status, disability status, and gender.	Yes; some data unavailable.
3. Did the program recognize and resolve conflicts of interest when appropriate? Yes Comments: The COV had no additional comments on conflicts of interest.	

[2] If "Not Applicable" please explain why in the "Comments" section.

Source: Jackets	

4. Additional comments on reviewer selection: Comment: COV is concerned that in this time of low funding, Program Officers have found that it is more difficult to recruit reviewers and panelists.

A.3 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE[3], OR DATA NOT AVAILABLE
1. Overall quality of the research and/or education projects supported by the program. Comments: Based on reviews of jackets and highlights, the COV concluded that the IOS portfolio is of extremely high quality. However, many of the descriptive data that support this conclusion are buried in annual and final reports, and therefore are not easily accessible. Source: Jackets and program information	Appropriate
2. Does the program portfolio promote the integration of research and education? Comments: In this directorate (in particular), broader impacts generally address the	Appropriate

[3] If "Not Appropriate" please explain why in the "Comments" section.

integration of research and education. In our sample of approximately 80 randomly selected proposals, the vast majority included integration of research with education as a central component of the Broader Impact activities. Further, the total number of graduate students supported on research grants in IOS over the time period considered was1783, approximately 2-2.5 students/award. Given the importance of broadening participation in science at all levels, the COV would have liked to have been able to describe the demographics of the graduate and undergraduate student populations supported (including ethnicity, gender, state or country of origin, institution type). Source: Jackets and program information	
3. Are awards appropriate in size and duration for the scope of the projects? Comments: Clearly, budgets are narrowing the scope of proposals. Low budgets are limiting the potential for innovative and transformative research. Further, because of declining funding rates, MANY meritorious awards are not being supported. Given the fact that the NSF budget is essentially unchanged, it is admirable that the size of the awards has been maintained. However, when the NSF budget increases, it will be critical to increase the size of the awards to match the growing costs of research. The typical award duration is still 3 years. The COV feels that is reasonable. Source: Jackets and EIS-Web COV module has a "Report View" that gives average award size and duration for any set of programs or program solicitations you specify.	Data not available.
4. Does the program portfolio have an appropriate balance of: • Innovative/potentially transformative projects? Comments: IOS is consistently supporting exciting and innovative projects, some of which are potentially transformative. It is clear that IOS is working to educate the scientific community to identify the transformative aspects of their work. The COV did not equate SGER awards with transformative work, and that view was shared by the Program Officers. In discussions with the Program Officers, the number of proposals that were identified as transformative was on the order of 5-10%. Further, they clearly considered transformative potential in their prioritization of proposals for funding. This criterion was complementary to evaluation based on the Intellectual Merit and Broader	Appropriate

Impacts of the proposal. In future, proposals with transformative potential will be easier to identify if this designation is formally tracked in the project jackets (for example, this information could be included in the Program Officer's review analysis). Source: Jackets and program information.	
5. Does the program portfolio have an appropriate balance of: • Inter- and Multi- disciplinary projects? Comments: The systems emphasis of IOS allows the vast majority of awards to serve as links across biology, from molecular to environmental biology. IOS has been particularly active in promoting inter- and multi-disciplinary projects. The COV learned that co-review across clusters, across divisions, and even across directorates was not uncommon, but detailed numbers were not available. However, 21% of IOS proposals are co-funded, usually between divisions and/or directorates. Other measures of inter- and multi-disciplinary are difficult to extract. It would be useful, for example, for Program Officers to include in the review analysis a statement that the proposal is either inter- and/or multi-disciplinary in nature. Source: Jackets, program information, and some people use as a proxy data on jointly funded projects. See EIS-Web COV module, "Report Review" and select "co-funding from" and "co-funding contributed to" to find jointly supported awards.	Appropriate; some data not available

