UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

EPA-SAB-EPEC-LTR-02-002

Honorable Christine Todd Whitman
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Review of the Southeastern Ecological Framework: An EPA Science Advisory Board Report

Dear Governor Whitman:

At the request of EPA Region 4, the Ecological Processes and Effects Committee (EPEC) of the EPA Science Advisory Board established a panel to review the Southeastern Ecological Framework (SEF), a decision support system intended to identify remaining natural areas in the southeastern U.S. of highest value for conserving regional biodiversity. Developed under a cooperative agreement between EPA Region 4 and the University of Florida, the goal of the SEF project is to enhance regional planning across political jurisdictions and to help focus federal resources to support state and local protection of ecologically important lands. The SEF provides information that can be applied within many of EPA's traditional programs to better achieve the Agency's mission. The SAB Panel commends EPA Region 4 for undertaking an assessment of regional landscapes, suggests ways in which the methodology might be enhanced, and comments on the applicability of the approach to other regions of the U.S.

Background

The creators of the SEF have correctly identified continuing habitat destruction and fragmentation as major risks to biodiversity and the functioning of ecological systems in the region. With this in mind, the SEF attempts to determine how existing conservation areas can be combined with new conservation areas and connecting corridors to enhance the protection of native biodiversity and landscape function. To this end, the SEF produces a map of priority natural areas of a minimum size ("hubs") and connecting corridors. The ecological significance of natural areas is assessed on the basis of criteria such as the diversity of habitat types, the extent of edge habitat, the presence of certain habitat types (e.g., wetlands, longleaf pine stands, old growth forest), the presence of protected areas (e.g., easements, reserves, Natural Heritage rivers), potential black bear habitat, and the presence of rare species. Current data related to these criteria are incorporated into the data layers within the SEF model so that the spatial overlaps can be identified. A series of 24 data layers were assembled, some with data region-

wide and others from only one state in the region. A set of decision criteria then were applied to the data to define the areas with the highest ecological significance (Priority Ecological Areas or PEAs) and areas with lesser, but still substantial, ecological significance (Significant Ecological Areas or SEAs). Areas with land uses that are incompatible with natural areas (e.g., urban, intensive agriculture, high road density) were excluded from consideration. PEAs greater than 5000 acres in extent were selected as hubs. A geographic information system (GIS) model then was used to identify landscape linkages (corridors), using SEAs with natural or semi-natural vegetation, to provide physical connectivity among hubs.

The process of using the Framework involves selection of appropriate spatially-explicit data, identification of PEAs and hubs, and use of those areas in decisions. The SEF builds upon the Florida Ecological Network (FEN) that was designed to identify landscapes and linkages necessary to support megafauna such as black bear. The FEN has been published in the peer reviewed literature[1], but there is no generally available documentation for the SEF. The SEF has been used for a variety of land-use decisions and clearly brings a valuable landscape perspective to those issues.

Charge to the Panel

The SAB was asked to review the SEF, including the adequacy of the general approach and the specific data layers. A panel of the Ecological Processes and Effects Committee met in July 2001 to respond to the following charge questions:

> Question 1: Is the Florida Ecological Network approach consistent with modeling an ecological framework for a region?
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> Question 2: Are the data layers used in developing the Southeastern Ecological Framework sufficient to indicate ecological integrity?
>
> Question 3: Would a similar model or approach be applicable for developing a framework for the U.S.?
>
> Question 4: Would additional or alternate data layers be needed for a national framework?
>
> Question 5: What modifications might be made to increase the utility of the approach as a decision support tool in meeting EPA's program activities and GPRA goals?
>
> Question 6: Discuss what linkages between various indicators and EPA programs or control authorities may help to elevate the use of SEF as a decision support tool?

The Panel's conclusions are based on review materials[2] provided by EPA Region 4 and oral presentations by SEF developers at the July 2001 Panel meeting.

