

Charge and Instructions

Charge to the Division of Environmental Biology Committee of Visitors

The 2003 DEB COV is charged to provide an assessment of the Division in two primary areas (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) the degree to which the outputs and outcomes generated by awardess are contributed to the attainment of NSF's mission, strategic goals, and annual performance goals.

For orientation to NSF's implementation of requirements for the Government Performance and Results Act of 1993 (GPRA), the following documents are available through various links on this COV web site: the National Science Foundation FY 2003 GPRA Performance Plan (also available at <http://www.nsf.gov/od/gpra/>), Core Questions to Committees of Visitors (COVs), and the Report Template for NSF Committees of Visitors.

In addition, we have included a combined set of questions specific to the Division level activities that we would like the COV to address. An electronic copy of the Report Template will be provided at the meeting to assist you in drafting your report. Please remember that all of this material should be treated as confidential.

Finally, please remember that your report must be completed and submitted before final adjournment.

**Division of Environmental Biology
Members of the Committee of Visitors
11-13 June 2003**

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DIVERSITY AND INDEPENDENCE OF COV MEMBERS

The 2003 Committee of Visitors for the Division of Environmental Biology (see attached list) was composed of 11 members, 5 females and 6 males. One member was from an underrepresented minority. One member was from a non-government organization (NGO). Two were from free-standing research institutions. The remainder were from universities.

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 issues 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.

Mary E. Clutter
Assistant Director
Biological Sciences

REPORT TO THE NATIONAL SCIENCE FOUNDATION

Review of the Division of Environmental Biology

11-13 June 2003

Committee of Visitors:

Ingrid C. Burke, Department of Forest Sciences, Colorado State University

Carla Caceres, Department of Animal Biology, University of Illinois Urbana-Champaign

Burt Ensley, BIO AC Representative

Carol Folt, Department of Biological Sciences, Dartmouth College

Terry Gosliner, Dept. of Invertebrate Zoology and Geology, California Academy of Science

Marianne Moore, Department of Biological Sciences, Wellesley College

Jim Munger, Department of Biology, Boise State University

Larry Page, Florida Museum of Natural History, University of Florida

Petra Sierwald, Field Museum of Natural History, Division of Insects

Bruce Stein, NatureServe

David A. Young, Dean, College of Liberal Arts and Sciences, Arizona State University (Chair)

INTRODUCTION

The Division of Environmental Biology (DEB) appointed a Committee of Visitors (COV) to conduct a review of DEB for FY 2000, 2001, and 2002. The charge to the committee was:

The 2003 DEB COV is charged to provide an assessment of the Division in two primary areas (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) the degree to which the outputs and outcomes generated by awardees are contributed to the attainment of NSF's mission, strategic goals, and annual performance goals.

In addition, the COV was asked to address a set of questions specific to DEB-level activities. These were:

1. Has DEB appropriately balanced their education portfolio?
2. Has the Division sufficiently supported synthesis activities?
3. In what direction is the science that comprises DEB programs and activities headed?

The eleven-member COV conducted its review 11-13 June 2003 at the NSF in Arlington, VA. Dr. Burt Ensley, representing the Advisory Committee for the Biology Directorate (BIO), participated in all COV sessions and provided valuable assistance with his knowledge and understanding of the NSF and BIO policy, programs, and history. The COV reviewed approximately 120 randomly selected proposal jackets (awards and declines), met with DEB Program Officers and staff, as well as Program Officers from co-funding Divisions (e.g., Division of Biological Infrastructure, Division of Integrative Biology and Neuroscience, Division of Molecular and Cellular Biosciences, Division of Behavioral and Economic Sciences), reviewed Program Annual Reports for the period covered by the review, assessed a variety of statistics regarding various program activities, and met with BIO Assistant Director Mary E. Clutter, BIO Executive Officer Joann P. Roskoski, DEB Director Quentin Wheeler, and Acting Deputy Director Penelope Firth to present a preliminary oral report on the COV findings and recommendations.

The COV thanks the DEB Director Quentin Wheeler and Acting Deputy Director Penelope Firth for their time and commitment to the review process and for supporting the efforts of the COV during the visit to DEB. Special thanks are due to Althea Ball and Dylan B. George for providing the additional data requested by the COV and for their technical and logistical support throughout the three-day review.

The results of the COV review are contained in the responses to the questions in the report template. The primary recommendations of the COV are interspersed throughout the report. The COV responses to the three questions provided by the Division are included under section C2 of the report template. The COV expresses its unanimous support for the DEB programs and recognition of the achievements of the program staff during the past three years. DEB staff has developed and implemented creative new programs and continue to evolve core programs in response to meeting the needs of the scientific community served by the programs of the DEB.

DEB-funded research is of vital importance to the NSF and the World. The DEB community of scientists addresses scientific issues central to the long-term health and sustainability of the planet. DEB programs and scientists have nearly unlimited intellectual capacity to conduct world-class research in the public interest. The integration of research in environmental biology with that of

other scientific disciplines will continue to be of paramount importance to the broader scientific community over the next ten years. This provides DEB with the unique opportunity to provide strong leadership in shaping the future agenda regarding multidisciplinary research on behalf of the scientific communities served by the DEB. In particular, DEB has a unique role to play in ensuring that adequate resources are provided to maintain the infrastructure (e.g., databases and collections) required to sustain these interdisciplinary research endeavors.

Actions taken in response to previous COV recommendation

DEB has undertaken a number of initiatives and strengthened many aspects of the program in positive ways in response to the 1999 COV recommendations. In particular, we note continued attention to soliciting new ideas, actively recruiting and recognizing the work of diverse panelists, and participation in and developing new initiatives. However, a number of the previous recommendations appear in this COV report as well, since the recommendations have yet to be addressed adequately. These include: increasing the number of *ad hoc* reviews that are returned; providing continued and focused attention to improving understanding of Criterion 2; improving the success of programs such as CAREER grants; engaging with community scientists in genomics initiatives; providing appropriate benchmarks against which to evaluate the progress of DEB programs in a number of areas; and, supporting post-doctoral training to maintain a highly trained and talented pool of scientists engaged in environmental research.

**FY 2003 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)**

Date of COV: June 11-13, 2003
Program/Cluster: all
Division: Environmental Biology
Directorate: BIO
Number of actions reviewed by COV¹: Awards: 42 Declinations: 21 Other: 3
Total number of actions within Program/Cluster/Division during period being reviewed by COV²: Awards: Declinations: Other:
Manner in which reviewed actions were selected: random

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. Please do not take time to answer questions if they do not apply to the program.

¹ To be provided by NSF staff.

² To be provided by NSF staff.

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

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) Comments:</p> <p>The NSF review mechanism is the international standard for peer review. It is clearly a superior model and we know of no other system that would accomplish the goals of supporting the best possible science based upon a peer reviewed evaluation system.</p> <p>However, the low number of <i>ad hoc</i> reviews that are received for each proposal concerns the COV. In some cases, there are no <i>ad hoc</i> reviews (see Section A3a). As a result, only the respective panel reviews these proposals. The low participation rate of the scientific community in the <i>ad hoc</i> review process may be due to increased workloads of successful scientists, as well as a diminishing culture of professional service.</p> <p>The COV encourages program officers to find additional incentives to increase participation in the <i>ad hoc</i> review process. Perhaps requiring a new element in the CV of the PI that is submitted with a proposal that lists "service to NSF during the past five years" might be useful [this would not be a review criterion]. Linking participation in NSF sponsored events, such as workshops, with active participation in the <i>ad hoc</i> review process might be considered.</p>	YES
<p>Is the review process efficient and effective? Comments:</p> <p>Generally, the process is efficient and effective. NSF's efforts to go paperless are laudable, and dwell time has decreased likely because of this.</p> <p>DEB should continue to allow program directors the ability to make some awards without <i>ad hoc</i> or panel reviews, including supplements and funding for some workshops (e.g., the one on the new Evolution Center). Such proposals are more efficiently and appropriately evaluated "in house."</p>	Yes