6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program? Comments: The COV has no concerns about IOS activities in this area. In addition to the interdisciplinary nature of the division, approximately 33% of awards granted are multi-disciplinary. However, the COV wonders if IOS budget constraints limit the feasibility of multi-investigator projects. Source: Jackets, program information, and EIS-Web COV module for information on award size.	Appropriate
7. Does the program portfolio have an appropriate balance of: • Awards to new investigators? NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant. Comments: The data in the self-study suggest that new investigators are funded at a rate slightly lower (12%) than all investigators (16%). The COV would like to see increased success among new investigators. IOS should develop and then better advertise mechanisms to improve the quality of submissions by new investigators. For example, the IOS could better utilize FastLane and the IOS homepage to direct new investigators to available proposal preparation resources. Source: EIS-Web COV module on "Funding Rate," filtered by PI Characteristic (use the pop-up filter).	Appropriate
8. Does the program portfolio have an appropriate balance of: • Geographical distribution of Principal Investigators? Comments: IOS awards continue to be concentrated in historically research-intensive states. The COV recommends continued outreach to PIs from EPSCoR states. Source: EIS-Web COV module, using "Proposals by State"	Inappropriate

9. Does the program portfolio have an appropriate balance of: • Institutional types? Comments: The higher success rates of applicants from 4-yr colleges demonstrate the efficacy of the use of RUI and RIG programs by IOS. Funding success rates of doctorate vs. non-doctorate institutions are very similar, which the COV commends. The COV encourages IOS to promote applications from Tribal colleges and universities; the COV remarked that there were no such applications in the last three years. Source : EIS-Web COV module, using '' Proposals by Institution Type''	Appropriate
10. Does the program portfolio have an appropriate balance: • Across disciplines and subdisciplines of the activity? Comments: The COV recognizes the significant challenge in determining an appropriate balance with such a diverse portfolio and limited funding. Some members of the COV had the impression that research related to microbes and fungi were underrepresented in funded research relative to other taxa. In addition, the COV noted that there was lack of balance in funding rates among the clusters. Some members of the COV noted that funding rates in neuroscience were lower than in other clusters. The highly fluid organizational structure of the clusters facilitates effective assignment of proposals for review. The COV was impressed in discussions with the Program Officers that they de-emphasize disciplinary and subdisciplinary boundaries. Source: Jackets and program information	Appropriate; see comments
11. Does the program portfolio have appropriate participation of underrepresented groups? Comments: The COV noted the increasing number of proposals and increasing funding rates for research grants to underrepresented minorities, although overall numbers are still distressingly low. IOS should continue to support underrepresented minorities throughout their education to increase the pipeline of minorities in science. QEM workshops that are funded by the Biology Directorate may be having a positive impact on the number and quality of proposals submitted. Source: EIS-Web COV module, using "Funding Rate" with the pop-up filter (this allows you to see female and minority involvement, where involvement	Inappropriate

means being PI or co-PI).	
12. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports. Comments: The COV noted that the self-study report highlights awarded projects that are directly relevant to priorities and missions. (Please see Section B for specific examples). The COV also notes that IOS's overall portfolio continues to make strong and sustained efforts in research and education in sciences. These activities are in accord with principles articulated in the National Research Council Report "The role of theory in advancing 21st century biology - catalyzing transformative research." The COV notes that IOS is taking the lead within the directorate in the use of eJackets for processing of all proposals. The COV applauds this effort in "going paperless." Source: Program information	Appropriate

13. Additional comments on the quality of the projects or the balance of the portfolio:

The COV was highly impressed by the quality and breadth of the integrative projects that were awarded. The COV was also impressed by the quality of many of the declined proposals and wished that there were sufficient funding to support them as well.

A.4 Management of the program under review. Please comment on:

1. Management of the program.

Comments:

The COV notes that the management of IOS is outstanding. It is clear that the division works as a team at all levels. The acting division director and deputy were able to articulate clearly the goals as well as functioning and practices of the division. They set a supportive, collegial tone for the division.

The Program Officers are outstanding in terms of their knowledge of their fields and ability to manage large proposal loads. They work effectively as a team, both within and across clusters. Because of the importance of institutional memory, continuity, and experience, the COV supports the goal of increasing the proportion of permanent Program Officers. These hires present an opportunity to increase the racial and ethnic diversity of the Program Officers.