Conclusions

a) **The Panel recognizes and praises the significant efforts that have gone into the SEF. Such a framework is useful for integrating EPA programs in a region, as well as for providing a landscape context for decisions by states, local governments, and private landowners in the region**.

The SEF is designed to meet EPA's goals of gathering and disseminating information pertinent to the ecological condition of a region. The prime value of the approach is that it provides a means to integrate complex data at a landscape scale in such a way as to aid decision-making. This analysis greatly adds to the value of existing data, indicates where information gaps exist, and proactively supports resource use decisions. The Framework primarily focuses on biodiversity protection, and it can be used to inform issues ranging from ecological implications of providing clean water and air and to assessing ecological impacts of global climate change. The SEF also can be used to set priorities for data collection and analysis, to select land to be protected for conservation reasons, and in other forms of decision-making.

The Panel supports the development of methods and data for regional assessment of ecological condition. Regions and landscapes are appropriate scales for managing ecological systems, and, thereby, ensuring future ecological functions and services. Having spatially-explicit data available for a region enables decision-makers to consider broad-scale implications of decisions; e.g., the extent to which the growth of human populations and transportation systems, as well as economic development, are fragmenting natural landscapes. The SEF provides a schema and contributes to the capacity of local communities and regions to consider connected actions and the cumulative and indirect effects of single projects within a larger geographic area. The development of a regional spatially-explicit database and tools for analysis also facilitates collaborative decision-making among multiple governmental and non-governmental entities. The approach is useful for such diverse needs as community planning efforts and NEPA analysis.

A valuable aspect of the effort to create the SEF is the coordination across federal, state, and private sources of natural resource data. For EPA to continue to align its programmatic efforts with performance goals at regional and national landscape levels, the Agency will need to rely on other state and federal agencies for sources of data, models and expertise. Additionally, conservation organizations such as the Association for Biodiversity Information and The Nature Conservancy will be a valuable source of data on locations and status of ecological systems, vulnerable species, and special sites of biodiversity significance. The SEF Workgroup's use of the Southeast Natural Resource Leadership Group to facilitate coordination of data needs and identification of resource concerns is a model for other similar efforts.

The effort to create a regional model to advance the management of the environment is a unique and important step forward in using data for decision-making. The fact that the SEF suffers from limitations in available data should in no way detract from the importance of trying to manage environmental conditions and the ecological services provided by those landscapes at the regional level. Although political boundaries occasionally are associated with geologic or

hydrologic relief, for the most part ecosystems and their elements do not recognize political jurisdictions.

b) **The Panel recommends that the SEF be enhanced to include a wider range of ecological attributes that are important to regional ecological integrity**.

The regional approach advanced by the SEF effort is a reasonable first step that can help the Agency achieve its broader mission in two key fashions. First it will encourage EPA to consider broader geographic boundaries in many of its traditional regulatory programs, such as the management of point sources. Second, it will assist the Agency more generally to focus its goals at the landscape level and on performance objectives associated with the biological aspects of ecological integrity.

Although the regional approach used by the SEF can provide significant benefits to EPA, the SEF should be revised to incorporate a broader range of ecological attributes in order to be most effective. For example, the SEF document emphasizes ecological integrity and ecological function, yet the approach oversimplifies the assessment by relying almost exclusively on the habitat requirements of megafauna as a surrogate for function. The paucity of data on functional attributes of landscapes makes it challenging to develop landscape approaches to process attributes. The SEF makes that need apparent and provides a means to incorporate and use such landscape functional data). Other aspects of biological condition (such as the protection of other native communities and focal species) are equally important, and there are many other elements of ecological integrity -- such as hydrology and geomorphology, disturbance regimes, and chemical and physical quality -- that also should be included in order to preserve ecological function and native biodiversity[3].

c) **The Panel recommends that the process for setting criteria to select priority lands be made explicit and that the criteria and the individual data layers used in the SEF receive additional peer review**.