<p>Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines? Comments:</p> <p>Overall the reviews are consistent with the criteria stated in program solicitations. However, the responses of <i>ad hoc</i> reviewers in addressing Criterion 2 are exceedingly variable (see Section A2 for suggestions regarding Criterion 2). Also, the announcement criteria for the PEET special competition included special emphasis on educational and development of tools for Systematics, but the reviewers focused more on research contributions. It is unclear whether sufficient instructions were provided to the <i>ad hoc</i> reviewers.</p>	Yes
<p>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? Comments:</p> <p>Individual reviews are highly variable. However, in general, the reviewers provided sufficient explanations for the recommended ratings and suggestions for revisions.</p>	Yes
<p>Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation? Comments:</p> <p>Panel summaries generally provide sufficient information to support the basis for the panel recommendation. However, panel summaries often do not address Criterion 2.</p>	Yes

<p>Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for her/his recommendation?</p> <p>Comments:</p> <p>This is an area we feel could use some improvement. Although many files were complete, we found some jackets that were not adequately documented. For example, in one proposal there were no <i>ad hoc</i> reviews attached, the panel summary was generally very positive, a rejection letter was attached that stated that the proposal did not meet the format guidelines. There was no documentation regarding how the proposal did not meet guidelines, and proposals that do not meet the guidelines are generally sent back to the investigators with a request for revision within three days. We could not reconcile the information to understand what actually was wrong with this proposal. This type of situation occurred with several of the “unusual” proposals (special programs). Also, in the case of proposals that are returned for formatting changes, is it really necessary to retain the original proposal and the resubmission?</p>	Yes and No
<p>Is the time to decision appropriate?</p> <p>Comments:</p> <p>Decision times are quite appropriate given the volume of proposals handled and the size of the staff of the various programs. The scientific community particularly appreciates the timeliness of the informal responses provided by program officers so that PI’s are able to respond to the next deadline</p>	Yes
<p>Discuss issues identified by the COV concerning the quality and effectiveness of the program’s use of merit review procedures:</p> <p>See above. Despite the minor logistical issues we mention above, the merit review process is adequate.</p>	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

Provide comments in the space below the question. Discuss issues or concerns in the space provided.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>Have the individual reviews (either mail or panel) addressed whether the proposal contributes to both merit review criteria?</p> <p>Comments:</p> <p>Nearly all of the individual reviewers addressed merit review Criterion 1, but the extent to which they address Criterion 2 varies greatly. Reviewers most commonly deal with Criterion 2 by briefly mentioning training undergraduate and graduate students or postdoctoral researchers. Some restate the intellectual merit while others attempted to place the work in a more applied context. When other outreach activities are included in the proposal (e.g. web site development, teacher outreach, etc.) individual reviewers may mention it. In our analysis of 20+ randomly selected proposals, individual reviewers who addressed both criteria ranged from 0% to 100%. There also was wide variation across programs in the way Criterion 2 was discussed.</p>	YES and NO
<p>Have the panel summary reviews addressed whether the proposal contributes to both merit review criteria?</p> <p>Comments:</p> <p>All panel summaries reviewed (n = 20+) addressed both merit review criteria. The majority addressed merit review Criterion 1 thoroughly and included both positive comments and constructive criticism. Panel summaries most commonly deal with Criterion 2 by briefly mentioning training undergraduate and graduate students or postdoctoral researchers. Panel summaries more frequently include statements of other societal impacts (e.g. conservation impacts, innovative outreach, emerging synthesis, advancing a junior scientist's career, etc.) than do individual reviewers. Occasionally panel summaries include Criterion 2 arguments not included in individual reviews that appear to bolster proposals favored by the panel for Criterion 1 reasons.</p>	YES

<p>Have the <i>review analyses</i> (Form 7s) addressed whether the proposal contributes to both merit review criteria?</p> <p>Comments:</p> <p>All of the Form 7s (review analyses) sampled (n = 20) indicated whether or not proposals addressed both review criteria. In fact, in one instance (a proposal that was not funded) both the panel and Form 7 comments addressed aspects of the broader impacts Criterion even though the PI neglected to do so. Quite often the comments on the Form 7s regarding Criterion 2 were simply a restatement of the panel comments. Unfortunately, the comments regarding Criterion 2 generally were not an assessment of the quality or significance of the impacts. Instead they were simply a description of potential impacts.</p>	YES

Discuss any issues or concerns the COV has identified with respect to NSF's merit review system.

The COV finds that the use of merit review Criterion 1 is highly effective. The majority of individual reviews provide insightful critiques and most panel summaries clearly synthesize the elements that most strongly influence whether or not the proposal is recommended for funding. In contrast, we were disappointed at the use of merit Criteria 2 at all levels [from the proposals through to the review analyses (Form 7s)]. Individual reviewers increasingly address Criterion 2, but those who do still vary greatly for each proposal. Virtually all panel summaries and review analyses now consider both criteria. Nevertheless, at all levels the evaluation of Criterion 2 is usually limited to listing of training or other opportunities. In far fewer cases, the work is placed in some broader context. Only in rare cases do the individual reviews or panel summaries regarding Criterion 2 indicate serious discussion of these aspects of the proposal. This pattern was consistent across panels and among proposals and independent of funding recommendation. Therefore, the COV concludes that the lack of consensus on how Criterion 2 is defined limits its efficacy as a merit review criterion.

The COV feels that that the strong emphasis and high quality of attention to Criterion 1 reflects the broad consensus among the scientific community and program officers that award decisions should be based primarily on the intellectual merit of the proposed science. We concur with this general approach. However, we also feel that the review process would be improved if DEB devises mechanisms to encourage PI's and reviewers to more seriously address Criterion 2. We concur with the recommendation of the ESC COV Report 2002 that DEB list several different suitable approaches to meet Criterion 2 on the review form [e.g., (1) promoting training and education, including mechanisms to increase participation of underrepresented groups, (2) having broad impacts on the scientific community at-large, (3) having broad societal impacts] and provide space for reviewers to comment on the inclusion of one or more of these components in proposal. Similarly, we recommend that panel officers advise PI's, *ad hoc* reviewers and panelists on the scope of this Criterion and the value of providing a more thoughtful assessment of this aspect of each proposal during proposal preparation and the review process.

A.3 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
<p>Did the program make use of an adequate number of reviewers for a balanced review?</p> <p>Comments: Examination of a random sample of 20 proposals revealed that program officers requested an average of about seven <i>ad hoc</i> reviews per proposal (includes only those proposals for which <i>ad hoc</i> reviews are requested). Unfortunately, only 43% of the requested reviews were returned. Thus, there are approximately three <i>ad hoc</i> reviews per proposal (range of 0 to 6). It is unfortunate that so few of the requested <i>ad hoc</i> reviews are actually returned.</p>	YES
<p>Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Program officers clearly place a premium on identifying reviewers with appropriate expertise and qualifications. This is seen in the high quality, constructive reviews we reviewed and assessments in other COV reports that we analyzed. It is not uncommon for <i>ad hoc</i> reviewers to mention their own limitations when proposals fall outside their area of direct expertise. The low response rate of <i>ad hoc</i> reviewers probably makes maintaining a balance of reviewers difficult. However, we emphasize the need for a sufficient set of reviews for each proposal, and the inclusion of senior and junior reviewers with broad disciplinary representation on all review panels.</p>	YES