The administrative staff operates effectively, working closely together as a cohesive and mutually supportive team. Professional development is clearly a priority in IOS, and this emphasis is reflected in the professionalism, enthusiasm, and stability of the administrative staff. Because of cross-training, staff members are able to manage an intense and dynamic workload.

The Science Assistants and STEP students make important contributions to the division. Their experiences at IOS will surely contribute to their future professional development.

The understanding of the division's mission by personnel at all levels was particularly impressive to the COV and is an asset to the research community it serves.

This division is a model for others within the Foundation.

2. Responsiveness of the program to emerging research and education opportunities.

Comments:
IOS not only responds to research trends, but also provides leadership to the research community. Emerging areas are identified through exchange of ideas and proposals across clusters, divisions, and directorates. The inclusive nature of the program descriptions available online encourages the submission of a broad range of exciting proposals. The recent realignment has increased the responsiveness of IOS programs to PIs. Through its emphasis on the importance and diverse nature of broader impact activities, IOS achieves effective integration of education with research.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:
A productive and exciting focus on systems biology is a strong theme in IOS. This is reflected in the realignment and in guidance derived from the recent National Research Council report "The role of theory in advancing 21st century biology - catalyzing transformative research." Published reports from IOS workshops show that IOS is soliciting and investing in new research visions from a broad array of scientists.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:
Overall, IOS responses to the previous COV's recommendations are excellent. Indeed, the changes that have been instituted since and in response to the recommendations of the 2005 COV have significantly strengthened the division internally and with respect to the position of IOS in the BIO Directorate.

Nonetheless, there remain recommendations that have not been adequately addressed. Among these are a set of recommendations related to tracking award outcomes and adequately addressing review criterion #2, Broader Impacts.

Recommendations related to tracking award outcomes included the following (quoted from the 2005 COV Report).

2005 COV Recommendation #1 - The 2005 COV committee recommended that better tools be developed for tracking the Division's ability to support outstanding science and education.

2005 COV Recommendation #9 - The COV believes that if NSF were more proactive in assessing the outcomes of its awards, the Foundation should be able to more clearly document its successes.

2005 COV Recommendation #17 - Improved collection of outcome data will greatly assist the foundation in justifying budget requests to congress

2005 COV Recommendation #24 - Improve tracking of outcomes from funded research by collecting data electronically in annual and final reports.

Despite the efforts of IOS, there has been no change in the annual and final project templates and the ability to assess outcomes of awards remains inadequate. While the COV acknowledges that there is considerable inertia to change Foundation-wide documents, these templates represent a significant impediment to assessment of the fundamental goals of the division and the entire NSF. The 2008 COV echoes the 2005 COV's recommendations and supplements them with division-level recommendations to address this issue in advance of changes at the Foundation level.

Recommendations related to tracking Broader Impact outcomes included the following (quoted from the 2005 COV Report).

2005 COV RECOMMENDATION #5 -The COV recommends that the NSF continue to stress the importance of review criterion 2 to both investigators and reviewers and develop measures to assess the impact of this criterion on NSF's outcome goals for People, Ideas, and Tools.

2005 COV RECOMMENDATION #7 -The 2005 COV recommended that Program Directors continue to stress to reviewers (both ad hocs and panelists) the importance of addressing criterion 2 with a level of rigor and insight consistent with assessments brought to other components of the proposal. Furthermore, the Program Directors should be vigilant in enforcing the return without review policy for proposals not addressing criterion 2.

Substantial effort has been made on the part of the division to improve the visibility of this criterion at

panels and in the funding process. However, as the IOS also recognizes there is still inadequate consensus on metrics to assess the value of Broader Impacts. Further, Broader Impacts are not yet sufficiently addressed in ad hoc reviews. We offer additional recommendations in this area.

5. Additional comments on program management:

Co-review of proposals is a common practice within the division, ensuring that proposals receive the best possible reviews.

PART B. RESULTS OF NSF INVESTMENTS

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The NSF mission is to:

- promote the progress of science;
- advance national health, prosperity, and welfare; and
- secure the national defense.