The SEF approach utilizes threshold criteria for determining which lands are classified as Priority Ecological Areas (PEAs) or Significant Ecological Areas (SEAs). Although the criteria are listed in the SEF document, the process by which the criteria were developed is not described. SEF documentation should make the process for selecting criteria explicit since the decision criteria likely will vary for different environmental management objectives.

While the Panel encourages continued development of this innovative tool, we also recognize that ongoing review of the results and components of the Framework is necessary. The Panel reviewed the general approach and direction of the SEF. However, a more detailed review of the procedure used in the selection of data layers, the process of combining layers, and the optimization procedure will give greater confidence in the approach. The detailed review will require a document that explicitly describes the SEF, the development of the priority area criteria, and the procedures used in its analysis.

d) **With the caveats noted, the Panel agrees that application of the SEF approach would be beneficial in other regions of the U.S., although different data layers and/or different criteria for selecting priority areas likely would be needed.**

Adopting the SEF approach in other regions requires that the procedure for selecting the priority ecological areas be clearly set forth. Detailed documentation of the approach, including a clear protocol and criteria for the selection of priority ecological areas, would facilitate transfer of the methodology to other regions. The Panel does not recommend that a single national methodology be attempted. However, since the Agency focuses on both regional and national concerns, consideration should be given to how the framework might be used at the national level. *A priori* planning would enhance the Agency's ability to integrate the results of various regional assessments into a national composite map of interconnected ecological areas.

A Regional Approach

Charge Question 1: Is the Florida Ecological Network approach consistent with modeling an ecological framework for a region?

Yes, the approach developed for the Florida Ecological Network (upon which the SEF is based) generally is applicable to a larger region, with some important caveats. The use of GIS-based tools to provide information to federal agencies, state and local governments, and other stakeholders is a desirable and needed activity for the EPA regions. The main goal of the SEF--to provide information on ecological value for remaining intact land tracts – is an important task for other EPA Regions as well. Development of tools like the SEF is appropriate for EPA at the Region level because such tools provide connectedness within ecoregions and watersheds that approaches developed by individual states may not. However, each Region has its own unique land-use patterns and ecosystem types. Therefore, selection criteria for significant ecological areas likely will differ among Regions, and these criteria should be developed on a regional, rather than a national, basis.

The most important limitation of the approach, and its extension from Florida to the Southeast, is the lack of a clearly defined process for choosing selection criteria for Priority and Significant Ecological Areas (PEAs and SEAs). The current set of criteria reflect a narrow definition of ecological integrity as "the functionality of intact lands." More widely accepted definitions of ecological integrity include the concepts of chemical, physical, and biological integrity[4] and the presence of diverse native species[5]. The SEF documentation might be revised to more accurately describe the scope of the effort and the title of the work expanded to state more clearly what is being done (e.g., SEF: A GIS-based Framework for Identifying Priority Ecological Areas).

We recognize that data limitations prevent a full assessment of ecological integrity within a GIS framework across the Southeast and that some aspects of ecological integrity are not expressed at the landscape scale. However, a more defensible process for choosing ecological and biodiversity selection criteria could be used. Criteria selection should be process-driven and

grounded in a clear conceptual model for ecological integrity. Additional scientific review, refinement, justification, and testing of linkages and hubs and their characteristics (e.g., sizes) is needed. A planning process that includes stakeholders (as used in EPA Region 5) might be undertaken. The selection criteria were chosen mainly to protect large animals that require large and connected tracts of land, notably the Florida panther in the FEN and the black bear in the SEF. The apparent assumption is that by using selection criteria that support top predators, other organisms and ecological functions will be protected. That model provides a reasonable first-cut in developing land-protection tools. However, land tract size and connectedness are not the only features that are important (and these characteristics are not important for all species). For example, in the southeast, endangered mussels are a group of focal species for which a different set of criteria might be used. Furthermore, habitat degradation might occur (such as by impacts due to invasive species, land management practices, or changes in disturbance regimes).