<p>Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups?</p> <p>Comments: Geography: Data were not available on the geographic distribution of <i>ad hoc</i> reviewers. However, considering the geographic distribution of panelists as a proxy for reviewers, there appears to be a reasonable balance. All 50 states were represented, as well as representation from outside the U.S. The largest number of panelists was from CA, NY, CO, IL, and OH. This roughly corresponds to the geographic distribution of principal investigators, suggesting that many panelists are drawn from the ranks of DEB PI's. Institution Type: The vast majority of reviewers are affiliated with Ph.D-granting academic institutions (82%). Non-profit organizations, including stand-alone research institutions such as natural history museums, rank second but provide just 7% of reviewers. Academic institutions devoted primarily to undergraduate education contribute just 3% of reviewers and business just 2%. These data suggest that increased emphasis should be placed on drawing reviewers from a broader array of institutions, especially teaching universities, non-profits, and business. Underrepresented Groups: Data were not available on the demographic characteristics of <i>ad hoc</i> reviewers. However, using panels as a proxy, we note that underrepresented groups generally represent 3-10% of panelists for most programs in most years. It appears that there is an effort to increase representation of these groups, and these figures are roughly comparable to the number of underrepresented PI's listed on total number of submitted proposals.</p>	YES
<p>Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: Conflicts of interest (COI) were clearly identified by program officers and appropriately addressed in accord with DEB and NSF guidelines. <i>Ad hoc</i> reviewers routinely self-identify conflicts of interest and do not participate in the process. Based upon the set of proposals examined by the COV, when program officers identify COI for <i>ad hoc</i> reviewers who inadvertently participated in the review process they were handled in accord with the guidelines and panel members were directed to ignore the review. Panelists and program officers who have COI with proposals do not participate in the review process and are not present in the room for discussions. It is quite evident that the program officers are extremely conscientious about resolving COI.</p>	YES
<p>Discuss any concerns identified that are relevant to selection of reviewers.</p> <p>Program officers are doing a fine job of identifying and selecting appropriate reviewers and resolving COI. It is very important that the programs continue to seek as large and diverse a pool of <i>ad hoc</i> reviewers as possible, especially given the very low rate of participation by individuals solicited to provide <i>ad hoc</i> reviews.</p>	

A.4 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, OR DATA NOT AVAILABLE
<p>Overall quality of the research and/or education projects supported by the program. Comments:</p> <p>The overall quality of research and education funded by DEB is exceptionally strong and the gold standard for environmental biology. We examined final reports when available (n=2), proposal summaries, panel summaries and Form 7s for 13 randomly selected jackets provided on 13 funded projects. With only one exception, the funded projects supported high quality research and student training. The one exception was a proposal funded in 2000 by Systematic Biology, which received unenthusiastic reviews, contained no preliminary data and proposed no student training. The Form 7 concluded that the project had "strong support" from systematists knowledgeable about the taxa involved, but the reviews did not support this view. The project appears to be an ordinary systematic study with little to qualify it as outstanding. In contrast, the other 12 projects all received highly positive reviews and appeared to involve very high quality research and educational activities. The high degree of competition for funding and the stringent review process generally assures that only high quality research is funded.</p>	Appropriate

<p>Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>Currently, most proposals are written to accomplish their stated goals in a period of three years at a total funding level of approximately \$100,000/year, which is the typical size and duration of DEB awards. However, forcing projects into these parameters may be constraining the nature of the questions that are addressed. LTER and LTREB do provide a mechanism for longer-term studies, but represent a small proportion of the awards made by DEB. The COV recommends that there be more flexibility in the duration of awards (e.g., more 4-5 year awards). As new tools for research (e.g. micro arrays) continue to emerge, an increase in the funding levels for individual awards will be essential. In addition, increased emphasis on review Criterion 2 probably will require an increase in size and duration of awards, especially as the salaries of post-doctoral positions and graduate research assistants are increased.</p>	Appropriate/Not Appropriate
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<p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • High Risk Proposals? <p>Comments:</p> <p>Although a number of types of project may involve risk of one type or another, we regard “high-risk proposals” as those with a potentially lower probability of success, but with the potential for innovative outcomes. Although there are programs that are riskier than others, one program within NSF is identified as being devoted to high-risk proposals, the SGER (Small Grants for Exploratory Research) program. Typically, SGER proposals are evaluated and administered by Program Directors, and the success rate is very high, typically 100%. However, as can be seen by the accompanying table, very few SGER proposals are submitted: in 2002, only 10 SGER proposals were submitted to the four main programs in DEB, equivalent to only 1.2% of the total number of regular research proposals submitted to the four programs. The small number of proposals submitted to and funded by this program is too small of an investment in high-risk programs. Part of the problem may be the high selectivity among program directors of the types of SGER proposals they will even consider. We note that programs typically cite one or two examples of high-risk proposals in their annual reports; however, citation of examples does not indicate the size of investment in an area.</p> <p>It is well known that PI’s often divert funds from existing grants (potentially weakening those projects) to gather preliminary data in what may be more high-risk projects. DEB in particular and NSF in general should “officially” recognize this phenomenon and substantially increase the funding of high-risk proposals. A seed-grant program, perhaps separately administered, should be established that actively solicits proposals that would focus on gathering preliminary data or exploring new, not-yet-proven techniques (e.g., the RO3 program of NIH).</p>									Not Appropriate
Number of proposals submitted	2000			2001			2002		
	SGER	Regular	SGER as % of Regular	SGER	Regular	SGER as % of Regular	SGER	Regular	SGER as % of Regular
Ecosystems	6	190	3.2%	4	154	2.6%	5	185	2.7%
Ecology	2	347	0.6%	6	178	3.4%	0	216	0%
Population Bio	5	247	2.0%	5	146	3.4%	3	234	1.3%
Systematic Bio	1	261	0.4%	0	241	0%	2	211	0.9%
Overall average			1.3%			2.1%			1.2%

<p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Multidisciplinary Proposals? <p>Comments: The term “multidisciplinary” is arbitrary and can be defined in a variety of ways, but if the number of jointly funded projects is used as the metric, the proportion of multidisciplinary proposals seems appropriate. Data for cross-directorate, cross-division, cross-cluster and intra-cluster jointly funded proposals indicate that the proportion of proposals that received funding from other programs ranged from 11-39 %. Some areas, such as Biocomplexity and IRCEB, are multidisciplinary by definition. Many projects in DEB are becoming increasingly multidisciplinary, and it is important to maintain a balance between topics generated by the PIs and multidisciplinary projects that are mandated by NSF.</p>	Appropriate
<p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Innovative Proposals? <p>Comments: Due to the high degree of competition, all NSF awards are innovative by definition. Indeed, NSF is the most effective driver for scientific innovation. With the increasing proportion of large-scale, complex, multidisciplinary proposals at the cutting-edge, there are ever-increasing costs associated with this innovation. Not only is the research itself more expensive, but once the project ends, there are the costs associated with archiving data, maintenance of collections, and disseminating these data to the scientific community and the public. There will be a need for increased funding of the total budget of the DEB if the program is to meet these post-project costs.</p>	Appropriate
<p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Funding for centers, groups and awards to individuals? <p>Comments: The recent trend in DEB appears to be to fund more centers and multi-investigator proposals and fewer single-investigator projects. This trend reflects the increase in need for multidisciplinary approaches to research addressing complex questions, as well as the emphasis at NSF to promote multi-investigator collaborations. The COV considers this a necessary development. For example, Planetary Biodiversity Inventories, the new initiative in BS&I, necessitates the collection of large numbers of organisms throughout the world over a relatively short period of time. Such efforts can only be successful if large numbers of investigators are involved. Other examples of collaborative efforts promoted by DEB include Collaborative Research at Undergraduate Institutions, Integrative Research Challenges in Environmental Biology, and Research Coordinating Networks. The ecological community views NCEAS, a center that originated in and is funded by DEB, as an exceptionally valuable resource. The Evolutionary Synthesis Center being contemplated by DEB is likely to be embraced by evolutionary biologists with equal enthusiasm and is viewed by the COV as an excellent initiative.</p>	Appropriate