To fulfill this mission, NSF has identified four strategic outcome goals: Discovery, Learning, Research Infrastructure, and Stewardship. The COV should look carefully at and comment on (1) noteworthy achievements based on NSF awards; (2) ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcome goals; and (3) expectations for future performance based on the current set of awards.

NSF investments produce results that appear over time. Consequently, the COV review may include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made.

To assist the COV, NSF staff will provide award "highlights" as well as information about the program and its award portfolio as it relates to the three outcome goals of Discovery, Learning, and Research Infrastructure. The COV is not asked to review accomplishments under Stewardship, as that goal is represented by several annual performance goals and measures that are monitored by internal working groups that report to NSF senior management.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes ("highlights") as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 OUTCOME GOAL for Discovery: "*Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering."*

The IOS has clearly supported research consistent with this Goal.

Comments:
As examples:

"CAREER (0546858): Venom evolution in sicariid spiders: A system for undergraduate training in integrative biology." It exemplifies IOS's efforts to support new investigators. It has outstanding scientific range and depth, and a highly developed undergraduate and community outreach program.

"(0642249) The energetic cost of burrowing." This multidisciplinary project from a female National Academy member has transformative potential. It will change the understanding of the role of worms in biogeochemistry by their effect on soil mixing. This project has strong outreach components, including teaching scientists how to interact with the media.

"(0714156) The ecophysiology of early angiosperms." This new investigator proposes to study the

evolutionary constraints on flowering plants. The proposal will be influential in understanding life in transition, in particular, how plants cope with climate change. This proposal has a unique international component in which US undergraduates will partner with Peruvian and Papua New Guinean undergraduates in field research projects.

The COV found a number of other noteworthy awards addressing critical national needs, including those in animal/bacterial symbiosis (0517007), pathogen/defense regulation (0715926), homeostatic regulation of neuronal ion channels (0641370), and a research coordination project focused on plant/virus ecology (0639139).

B.2 OUTCOME GOAL for Learning: "*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens."*

Comments:
The vast majority of IOS awards support the development of the scientific workforce. Many also expand scientific literacy through K-12 outreach and development of activities that involve the public in science-based activities.

The 2005 COV report contained a comparable section titled Outcome Goals for People. This statement is strikingly consistent with the 2008 COV's views, both in terms of strengths and weaknesses. Both groups noted that the division is working exceptionally hard to promote a broad range of highly creative educational activities, including activities that bring scientists together with K-12 teachers. For example, an MBL workshop enabled 24 high school teachers to discover "the microbial world within," which led to the development of new teaching modules for high school students. As another example, a Harbor Branch Oceanographic Institute cruise involved high school teachers, undergraduates, graduate students and postdocs in research to understand the vision in shrimp. Their experiences were chronicled and that log was made available online for the purpose of public education.

Much of the relevant data on Broader Impacts is well-documented in annual and final reports, but in this form it is not easily accessed by Program Officers and review panels. It was therefore extremely difficult for the 2008 COV to determine the learning outcomes resulting from IOS awards. The COV STRONGLY recommends modifying the annual and final reports to facilitate data collection to address this outcome goal.

B.3 OUTCOME GOAL for Research Infrastructure: "*Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools."*

Comments:
IOS has supported research that has led to the development of new research tools and the use of existing tools in innovative ways.

For example, IOS researchers used a novel technique called Scientific Rotoscoping to visualize the movement of bones within a living organism. This technology involves simultaneously recording standard video of moving animals, and X-ray images of their moving skeletons. From these images an animated 3-D computer model of the moving skeleton overlaid on the digital recording of the moving animal can be used to study coordinated skeletal movement with animal movement for the first time. Based on the findings of this research, the investigators are building a dual x-ray facility,

simplifying and enhancing the Scientific Rotoscoping.

As a second example, another IOS scientist is part of a project that is establishing a national facility for studying the neuroanatomical and functional organization of the mammalian brain. This is being accomplished by assembling the contents of three major comparative mammalian brain collections. This is the first comparative neuroanatomical database of its kind and will be made readily available to teachers at all levels of education and to the public at large.