Focal species are species that exert a disproportionate influence on ecosystem condition or provide information about the ability of the system to support other species. The approach for selecting focal species was first set forth by Lambeck (1977)[6], but the selection and application of focal species is more fully set forth by the Committee of Scientists (1999)[7] and Noon and Dale (2002)[8] It is reasonable to choose one or more focal species as one approach for reporting on the status of an ecological system. The less adequate the habitat for each focal species, the greater the risk to other native species. Because candidate focal species interact with ecological systems in diverse ways[9], there are benefits to using a set of focal species in any analysis. Thus, it is important to consider if the SEF includes the key focal species for the region. Clearly some of the megafauna (e.g., black bear) and rare species are included in the approach. However, it is not apparent if other types of focal species are a part of the analyses. Rather than focusing on large megafauna alone, a diversity of focal species would be helpful in exploring the value of the SEF approach as it develops. The Panel recommends that a set of species may best capture the ecological conditions of a region but recognizes that the set will vary from place to place (both within the region and from one region to another).

In addition to data on a broader range of focal species, other important aspects of ecological resources in the region should be considered in expanding FEN to the Southeast. They include the variety of land management approaches (some of which are compatible with measures of integrity), natural succession, changes over time in land-use that affect ecological integrity, and climate change.

Another area of major concern to the Panel was the time scale for updating data fundamental to the framework. The 10-year schedule for data revisions mentioned by the presenters suggests that (1) the current maps of areas to be protected (i.e., hubs and corridors) might be inaccurate given land-use changes that may have occurred since the supporting data were collected (as long ago as 1993, in some cases) and (2) substantial alterations in the landscape may occur (i.e., loss of PEAs or SEAs) prior to updating the framework with newly collected data. The developers of the framework should consider protocols for ground-truthing and assessing the accuracy of their current product, as well as for updating the framework at appropriate time intervals. Changes in land-use, including development/degradation of valued land parcels or restoration of previously excluded lands, occur in real time and the utility of the SEF necessarily will be evaluated in this temporal context.

The development of the "cost surfaces" and subsequent optimization that produced the network of connected areas are innovative components of the overall methodology. However, this approach, necessitated by the limited capabilities of the commercial GIS software, demonstrates that the software also can constrain the intellectual development and implementation of the proposed framework. For example, several optimization procedures have been developed that are not part of any GIS. In any case, the user needs to fully understand how the optimization occurs so that the analysis is interpreted correctly.

Sufficiency of SEF Data Layers

Charge Question 2: Are the data layers used in developing the Southeastern Ecological Framework sufficient to indicate ecological integrity?

No, the data layers used are not sufficient to characterize ecological integrity, which includes chemical, physical and biological integrity or maintenance of structure, function, and composition. However, the attributes included in the current SEF may be sufficient for a more narrow purpose, i.e., that of identifying lands important for the preservation of large megafauna.

In the narrow sense used by its authors, the SEF consists of ecological hubs and landscape linkages. These data layers are insufficient by themselves to capture the ecological integrity of the southeastern region as many ecological communities and species naturally occur in small patches and will not be included in the hub and corridor framework. Hence, the other data layers comprising the Priority and Significant Ecological Areas will be required to capture those other components of biological diversity or integrity. The Panel recognizes and praises the enormous efforts that have gone into compiling and developing the layers currently in the greater SEF, as the combination of these data layers obviously is already a great potential assistance to local planners. Nonetheless, the Panel identifies some important missing data layers that are needed if the full array of species and ecological systems and processes are to be evaluated using the framework in the Southeast; for example:

a) As the SEF document notes, the habitat classification used for the SEF, unlike the finer-level (Landsat-based) classification used in the Florida Ecological Network (FEN), was coarse, which prevented the identification of the full suite of ecological systems and led to the mis-classification of some altered areas (e.g., pine plantations) as natural ecosystems. The National Land Cover Data Base now has data available at a 30 meter resolution (at no cost) that can be used to develop finer resolution land cover classes. The Panel encourages an effort to develop a new, finer level classification of ecological systems across the region so as to identify the full set of ecosystem types.