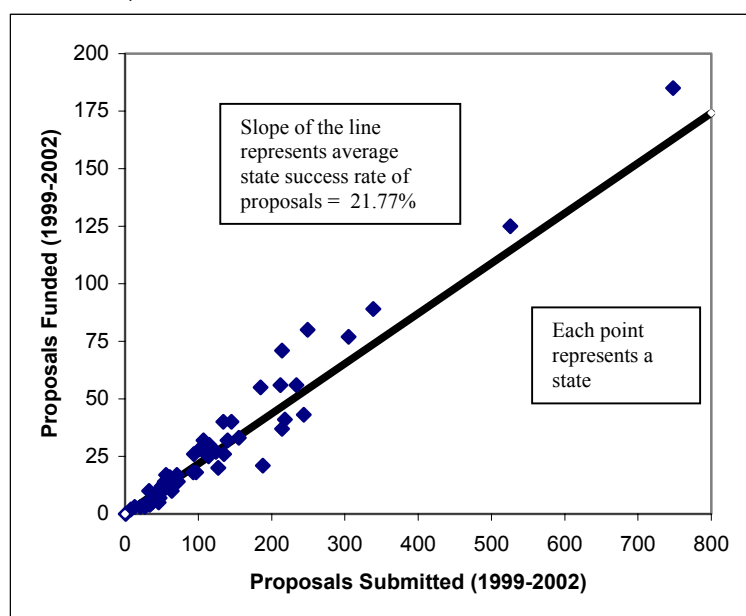
<p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none">• Awards to new investigators? <p>Comments: New investigators are well supported by DEB. For example, a total of 400 new investigators per year in 2000-2002 were supported with these evenly distributed evenly Ecosystem Studies, Ecology, Population Biology, and Systematic Biology. Percent of total awards to new investigators ranged from 29-37% for each of the Ecology Cluster, Population Biology, and Systematic Biology programs.</p>	Appropriate
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Does the program portfolio have an appropriate balance of:

- Geographical distribution of Principal Investigators?

Comments:

We examined distribution of proposals funded in two ways. First, we plotted the number of proposals funded in each state vs. the number of proposals submitted from each state. The line on the graph represents the average per-state success rate, 21.77%. Points that occur above the line represent states with a higher than the average success rate; points below the line represent states with lower than average success rate. One trend is very apparent. The five states with the greatest number of proposals (CA, NY, IL, MA, and NC) all have higher than average success rates. This means that, necessarily, the remaining smaller states must have lower than average success rates. In fact, of the ten states with fewer than 40 proposals submitted, seven had success rates that were lower than average.



A second way of looking at trends in geographic distribution was to compare EPSCoR states with other states. The twenty EPSCoR states have been identified as having relatively low rates of federal funding. When the success rate of EPSCoR states is compared to non-EPSCoR states, the result indicates that the success was significantly lower ($t = 2.89$; $P = .003$) in EPSCoR states (sample means of 18.8 and 23.3%, respectively). There are undoubtedly a number of reasons for the lower success rate of EPSCoR states, and DEB should investigate these. It is clear that the EPSCoR program has not yet met its goal of bringing EPSCoR states up to the level of funding of non-EPSCoR states. NSF should use the EPSCoR program to further strengthen the infrastructure, training, etc., in EPSCoR states. In addition, EPSCoR states should be the location of "how to" workshops regarding the preparation and administration of grant proposals.

Appropriate/Not
Appropriate

Does the program portfolio have an appropriate balance of:

- Institutional types?

Comments. Available data allow us to compare success of proposals at RUI (undergraduate) institutions to non-RUI institutions. Although there is not separate funding to support RUI grants, RUI proposals supposedly are given special consideration by panels and program directors.

% success for submitted proposals	2000		2001		2002	
	RUI	Regular	RUI	Regular	RUI	Regular
Ecosystems	33%	28%	18%	26%	40%	19%
Ecology	66%	21%	43%	35%	23%	19%
Population Bio	20%	27%	70%	34%	19%	22%
Systematic Bio	60%	20%	60%	30%	40%	28%
Overall	43.3%	23%	45%	31%	25%	22%

Number of proposals submitted	2000			2001			RUI	Regular	RUI as % of Regular
	RUI	Regular	RUI as % of Regular	RUI	Regular	RUI as % of Regular			
Ecosystems	6	190	3.2	11	154	7.1	5	185	2.7%
Ecology	9	347	2.6	14	178	7.9	13	216	6%
Population Bio	10	247	4.0	10	146	6.8	27	234	11.6%
Systematic Bio	5	261	1.9	5	241	2.1	10	211	4.7%
Overall average			2.9%			5.6%			6.5%

These data show two patterns: (1) that success at receiving funding for a RUI is generally higher than for non-RUI proposals, although that success dropped off substantially in 2002 (dropping from the mid-40's percent to 25%). (2) The number of RUI proposals submitted is very low. The number of RUI submissions was only 2.9% of the number of submissions of regular proposals in 2000, increasing somewhat to 6.5% in 2002. We are unsure of the reasons for the small number of submissions of RUI proposals. We are under the impression that program directors and panel members are somewhat welcoming of RUI proposals. Perhaps program directors need to be more aggressive in seeking proposal submissions from investigators at RUIs. DEB should strive to make submission and funding rates at RUI institutions at least reasonably comparable to that at non-RUI institutions. In that regard, DEB might adopt a system similar to R15 program at NIH, which is a separately evaluated program that provides funding for investigators at institutions that are primarily undergraduate in nature.

Appropriate/Not Appropriate

<p>Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> • Projects that integrate research and education? <p>Comments:</p> <p>Research and education are occurring synergistically across all programs to a high degree as measured by the number of undergraduates and graduate students being trained or mentored. DEB awards supported 930 undergraduates and 544 graduate students in 2002 alone. Many of these positions were supported by proposals that include funding for some combination of undergraduates, graduate students, or postdoctoral associates. However, proposals that are typically considered more educational in scope (i.e., RUI, ROA, CAREER) comprised only a very small proportion of DEB submissions (e.g., 8-12% over 2000-2002). We encourage DEB to carefully examine the reasons for the low number of CAREER and ROA proposals, and implement strategies to increase participation in these programs.</p> <p>Public outreach and education activities at the K-12 level are difficult to quantify, although an increasing number of investigators are requesting RET supplements for secondary school teachers.</p> <p>Finally, opportunities for public science education (i.e., informal science education) could be expanded greatly by creating a new multidisciplinary program that partners environmental biologists with people who work in public venues (e.g., media and museum exhibit experts).</p>	Appropriate
<p>Does the program portfolio have an appropriate balance:</p> <ul style="list-style-type: none"> • Across disciplines and subdisciplines of the activity and of emerging opportunities? <p>Comments:</p> <p>In general, there appears to be an appropriate balance among programs and clusters. The success rates for regular research proposals in Ecosystems, Ecology, Population Biology and Systematic Biology were all approximately 20%. For regular research awards, between 185-261 proposals were submitted. More proposals were submitted to the Systematic and Population Biology cluster than to the other programs, and SYSPOP received 48% of the awards. LTER, LTREB and BS&I received fewer proposals and had success rates ranging from 13% to 42%. Awards to emerging opportunities such as AToL, EID and IRCEB represented 9% of the total awards but were awarded over \$31.3M in 2002.</p> <p>There is a perception that proposals for projects focusing on field-based population ecology have a lower success rates in the Population Biology Program than do other sub-disciplines. DEB should look into this issue.</p>	Appropriate

<p>Does the program portfolio have appropriate participation of underrepresented groups? Comments: At the level of DEB, we found no bias in the success rates of proposal submitted by the various underrepresented groups. However, the main issue continues to be the low number of submissions from members of underrepresented groups. Approximately 20% of proposals were submitted by female PIs. Of the proposals that were submitted, the success rate of female PIs was comparable to that of male PIs (23-28%). Typically, the submission rate by minority PIs represented 3-5% of total proposals, but the funding rate of these proposals was comparable to that of other groups. This comparable funding rate was not the case at the level of cluster, where underrepresented groups in the Ecosystems and Ecology programs had a success rate of 0-17%.</p> <p>The lower submission rates by women and other underrepresented groups are likely in large part a reflection of their under-representation in the workforce. Therefore, we recommend that DEB continue to encourage submission of proposals from women and minorities. In particular, we recommend continued attention to programs designed to increase the participation of women and minorities in the workforce, such as UMEB, REU, CAREER and post-doctoral fellowships.</p>	Not appropriate
<p>Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: DEB meets an important national need by funding basic research in systematics, population biology, ecology, ecosystem studies, and surveys of biological diversity. No other sources of significant funding are available to support these areas of research. The need is urgent given the major changes occurring in the natural world. The time remaining is short for the discovery and documentation of biodiversity, and for understanding the natural ecological processes and the impacts of human modifications on natural systems, including global climate change. Information generated by projects funded by DEB is used by a significant and large array of scientists, educators, policy makers, and the general public. Planetary Biodiversity Inventories, the new initiative in BS&I, strikes the COV as a particularly important and welcome addition to DEB programs in that it will generate vast amounts of data useful to environmental biologists and policy makers.</p>	Appropriate
<p>Discuss any concerns identified that are relevant to the quality of the projects or the balance of the portfolio.</p> <p>These concerns are discussed above under each of the questions.</p>	

A.5 Management of the program under review. Please comment on:Management of the program.