PART C. OTHER TOPICS

C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

As a result of its realignment and strong portfolio of integrative biology, IOS is ideally suited to participate in large-scale projects such as Life in Transition and NEON. There are also new opportunities to leverage existing NSF resources. For example, organismal and systems biologists could participate in research at established LTER sites. Collaborations of IOS with such programs should be a priority.

C.2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

The COV has no additional comments.

C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

The COV has identified the difficulty of collecting outcome data from annual and final reports as a major barrier to assessing research and broader impact outcomes. Development of a new report template that facilitates collection of data for assessment is essential. PIs should be strongly encouraged to provide demographic data on all personnel involved in NSF-funded projects. A strong focus on inclusion of underrepresented minorities at all levels (PIs, reviewers, panelists, staff) must be maintained. Clearer guidance should be provided to PIs and reviewers on the development and assessment of Broader Impact grant components.

C.4. Please provide comments on any other issues the COV feels are relevant.

The COV has no additional comments.

C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

Documents summarizing the overall organizational structure of NSF would have been helpful to have prior to the COV to give COV members a clear, up-to-date idea of the position of IOS within NSF. A guide to NSF acronyms would have been helpful.

The COV was hampered in its activities because of the lack of key descriptive statistics and the difficulty of extracting information from NSF databases regarding individual proposals (for example, the demography of IOS-supported graduate students and the number of proposals submitted to a panel in a particular cycle). New database structures and/or new data mining tools should be developed for the compilation and analysis of the information that NSF collects.

There appears to be a subtle mismatch between the assessment requested (which appeared to require analysis of descriptive statistics) and the evidence provided (examples, highlights, and specific proposals). The COV is not an advocate of "bean counting" without context, as its answers to many of the preceding questions might imply. But anecdotes are more powerful when supported by the numbers. Thus, the COV sees a need for a revised COV report template that permits easier merging of quantitative and qualitative judgments.

ADDITIONAL IOS-Specific Questions:

1. **Funding rates across the Foundation have declined during the period under review, due in large part to budgetary limitations. There is also an increasing emphasis on identification and funding of potentially transformative research. Given these funding constraints, are IOS Program Directors taking appropriate risks to enable transformative research? What metrics can be applied to monitor the effectiveness and impact of IOS emphasis on supporting transformative research?**

Now that NSF asks PIs to consider and state whether their proposed research is potentially transformative, the COV suggests that PIs, reviewers, and panelists be alerted to the newly adopted language in the Grant Proposal Guide, perhaps even on the IOS homepage. In addition, COV hopes that program officers will be able to assist PIs in identifying potentially transformative aspects of proposed research. In discussions with the program officers, the COV learned that transformative research can be defined and assessed differently from panel to panel in IOS, and that such flexibility and fluidity were regarded as positive. The program officers and the COV also recognize that not all meritorious work will be transformative.

The question of what percent of funding from each cluster should be allocated to transformative research was not fully resolved. A rough estimate of the current allocation might be 5-10%, and program officers stated that not all potentially transformative proposals were funded. The COV believes that program officers are exercising appropriate judgment in determining the level of resources to be applied to potentially “risky” yet possibly transformative science. Occasionally, but not always, SGER grants can be used to support potentially transformative research.

The COV concurred with the program officers that the nature and funding of transformative research needs to remain flexible. Nevertheless, the COV recommends that IOS develop tracking tools to measure and monitor the transformative success of each proposal; such metrics might include adoption of research methods and concepts by other disciplines, high impact publications, patents and invention reports, etc.

2. **The recent realignment of the Division has led to an increased emphasis on systems analyses. We would appreciate feedback from the COV on IOS-related topics that could be targeted for one time, short term investment that would enhance our existing portfolio. In this same context, we would appreciate advice from the COV about how IOS may stimulate discussions about systems approaches to understanding organisms in the PI communities served by IOS.**

Scientists funded by IOS work on phenotypes and functionality, thus forming a bridge from molecular biology at smaller scales to population biology and ecology at larger scales. As

such, IOS comprises people, approaches, and tools that can connect work going on in other divisions. Perhaps IOS could make special efforts to promote work that forms new links between traditional IOS approaches and research in other divisions. Further, the position of IOS as a natural link could enhance broader impacts by forming stronger partnerships with EHR to increase the utilization of organismal biology in training and outreach portions of projects.