b) As the SEF document also notes, the Element Occurrence (EO) data from State Natural Heritage Programs, the primary source of location data for ecological communities and vulnerable species, is incompletely represented (only 3-4 of eight states). The Panel encourages an effort to obtain complete Heritage data across the region, especially as digitized polygons rather than as simple point

coverages. The Panel also recognizes the sensitive nature of some of these data, but urges that ways be explored to permit the use of the data in local and regional land-use planning while maintaining adequate security for species and habitats that require it. For example, perhaps precise locations can be disclosed but the species' identity can be hidden as necessary. Issues of confidentiality regarding certain data sources (e.g., locations of protected species) may constrain the usefulness or implementation of the framework for different regions.

c) To the extent that priority sites of ecological integrity (or biodiversity conservation) have been identified by other parties, such sites would be a very useful additional data layer. For example, critical sites have been identified by The Nature Conservancy and Heritage programs in ecoregional or state conservation planning and by military land managers in the region (e.g., at Fort Benning, Georgia). Descriptions of such sites typically define their unique attributes in terms of composition, structure, and function. Consideration also should be given to defining the spatial scale of concern. For example, for rare species, the concern might be at the global, regional, or state level. The more clearly the priorities are defined, the more readily the framework can be used to help local planners answer the question: "What is most important to protect?"

d) The SEF methodology does not consider historically-recorded disturbances or stressors that might influence the structural and functional integrity of lands potentially identified as PEAs or SEAs (such as water or air pollution). Similarly, geomorphic, edaphic, and atmospheric aspects of landscapes are not included in the framework, even though larger scale or regional data on these aspects exist or might reasonably be developed. These omissions should be corrected in future versions of the SEF. Data describing ecological function (e.g., productivity, decomposition, and nutrient cycling) are largely unavailable at regional scales. This data limitation also constrains the framework's ability to assess ecological functioning of landscapes.

e) Many ecologists now recognize that defining ecological integrity requires using not only the current location of ecosystems, but also, in the face of climate change, general physical characteristics that show how ecosystems may alter in response to changing conditions. Information on climate (e.g., temperature and precipitation) and geophysical attributes (e.g., soils and topography) are predictive of both the current and potential distribution of vegetation types, and thus of the distribution of plant and animal species[10]. The Panel encourages the incorporation of this type of information and approach as it becomes available, into the Framework.

f) More attention should be given to the fuller development and integration of data layers that address the composition, structure and function components of ecosystem integrity as they relate to landscapes. While landscape linkages and riparian corridors provide one such component, they are not sufficient. For

example, the ecological integrity of lotic (flowing freshwater) systems depends upon the maintenance of natural hydrology and geomorphology (e.g., natural flow regimes, connectivity between rivers and their floodplains). Such systems could be identified and mapped as potential areas of high ecological integrity, drawing upon data and methodologies developed by The Nature Conservancy, Aquatic Gap programs, ABI, and others.

g) As data become available, it would be useful to map some additional, stressor data layers as a contra-indicator of ecological integrity. These might include such things as the presence of urban areas and roads, invasive species locations, changes in disturbance regimes, air pollution isoclines, and diminished stream water quality or quantity.

Transferability of the Approach

Charge Question 3: Would a similar model or approach be applicable for developing a framework for the United States?