Comments:

The DEB staff appears to work as a team with the shared mission of serving the scientific community. The program officers seem to be open and accessible to investigators. Based on our assessment of the items in A1-A4, the various programs seem to be managed reasonably well and efficiently, and we are impressed with the number and quality of proposals that are processed and funded.

Responsiveness of the program to emerging research and education trends.

Comments:

DEB program officers clearly have been the initiators of some of the flagship innovative programs coming from NSF during the past several years: Tree of Life, Planetary Biodiversity Inventories, Undergraduate Mentoring in Biology, the National Environmental Observing Network, Integrative Research Challenges in Biology, and the continuing Long Term Ecological Research Network. These programs are unique as national funding initiatives that are leading or will lead to highly visible and important new knowledge with substantial societal impact. Many of the smaller programs have been particularly effective, as well, including the Research Experience for Undergraduates, Schoolyard LTER, and the Small Grants program.

We note that a large number of those programs we listed above have moved from the DEB to either jointly managed programs (Emerging Frontiers) or other Divisions, some even outside the Directorate. The current management of these programs should include the vision and expertise that spawned them, wherever the programs are moved. It is a sign of success that programs initiated within DEB are disseminated across the Foundation. We encourage DEB to continue to be responsive in generating new programs and opportunities, and to continue to promote mechanisms that allow ideas to percolate up from the scientific community.

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

Comments:

When we look at the current balance of awards, we note that some of the smaller grant programs are not generating many proposals to DEB (e.g., ROA, SGER and RUI). We strongly suggest that, as part of the planning and prioritization process, DEB evaluate these programs to see if there are better mechanisms for involving the appropriate community in these opportunities. Workshops are an invaluable strategy for internal and external planning processes. We encourage DEB to be as inclusive as possible in their distribution of workshops participants and locations.

Discuss any concerns identified that are relevant to the management of the program.

1. Personnel structure:
 - a. The existence of rotators and permanent staff is a very productive way to achieve both continuity and continual new vision. It is likely that this balance has contributed in large part to the substantial success of the Division. We encourage DEB to continue to balance rotators and permanent staff throughout its programs. We are concerned that currently there is no permanent NSF staff associated with either the Ecology or the Ecosystems programs. These programs may need the continuity that only can be achieved by having some permanent staff. While rotators have the potential for providing crucial vision and input from frontline scientists, NSF experience is critical to strategically implement or advocate for the vision provided by fresh rotators. We also recommend that the practice of rotating Division directors be continued and that the Deputy Director position be made permanent.
 - b. The identification of rotating program officers in DEB is a process that is opaque to the scientific community. Though we are certain that the intent is not so, the system has the appearance of being insider-managed and closed to the broader community. The COV recommends that the system should be modified to enhance its transparency and the probability that high-quality scientists are attracted to DEB as rotators. While IPA's are an efficient mechanism for enabling university faculty to work at the NSF, we still encourage the DEB to use open searches, traditional to the academic community, when recruiting permanent and rotating staff. We strongly recommend that a process be implemented that includes an open and objective search procedure, that reaches beyond personal invitation and selection, for all rotating positions within DEB.
2. Panel Structure:
 - a. We have observed that panel members are frequently receiving a very large number of proposals (15-20). Investigators have invested considerable effort into preparing their proposals, and each proposal deserves the focused attention of those who will be reviewing them. We suggest that the Division consider reducing panelist loads to 10-12 proposals. This could be accomplished by increasing numbers of panels or panelists.
 - b. A 3-year panel term seems prohibitive for faculty with large teaching loads, whether at undergraduate teaching institutions or research universities. Program officers may want to consider a subset of panel positions with shorter terms, or shared positions among individuals with this type of teaching commitment.
3. Interactions among Programs
 - a. The future of environmental biology is dependent upon how well we inspire interdisciplinary science, and the current interdisciplinary programs are demonstrating successful interaction among NSF divisions. We recognize that forging interdepartmental programs is one of the most difficult tasks of an institution. Our sense is that the interactions and connections among divisions and programs should be continually strengthened, and we suggest that DEB increase its efforts to facilitate processes that encourage cooperation.
 - b. The continued high level of success that DEB has experienced is due to the intellectual investment of the staff. We suggest that the Division and the Directorate maintain the intellectual engagement of the DEB staff as programs are moved from DEB to other organizational levels.

4. Transparency of the System

- a. Our perception is that there are some traditions of communication with the broader community that could be clearer and more inclusive. For example, questions have been raised about how the invitation lists for workshops, or Dear Colleague letters are generated. We suggest that DEB increase the distribution of these communications to as broad a pool as possible to achieve greater representation and participation, and that DEB work diligently to be sure that the community understands how reviewers, panel members, workshop members, staff, etc, are selected.
- b. The COV recognizes that experienced investigators have developed an understanding of how the Division operates that assists them in generating successful proposals. We encourage DEB to think about ways to make this type of information more readily available to young investigators. One mechanism could be posting some information about the DEB and NSF (e.g., as easily found web pages of organizational charts and acronyms). We understand that the seminars presented by program officers at national meetings have been very well received and we encourage more of them.

PART B. RESULTS: OUTPUTS AND OUTCOMES OF NSF INVESTMENTS

NSF investments produce results that appear over time. The answers to questions for this section are to be based on the COV's study of award results, which are direct and indirect accomplishments of projects supported by the program. These projects may be currently active or closed out during the previous three fiscal years. The COV review may also 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. Incremental progress made on results reported in prior fiscal years may also be considered.

The following questions are developed using the NSF outcome goals in the FY 2003 Performance Plan. The COV should look carefully at and comment on (1) noteworthy achievements of the year based on NSF awards; (2) the ways in which funded projects have collectively affected progress toward NSF's mission and strategic outcomes; and (3) expectations for future performance based on the current set of awards. NSF asks the COV to provide comments on the degree to which past investments in research and education have contributed to NSF's progress towards its annual strategic outcome goals and to its mission:

- To promote the progress of science.
- To advance national health, prosperity, and welfare.
- To secure the national defense.
- And for other purposes.

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes (nuggets) as appropriate. Examples should

reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 NSF OUTCOME GOAL for PEOPLE: Developing “a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens.”

Comments:

Comments:

Based on our review of DEB annual reports, supplemental data, previous COV reports, program nuggets, and our random review of proposal jackets, we commend the DEB programs for actively promoting activities to develop “a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens.” DEB programs engage in a number of activities that promote this development, such as innovative training programs [e.g., the Doctoral Dissertation Improvement Awards (DDIG), CAREER awards], outreach to the K-12 community (e.g., Schoolyard LTER’s, RET’s), enhanced opportunities for traditionally underrepresented students (e.g., UMEB), expanded prospects for conducting DEB research in undergraduate institutions (e.g., RUI’s, RET’s, REU’s specific workshops). The DEB scientific community appears to support these activities. Undergraduate students at most colleges and universities are actively encouraged to seek REU fellowships, REU recipients commonly go on to graduate school, minority students are actively recruited, and new initiatives to train teachers and develop outreach web site are being proposed regularly. However, the COV also notes that there are also some levels (e.g. post-doctoral, accomplished mid-career scientists), which have far fewer targeted opportunities for receiving support. Similarly, some existing programs (e.g. CAREER, RUI’s, and ROA’s) appear to have sub-optimal levels of application and support. The COV supports targeting or otherwise encouraging applications from women, minorities, and faculty from undergraduate institutions, and we urge DEB to consider developing new mechanisms to provide postdoctoral opportunities, to forge innovative links between research and education, and to allow researchers to “retool” to pursue investigations in new directions.