We feel that the COV is not necessarily the best body to recommend topics for special support. Because of their broad exposure to cross-cutting science, the COV recognizes that program officers within the division are better able to identify special program opportunities and to set division priorities.

Nonetheless, we have some ideas:

1) "Mini-training" grants - much smaller scale (cohorts of 3-4 students) but targeting interdisciplinary work between labs working in divergent areas
2) Methodological development - provide additional support for research that adopts new technologies (i.e., technologies that are currently under-utilized in IOS-supported research). This suggestion arises from our perception that integrative biology requires research breadth, often at the expense of specialization that fosters technological expertise. Additional funding could be used, for example, to allow IOS PIs to add collaborators who are technological specialists or to train outside their specialty.
3) The BioAC representative on our COV informs us that "Life in transition: origins, adaptation, energy" is to be a new priority area for the Biology Directorate. Research in IOS is already well aligned with this theme; thus, there may be opportunities to couple IOS special funds with other sources of funding within the directorate.
4) The COV is impressed that functional genomics, behavior, and development are now prominent in ecological and evolutionary research, including long term projects that have sought the mechanistic bases of adaptive evolutionary change. Two examples are the discovery of genes regulating beak size differences in Galapagos finches (funded by IOS: 061627) and work showing the genetic and physiological bases of recurrent ecologically-driven divergence of stickleback fish. The COV feels that IOS should encourage projects that link behavioral and functional studies with LTER and NEON projects, and that such linkage will provide a rich scientific yield.
5) The COV also strongly encourages the support of cross-cluster projects within IOS.
6) Based on panel experience, the COV recognizes that there are often highly meritorious proposals that are so expensive that they would dominate the budget of individual panels. Funds could be strategically applied to support especially exciting (including potentially transformative) proposals that exceed budgetary limits of panels.

3. Please provide advice regarding strategies that IOS might employ to encourage PIs to include assessment and impact metrics with respect to descriptions of Broader Impacts in their proposals?

By examining external and panel reviews of approximately 80 proposals, the COV determined that reviewers now pay more attention to broader impact criteria; increased

attention and creativity related to this criterion were noted over the three year period. It was clear that virtually all panel summaries paid considerable attention to broader impacts of the proposal.

Nevertheless, the COV believes that IOS needs to continue to ensure that PIs, as well as reviewers, understand the importance of this criterion for every proposal. Excellent experimental design without significant broader impacts is not excellent, fundable science. The COV also noted that it is not clear to PIs how broader impacts are assessed and how this information is used by the Foundation. The COV believes that there is first-rate information about the outcomes of broader impacts in annual and final reports. These data are not adequately mined and evaluated by IOS.

In the short term, the COV recommends that a scientific assistant be assigned to compare the outcomes of broader impacts described in annual reports with broader impacts described in proposals, and to provide feedback to PIs. In the long term, the COV recommends changes to the annual and final report forms to provide simple rubrics about broader impacts that can be mined more easily to produce concrete, quantifiable data. For example, race/ethnicity of students trained could be entered in a form easy to track. IOS should also keep track of institutions that are particularly strong in broader impacts and consider recognizing the achievements at these institutions.

4. How can we improve the descriptions of our Clusters to make their emphases clearer to potential PIs?

Based on discussions with IOS POs, the COV understands that the goal of the Division and Cluster descriptions is to inform the PIs about funding priorities and program organization. In line with these goals, the COV felt that the current IOS Division and Cluster descriptions are very much improved and inclusion of relevant links and funding rates are particularly helpful. The COV had suggestions for additional improvement.