The COV also finds that it is difficult to assess the impact of the outcomes related to this “NSF Outcome Goal for People” compared to three years ago, since few benchmark data are provided. DEB program officers should establish these benchmarks and provide them, along with clearly articulated expected outcomes, to future COV so that the COV can provide more meaningful assessments of the progress in achieving this goal.

Examples of activities that recently have been supported by DEB programs are provided below to illustrate the current diversity and depth of these types of activities.

B1. Nuggets:

Michael Vanni
Miami University
0227669

A Research Experience for Teachers supplement was recently awarded to Mike Vanni (*Omnivory and the Stability of Aquatic Food Webs*). The primary goal of this study are to assess 1) whether omnivores stabilize food webs, and 2) the mechanisms by which omnivores confer stability. The research employs experimental ponds as model systems, and uses pulses of sediments and nutrients as perturbations. For this RET supplement, Vanni will collaborate with Sue Bartow, who

teaches science to K-8 students at the McGuffey Foundation School. Bartow will be involved in developing several exercises, for implementation by 5/6 and 7/8 graders, that relate directly to the goals of 9982124. The first of these exercises involves field sampling of different streams; Bartow will gain experience in deciding field sampling programs, in learning methods used to sample streams and to quantify nutrient concentrations, and in supervising grades 5-8 as they sample streams. The second project involves experiments used to assess nutrient limitation in freshwater algae. Bartow will explore alternative methods for conducting standard nutrient limitation experiments and then conduct these experiments with her students with help from undergraduate students at Miami University as part of Miami University's new REU Site program (www.muohio.edu/ecoreu). Thus, there will be a synergy between the REU and RET programs at Miami University. As a result of her research experience, Bartow will bring experiential learning, through laboratory and field experiments, into primary and middle school science curricula in her school.

Ann Kinzig
Arizona State University
9910620

Workshops in ecosystem sciences include a range of scientists from senior PI's to students, women, members of under-represented groups, and international participants from countries that lack a strong science infrastructure. One that was both very effective and represents this commitment to diversity is a workshop by Ann Kinzig.

This workshop led directly to a special issue in the journal *Ecosystems* in a special section entitled "Bridging disciplinary divides" pp 709-764. Authors: 1) A.P. Kinzig; 2) K.C. Ewel; 3) J.M. Antle et al; 4) S. Hanna; 5) W. Ascher; 6) D. Ludwig.) Three of these lead authors are women (Kinzig, Ewel, Hanna). It is also notable that the thinking that emerged from this workshop is integral in a newly published edited volume in the Princeton Monographs series (Kinzig, Ann P., Pacala, Stephen W., and Tilman, David. 2001. The functional consequences of biodiversity: Empirical progress and theoretical extensions. Princeton University Press.).

A brief abstract of this workshop is as follows. Environmental goods and services have fueled economic growth and serve as the basis for human well being. Yet much of this "natural capital" is unpriced, and therefore frequently undervalued, leading to its use or degradation in excess of that which would best serve the public good. Methods for proper valuation of these services are needed, together with an increased understanding of the biogeophysical factors that form their bases. Natural and social scientists have been collaborating on these questions from over a decade, but these collaborations have been isolated and limited. At present there is no common understanding among scholars as to the most important unanswered questions or most fruitful directions for future research. This interdisciplinary workshop assessed the current literature on natural capital and its valuation and identify the most crucial gaps in that literature. This assessment served as the basis for a larger effort in 2000 that produced a comprehensive research agenda for the field and informed the NSF Biocomplexity in the Environment competition entitled "Dynamics of Coupled Natural and Human Systems."

Kerri Vierling
South Dakota School of Mines and Technology
0133854

Vierling's CAREER award (*A Keystone Species Approach to Determining Post-Fire Successional Influence on Cavity user Communities in the Black Hills, South Dakota*) addresses the relative importance of different woodpecker species on the community of organisms using secondary cavities in various post-fire pine forests in the Black Hills, South Dakota. In this research, Vierling and her students will examine woodpecker and secondary-cavity user communities in unburned

treatments, recent burns (< 2 years old) and in older burns (>10 years old). The relative importance of individual woodpecker species to the secondary cavity-user community will be determined by monitoring the use of woodpecker cavities during the breeding and non-breeding seasons in each treatment. Wind Cave National Park is the primary site both for field research and for a field ecology curriculum that will be taught to American Indian students. This study provides a unique opportunity to integrate research and ecological education with American Indian students by combining a culturally relevant field site (Wind Cave) with culturally relevant organisms (woodpeckers). The field ecology course planned results from a collaboration among the South Dakota School of Mines and Technology (SDSM&T), Oglala Lakota College, and the SDSM&T Scientific Knowledge for Indian Learning and Leadership program (SKILL). For the pre-college cohort from the SKILL program, Vierling combines field ecology with research activities at the Wind Cave. This combination of research activities and educational activities will provide excellent opportunities to integrate research and education for a group that has traditionally been under-represented in the sciences.

Scott Edwards
University of Washington
0127168

The UMEB program provided a supplement to an award to Scott Edwards that enabled Edwards to bring 15 minority undergraduates to make presentations on their research at the annual meeting of SSE/SSB. Edwards also organized a set of mentors to assist the students, as well as several activities that provided the students with career information and networking opportunities. This project was exciting for several reasons; 1) it enhanced Edwards' own research project, for several of the students that he brought to the meetings worked in his own lab; 2) it provided minority undergraduates a chance to present their research at a large meeting, and to learn much more about career opportunities in evolutionary biology; 3) it was a successful pilot project for UMEB, which in FY02 instituted a formal mechanism to make such awards to scientific societies, engaging them as partners in bringing full range of national talent to environmental biology.

B.2 NSF OUTCOME GOAL for IDEAS: Enabling “discovery across the frontier of science and engineering, connected to learning, innovation, and service to society.”

Comments:

1. New programs with high potential for enabling discovery, learning, and service:
 - a. DEB has been very innovative at initiating new programs with a very high likelihood of leading to new discoveries and linking to education and service. For example, one of the most compelling current environmental issues is the effects of humans on biological diversity, and there is a strong need for establishing a knowledge base on organisms. The Tree of Life program, initiated by DEB, has funded projects that map many of the major branches of life that will provide a roadmap for our understanding of its diversity and the potential impact of extinction. The Planetary Biodiversity Initiative is highly innovative and is clearly working towards Mission 1 of the Systematics Initiative 2000, to make a global inventory of species on our planet. There is a synergy that is formed out of new programs, and the PBI initiative can be linked with the Tree of Life.
 - b. The Undergraduate Mentoring in Environmental Biology program, in addition to Foundation-wide programs such as REU and ROA, has been very successful in training the scientists of the future. Schoolyard LTER has made a major contribution in bringing ecology into K-12 classrooms.
2. The COV has been impressed by the scientific results generated by the DEB during the past four years, as evidenced by the “Nuggets” provided by the program. These nuggets clearly articulate the impact of the fundamental research that is being undertaken with funding from DEB programs. As one of the many examples provided, proposal DEB-9806923 by Jessica Gurevitch evaluates the population dynamics of pitch pines in Long Island. The participants of this project include NY state park rangers, fire fighters, local conservationists, academic researchers, the Nature Conservancy and local and state political officials. The research has been widely disseminated in the media, including local TV coverage, several articles in the Long Island paper Newsday and in the New York Times. Another example is DEB-0207085, PI Gionvannoni, which has resulted in the development of groundbreaking sampling techniques for marine microbes that have technological impacts well beyond the discipline. There are many others, addressing the consequences of invasive species, global climate change, and human induced extinctions. Many of the contributions from the LTER program have demonstrated the unique capabilities of that program for elucidating human impacts on systems that have relevance over decadal time scales.

B.3 OUTCOME GOAL for TOOLS: Providing “broadly accessible, state-of-the-art and shared research and education tools.”

Comments:

Examples of shared research and education tools resulting from DEB-funded projects include internet-accessible databases, computational programs for phylogenetic and ecological analyses, interactive identification keys, digital libraries, and networks (RCNs) to enhance communication among researchers and educators. Support for development of these tools significantly enhances the ability of scientists to conduct research and to distribute information to the widest possible number of users. However, funding for some tools is grossly inadequate, including development and maintaining particularly large databases such as those associated with institutional collections of biological specimens and development of electronic networks to link these databases. In addition, funding appears to be inadequate to support the purchase of advanced educational instrumentation (e.g., mass spectrometers).

PART C. OTHER TOPICS

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

- A. We regard the small number of proposals to SGER program as indicative of too small of an investment in high-risk programs. DEB in particular and NSF in general should substantially increase the funding of high-risk proposals. We recommend that a seed grant program, perhaps separately administered, be considered that would actively solicit proposals that would be used to gather preliminary data or to explore new, not-yet-proven techniques.
- B. The number of RUI and ROA submissions is surprisingly and low. Primarily undergraduate institutions, by their very nature, educate a substantial number of undergraduates but receive a relatively small share of NSF grants. To facilitate the involvement of undergraduate students in research, NSF in general and DEB in particular should strive to make submission and funding rates at RUI institutions at least reasonably comparable to that at non-RUI institutions.
- C. Success rate of proposal submissions from EPSCoR states was significantly lower than that from non-EPSCoR states. It is clear that the EPSCoR program has not yet met its goal of bringing EPSCoR states up to the level of funding of non-EPSCoR states. DEB and NSF should use the EPSCoR program to further strengthen the infrastructure, training, etc., of EPSCoR states.

- D. The fact that most proposals are limited to three years duration and approximately \$100,000/year may constrain the types of questions that can be addressed. More flexibility in the duration of awards and size of awards is recommended.
- E. Rates of proposal submission by URG are low. We recommend continued attention to programs designed to increase the participation of women and minorities in the workforce such as UMEB, REU, CAREER and post-doctoral fellowships
- F. As identified in C2 below, this COV and a previous COV have identified the need for the funding of postdoctoral fellowships as well as mid-career awards that enable investigators to pursue new research directions. Given that the need for mid-career awards may be especially acute at undergraduate institutions or in relatively isolated universities, we recommend that DEB consider meeting these two needs simultaneously by establishing a postdoctoral fellowship program to enable both research and teaching at primarily undergraduate institutions. Such a program would link post-docs interested in a career in undergraduate teaching and research with mid-career scientists who might benefit and welcome the infusion of new ideas and expertise. The post-doc would potentially bring experience with the latest technologies and new ideas, whereas the mid-career scientist could serve as a teaching and research mentor.
- G. NSF has not responded to the increase in major expenses of biodiversity documentation that natural history institutions require. In recent years, NSF has responded effectively and appropriately to the major crisis facing the planet, the increasingly rapid loss of biodiversity. This response has produced new programs and initiatives (PEET, PBI and RevSys) that have met enthusiastic response from the scientific community. This enthusiasm results from the fact that the programs enhance our understanding of the products of organic evolution, and enable us to understand and predict impacts of human activities. Data generated are useful for a wide variety of scientific research programs, educational and outreach activities, and environmental policy decisions. Projects funded by these programs generate vast samples of biological organisms and associated data that must be archived in permanent institutional collections. For example, Fisher and Griswold's inventory of Madagascar arthropods funded by BSI (0072713) has generated 2-3 million specimens of insects, including more than 800 new species of ants. Funds are typically included in the project budgets for many of the associated costs, including identification of target groups of taxa, cataloging, and storing specimens (jars, pins, alcohol, labels, freezers, etc.). Of concern to the COV is that NSF has not responded to the increase in major expenses of biodiversity documentation that natural history institutions require: the need for long-term modern storage facilities for the specimens (including tissues for genetic studies), expert verification of the integrity of the specimen-associated data, and development and support of the CYBER infrastructure for dissemination of information associated with the specimens. Specimen-based data form the basis for understanding the distribution of species through space and time, and thus provide information for many critical questions facing scientists and policy makers. Without adequate support, optimal availability and use of data cannot occur. The CYBER infrastructure would form an incredibly useful platform for research and education. Information would include digitized images and morphological and other data as well as locality and temporal data on specimens. All information should be available to everyone in the world. Traditionally, some of this support has come from the Biological Research Collections Program. Funding for this program has remained flat for 13 years. Other support has come from Biological Data and Informatics. However, significant additional resources must be found to support these important and irreplaceable archives of the world's biodiversity data.

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.

Answers to the Division-specific questions:

1. Has DEB appropriately balanced their education portfolio?

The DEB education portfolio appears well balanced in terms of its support of students. Using either dollars or numbers of students as a metric, undergraduate and graduate students are benefiting significantly from DEB support. Furthermore, K-12 students also are well served by the LTER schoolyard project.

The COV, however, believes that the people (post-docs, young and mid-career faculty) that are training and teaching many of these undergraduate and graduate students could be better supported by DEB. We echo strongly the recommendations of the 2002 Ecological Studies COV that identified a need for more support of postdoctoral research students and the "retooling" of mid-career scientists. Because a DEB postdoctoral fellowship program does not exist, established scientists should be encouraged to include funding for post-docs in their regular grants. The post-doc stage is particularly important for women and underrepresented groups. As salaries for post-docs are increased the size of regular awards will need to increase accordingly. We also strongly suggest that DEB consider establishing career awards for mid-career scientists. Because the field of environmental biology is exploding in content and technology, mid-career people could benefit from awards allowing them to retool to facilitate work in new directions. Such awards may be especially critical for faculty at primarily undergraduate institutions who often are more isolated from the cutting edge of multidisciplinary projects in the field of environmental biology. Finally, CAREER awards are outstanding opportunities for junior faculty but the appropriate balance of research and education expected in these proposed projects is often unclear to PI's. Therefore, we recommend that PI's be encouraged to seek advice from those who have received these awards.

2. Has the Division sufficiently supported synthesis activities?

It is readily apparent that DEB has initiated a wide variety of synthetic activities and has developed new programs to support these activities. Numerous NSF-sponsored workshops have explored the development of new ways to integrate research collaboration across disciplines. NCEAS serves as a model of a synthetic center to explore wide-ranging environmental issues. Exploratory efforts to develop a similar evolutionary center are well underway and are laudable. Research Coordination Networks and Integrated Research Challenges in Environmental Biology also clearly reflect this kind of synthetic activity. LTER's are providing critical monitoring and experimental data, and the recent 20-year review recognizes that additional resources over those provided for data collection will be necessary to take best advantage of the opportunities to integrate data among sites, and to expand into other areas such as conducting baseline biotic surveys at the various sites. These integrative activities have received considerable attention and focus by DEB staff, and we encourage DEB to continue to foster this kind of synthesis, since synthetic work will become increasingly important in future investigations under the auspices of DEB.

3. In what direction is the science that comprises DEB programs and activities headed?

DEB core programs continue to generate exciting, innovative and cross cutting research and the COV finds that the scientific balance of the current portfolio is extremely strong. Mechanisms for identifying and generating new directions (both internal and external) are clearly prospering as seen from the rapid generation of fundamental science, the success and breadth of new initiatives, and the inclusion of a diverse group of scientists and educators in DEB programs. Multidisciplinary has

long been at the core of DEB science. This has enabled the DEB community, programs and program officers to generate novel multidisciplinary research projects in every core area. This trend will certainly intensify in coming years as DEB scientists tackle complex fundamental problems in environmental biology. Moreover, the DEB community addresses scientific issues central to long-term health and sustainability of the planet. Therefore, DEB has unlimited capacity to conduct vitally important research in the public interest.