1) The COV recommends that the Cluster and Program descriptions adequately highlight the ways in which work in IOS integrates into NSF BIO's emphasis on Life in Transition: origins, energy and adaption. This connection should feature prominently on the "About IOS" page and a link should be made to the BIO AC's recent presentation on Life in Transition
2) The "About IOS" summary description should include a statement about proposals appropriate for review in more than one cluster to explain that POs work together to assure the best review and co-review.
3) In comparison to the other Cluster descriptions, the COV felt that the description of the Behavioral Systems Cluster is not sufficiently substantive. Additional detail should highlight the breath/scale and depth of work funded in the Cluster.
4) Descriptions of the programs within the Developmental Cluster need to be edited to remove redundancies. The COV felt that the questions provided in the Evolution of Developmental Systems Program description or the information provided by the Neural Systems Cluster were very helpful and could serve as models.
5) The COV suggests that all descriptions be edited and proofed very carefully.

6) The descriptions of Program Officers' areas of expertise should be more informative and uniform in detail across clusters; the links at the top of the page should link to that same descriptor

5. Are there important areas of investigation/ research communities in organismal biology that are not well-served or overlooked, by the current Cluster/ Panel structure? If so, how might this be addressed?

Based on the descriptions of the clusters as well as the range of projects that have been supported over the past three years, the COV felt that most of the important facets of organismal biology are currently being served quite well. The realignment of the cluster structure is more effectively covering all areas than did the previous IOB structure. The COV noted that, as the emphasis on theory increases, as seems likely given the current focus of IOS, it will be important to ensure that sufficient reviewer expertise in that area is included. The COV did discuss several topical areas that do not fit easily within the described clusters. However, given the fluidity with which the program officers are now formulating panels, it is likely that these areas can be accommodated within the current structure, particularly if the PIs speak with program officers before proposal submission. There were, however, several specific topical areas for which the COV did not see an obvious fit in the cluster descriptions. The COV thus recommends that IOS clarify that the following are included within IOS, and identify the cluster to which proposals addressing these questions should be submitted.

- The role of microbes in all appropriate areas. The COV noted that microbes were explicitly mentioned in only one cluster description, but should be included in many of these descriptions.
- Descriptive or discovery-based studies of neural systems at the genomic level.
- Studies of animal behavior that include a psychological focus.
- Mathematical modeling of developmental processes and phenomena.

The COV noted that IOS has been very responsive to new developments that arise within the realm of integrative and organismal biology. For example, evolutionary studies of development are relatively new, but IOS has responded to the demand and the possibilities of advances in knowledge and understanding inherent in this melding of disciplines. This was evidenced most recently by the impressive response to the 2005 workshop on Evo Devo by the elevation of this topic to a designated subtopic within the Physiological and Structural Systems Cluster. Maintaining this same level of responsiveness and vigilance will be important as new areas arise in the future.

RECOMMENDATIONS

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS

- **Provide clear data for the COV to assess the effectiveness of the merit process**. The staff had difficulty in extracting critical data such as demographics and number of proposals that were co-reviewed from the existing databases in order to allow the COV to evaluate certain aspects of the programs.

- **The COV recommends that IOS develop a strategy that will allow easy tracking of proposals that are designated as potentially "transformative".** Program Officers and panel members should also create a record for the rationale for this designation. This will support the NSF-wide goal of support transformative research and will assist in the documentation thereof.

- **The COV recommends investment in the development of tracking and assessment tools to measure and monitor the success of each proposal.** The annual/final reports should be used to gather information on the impact of the award (students trained, publications, grant awards, student and post doc training, presentations, invention reports, adoption of research methods and concepts by other disciplines, etc.).

- **The COV recommends that the NSF provide clearer language, guidance, and examples of expected broader impact aims for all levels of the application and review process.**

- **The COV recommends that the PI include in the grant application supporting documentation for not only the research but also the broader impact component of the project.**

- **The COV recommends that IOS Program Officers continue to emphasize to panelists the need to comment more substantively on the merit of proposed Broader Impact activities and communicate that to PIs in the panel summary.**

- **The COV recommends changes to the annual and final report templates to provide simple rubrics about broader impacts that can be mined more easily to produce concrete, quantifiable data.**

- **The COV recommends IOS should identify institutions that are particularly strong in broader impacts and recognize their achievement.**

SELECTION OF REVIEWERS

- **The COV recommends that the NSF revise instructions to applicants and reviewers to emphasize the importance of providing accurate and complete demographic data to the overall mission and accountability of the NSF.**

- **The COV recommends that the IOS continue to invite a diverse array of panelists from different ethnic groups, areas of the US, and types of institution to ensure breadth in the review process.**

- **As the emphasis on theory increases, it will be important to ensure that sufficient expertise in that area is included in the review process.**

RESULTING PORTFOLIO OF AWARDS

- **IOS must continue to advocate for more funds as the number of meritorious proposals far exceeds what the division can fund.**

- **The Program Officers' review analysis template should include a query that designates a project as inter- and/or multi-disciplinary.**

- **The IOS should consider using one-time target funds ($5-10M) to underwrite inter-/ multi- disciplinary research that involves multiple PIs.**

- **The IOS should continue to promote the support of new investigators and proposals from EPSCoR states and tribal colleges and universities.**

- **Given the lack of awards to Tribal colleges and universities, the COV encourages IOS to promote outreach efforts to identify and mentor PIs from these institutions.**

- **The IOS should Increase the quality and number of underrepresented minority PIs that receive funding through mechanisms such as Quality Education for Minorities workshops.**

MANAGEMENT

- **The IOS should develop metrics that highlight notable successes for self assessment (including future COVs).** For example, how many CAREER awardees are selected for PECASE awards? How many IOS awardees are members of the National Academy of Sciences (or have been otherwise recognized nationally and internationally)?

- **The IOS should continue to increase the proportion of permanent Program Officers, as well as the diversity of the Program Officers.**

- **The COV recommends that Science Assistants be assigned to compare the outcomes of broader impacts described in annual reports with proposed broader impact described in proposals, and provide feedback to the division.**

IMPROVING INFORMATION DISSEMINATION

- **The IOS should strive for more uniformity in cluster descriptions with respect to content, style and level of detail.**

- **The IOS should provide additional links to existing NSF resources from their homepage. For example, new investigators could be directed to examples of excellent proposals.**

OTHER TOPICS

- **The IOS should create new opportunities to leverage existing NSF resources such as participation in research activities at LTER sites and NEON.**

- **The IOS should develop a new report template that facilitates the collection of data for assessments, especially of broader impacts.**

- **The IOS should develop new (relational) data base structures and/or new data mining tools for better compilation and analysis of the information that NSF collects.**

ADDITIONAL IOS-SPECIFIC ISSUES

Q1 about transformative research:

- **PIs, reviewers, and panelists should be alerted to the newly adopted language in the Grant Proposal Guide, perhaps even on the IOS homepage.**

- **Program Officers and panelists should clearly identify the transformative potential of proposals.**

Q2 about things to do with one-time investment:

- **The COV was pleased with the current role of Program Officers in developing these areas and provided some ideas for IOS consideration.**

Q3 about assessment and impact metrics

- **IOS needs to continue to ensure that PIs, as well as reviewers, understand the importance of the broader impacts criteria for every proposal. Excellent experimental design without significant broader impacts is not competitive, fundable science.**

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Q4 about descriptions of Clusters

- **The COV recommends that the Cluster and Program descriptions adequately highlight the ways in which research funded by IOS interfaces with the NSF BIO's emphasis on "Life in Transition: origins, energy and adaptation".**

- **Educate the community about the nature of the co-review process.**
- **The online cluster descriptions should be equivalent in their depth and breath.**
- **The descriptions of Program Officers' areas of expertise should be more informative and uniform in detail across clusters.**

Q5 about areas not well-served

- **The COV suggests several areas that may not be well served by the current structure and recommends that the IOS evaluate these suggestions and adjust their priorities appropriately**

SIGNATURE BLOCK:

_____

For the [Replace with Name of COV]
[Name of Chair of COV]
Chair