However, to reach its remarkable potential, rapid growth of multidisciplinary necessitates the growth of new partnerships and mechanisms for information sharing, synthesis and access among scientists, administrators, and the public. Immense growth in computational capacity, genomic mapping tools, monitoring of global biogeochemical systems and many other technological advances are generating data, collections and other physical outputs at rates that currently far outstrip the ability of existing infrastructures to adequately handle them. The COV feels that as DEB programs move forward in the next few years, some of their greatest challenges will be to build and strengthen effective institutional partnerships and infrastructure and to maintain community input to generate and evaluate emerging areas of study. These are all necessary for the DEB community to realize their full creative potential for generating new knowledge in environmental biology.

We endorse the recommendation of the last COV that DEB prepare a strategic plan that outlines emerging research topics and identifies priorities for growth in the Division. There should be budgetary planning that is connected to this strategic plan. The following list identifies areas of rapid development and potential for DEB scientists that should be considered in developing the DEB plan.

- 1) **Multidisciplinary programs** – DEB must foster innovative programs and structures that support nimble and creative multidisciplinary science. Multidisciplinary areas fundamental to DEB programs that are of broad societal impact and likely to grow rapidly in the near future include:
 - a) Genomics/proteomics/informatics. – Explosive growth in these areas already is reflected in research in virtually all DEB core programs. Scientists will soon be able to sequence the genome of almost any organism in a fairly short period of time. DEB should facilitate opportunities for the community to take an active and leadership role in the national dialog to prioritize the species that are sequenced to meet DEB core research missions. One mechanism is to support a workshop or series of workshops on this issue.
 - b) Phylogeny and systematics – DEB research in this area addresses the fundamental diversity of life at a critical time in evolution of the planet.
 - c) Computational biology
 - d) Conservation and sustainability – Cross cutting programs expand our capacity to address fundamental aspects of the earth's stability and health.
 - e) Global biogeochemical cycling – New technologies and approaches enhance our ability to address global climate and ecosystem health, with major policy and economic implications.
 - f) Human/health/environment interactions – DEB is the natural home for cutting edge research investigating vital connections between impacts of humans on the environment and the environment on humans, especially human health. The Ecology of Infectious Disease Program and several Biocomplexity grants originating within DEB illustrate the unlimited opportunity and need for research explicitly designed to address such questions of major societal impact.
 - g) Systems biology

- 2) **Synthetic and integrative activities** – One of the primary missions of DEB must be to strengthen and expand its activities to synthesize and integrate. The NCEAS success can be modeled for other synthetic enterprises undertaken by DEB core programs and scientists.

- 3) **Educational programs and outreach partnerships** – Key NSF agency wide goals include educating the public about complex, multidimensional issues, and fostering a generation of scientists adequately prepared to engage in effective multidisciplinary science and outreach for the public good. The establishment of merit Criterion 2 in the review process of NSF has opened the door to the development of a variety of new partnerships and opportunities. DEB must take an active role in leading the community (investigators, reviewers, administrators) to achieve this broad initiative. In addition to programs initiated within DEB, this division also could build partnerships with other key divisions at NSF. For example, DEB and ISE could bring their communities together to more effectively and broadly disseminate results of environmental research in an engaging, accurate, and compelling way.

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

The Agency has been on an aggressive growth path over the past several years, designed ultimately to double its overall budget. Inherent in this growth are several key issues for DEB. Much of this new funding is related to new, increasingly multidisciplinary programs. We applaud the agency's focus on multidisciplinary issues and research, but feel that additional mechanisms are needed to promote communication among relevant divisions, including DEB. As ideas emerge and are brought to scale, special efforts are needed to ensure that domain specialists in DEB and other relevant divisions continue to be involved both in the transition and long-term stewardship of the programs. For example, managing "emerging frontiers" research in a separate, virtual unit has certain advantages, but must be done carefully to ensure that it encourages the continued evolution and vibrancy of DEB. The agency's budget growth opens many new opportunities, but care should be taken to ensure that core programs share (both in real terms and perception) in the agency's overall success and budget growth. The COV also notes that there are aspects of the current COV assessment and review procedures that limit value of the COV. Collection of meaningful and consistent data division-wide would greatly enhance the ability of future COV to evaluate progress and to help DEB to achieve desired outcomes.

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

We understand that Criterion 2 is an important part of the mission of NSF, and our sense is that the program officers have been doing well at verbally reinforcing its importance to panels. However, proposal elements that address Criterion 2 are often criticized by reviewers and panels, and the evaluation of outreach and education activities may even decrease the probability of funding. Even in successful proposals, the amount requested to implement Criterion 2 is often reduced in the final award. There needs to be better alignment of the importance of Criterion 2 with the priorities of the DEB and the funding of individual projects.

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

We deeply appreciate the work of the DEB staff in preparing materials for the COV. Here we make a number of suggestions that would further facilitate the work of the COV and allow it to devote its time to evaluating broader scientific, educational, managerial, and societal-impact issues facing the DEB.

1. The DEB should prepare a concise self-study document for use by the COV. In periodic reviews of programs at academic institutions, the institution provides a self-study report that

includes the vision for the program. We suggest that NSF programs under review go through a similar self-study process, involving a careful examination of the program and a complete analysis of relevant data, resulting in a written report on which the COV can base its evaluation.

2. The self-study should clearly define division goals and expected outcomes (e.g., Part B1 NSF Outcome Goal for People) and should establish division-specific benchmarks for all division goals and outcomes.
3. As part of the self-study, DEB should conduct an internal “audit” prior to the COV visit to determine the integrity of program operations and program-level technical and managerial matters (e.g., most of the questions in Part A). The audit should include all data and analyses that are needed to answer questions on the COV template, and should (at a minimum) include analysis of:
 - a. Division-wide benchmarks that can be used to assess achievement of expected outcomes.
 - b. Analysis of adequacy of the review process, etc.
 - c. Analysis of the number of proposals submitted, success rate, and dollars awarded within each program for each of the previous three years by state, institution type, new vs. previously funded PI, gender, ethnic group, number of PI’s (single vs. multiple).
 - d. Description of the number of proposals funded that include other agencies/divisions/etc., and the identity of those groups.
 - e. Analysis of the duration and size of grants within each of the programs.
 - f. Budget allocations across all parts of NSF and over time (present year and past 4-10 years) so as to facilitate the answering of questions regarding funding trends.
4. Annual reports should all be in the same format (program to program and year to year) and they should include data that aid the COV in addressing questions.
5. The work of the COV could be facilitated by the following:
 - a. Access to a network drive that could hold shared files.
 - b. Make it clear that COV members are to print off materials (reports etc.) or that they will be provided hard copies.
 - c. Supply materials substantially earlier than four days before the meeting so as to give the COV more time to preview reports and data.
 - d. Provide information (self-study, audit, annual reports, supporting data) to COV members well in advance of the COV meeting.
 - e. The use of Microsoft WORD tables on the template for the COV report caused several problems. For example, if a response took more than one page, it was difficult to format the appropriately.
 - f. Provide a minimum of 100 proposal jackets for examination by the COV.
6. We are uncomfortable with the use of “nuggets” as a means of evaluation. We noted that many annual reports seem to rely on the presentation of examples to indicate the strength of a program. Arguing from anecdotes is perhaps the weakest form of argument and should not be used even in qualitative evaluations. Their use should be for illustrative purposes only.

The COV for Ecological Studies, 2002, consisted of the following individuals:

Taber Allison – Massachusetts Audubon Society (NGO), chair

Jim Collins – Arizona State University, Bio AC rep (*ex officio*)

Edith Allen, University of California, Riverside

Fred Benfield - Virginia Tech

Carol A. Couch, U. S. Geological Survey

Gustavo Fonseca, Conservation International

Laurel Fox, University of California, Santa Cruz

Richard Holmes - Dartmouth

Bruce Hungate - Northern Arizona University

Emily Stanley - U Wisconsin

Mary Ann Vinton, Creighton University