The SEF approach produces a framework (or map) for the southeastern U.S. that identifies sites important to the preservation of megafauna. The general ***approach*** utilized for the SEF — i.e.,the identification of critical ecological "hubs" and "corridors" that have unique value in preserving aspects of ecological function, structure, and composition — is applicable to other regions of the U.S. The Panel does not recommend that a single national methodology be applied to generate a national framework because the criteria for selecting priority ecological areas will differ in different regions of the country, and the data layers will need to be appropriate for the types of ecological systems being assessed. However, the Panel does endorse adopting the approach in multiple regions and, thereby, gaining a picture of priority ecological areas for the U.S. when all its regions have such a framework. A national map of hubs and corridors, developed from the integration of regional frameworks, would provide a national perspective for decisions affecting conservation and land management. The underlying data layers, including important ecological areas not included in the framework products because of their location or smaller spatial extent, also would be a valuable product of the effort.

A national effort should:

a) Be implemented at the *regional* level;

b) Be *peer reviewed* in each region with attention to identifying regionally appropriate ecological criteria prior to implementation; and

c) Be *integrated* at the national level from the set of regional efforts with attention to assuring seamless integration along regional boundaries.

As with the individual regional frameworks, a national integration should be considered a work in progress, flexible enough to adapt to new data layers, to be appropriate to all regions,

and to provide new insights on the efficacy of implementation criteria. Developing training guides that include detailed documentation of the procedure and criteria for selection of PEAs and SEAs would be necessary.

Charge Question 4: Would additional or alternate data layers be needed for a national framework?

Yes, as noted above, developing a national composite framework (or map) from the integration of regional frameworks would require additional data layers because the selection of data layers for any particular locality or region is to a large degree dictated by the type(s) of ecosystems, communities and organisms that occupy that region. For this reason, it is likely that additional or alternate data layers would be needed for extending the SEF to other regions.

Developing protocols for selection of data layers would facilitate the transfer of the approach to other regions and would ensure that the approach is applied consistently. Such consistency is critical if the set of regional approaches can be expected to produce a national perspective. Training guides and documentation of the approach are also necessary for such consistency. As the use of tools like the SEF expands within EPA, Regions should carefully consider other types of data layers-- particularly physical land attributes, prior land-use histories, presence and extent of water-quality data and aquatic species – based on their unique regional needs.

The data layers shown in Table 1 (Criteria for selecting Priority Ecological Areas for the Southeastern Ecological Framework) and Table 2 (Criteria for selecting Significant Ecological Areas) of the review document were developed from the Florida Ecological Network and expanded for the SEF. Scaling of the SEF to broader geographic areas, or extension to other regions, would require consideration of a number of factors including: the indigenous flora and fauna of the region; the dominant communities existing in the region; reference conditions for those communities (e.g., species richness, density, and community diversity); the purposes served by corridors in the region; the availability and scope of existing datasets; and the compatibility of the data with the software employed.

A number of the data layers used in the SEF, considered generically, would have broad utility in designing many, if not all, regional frameworks. These data layers, however, would likely require redefinition, normalization, and independent peer review to confirm their applicability to regional or local conditions. Some examples of broadly applicable data layers in the SEF include existing public conservation lands and private preserves, roadless areas, and the occurrences of rare species and communities. These types of data would be important to consider in the identification of ecological hubs and corridors for virtually all regional frameworks.

The specific quantitative criteria that determine how data layers are identified — the thresholds for PEAs and SEAs — would ***not*** be nationally consistent even for examples of broadly applicable layers above. For example, dominant species requiring large habitat areas, such as the black bear used in the SEF, would need to be selected on the basis of those focal

species indigenous to the area. For this reason, more in-depth consideration of habitat type, dominant species, etc. would be needed to develop data layers for each region.

In contrast, a number of data layers used to identify PEAs and SEAs in the SEF are obviously unique to the region, or even to Florida in particular. Examples include Florida State Aquatic Preserves, Florida Natural Areas Inventory, and Florida Fish and Wildlife Conservation Commission data. These data would not be relevant to a framework for other regions, but similar datasets of protected natural areas developed by other regional or state authorities could likely be substituted.

In summary, the criteria used in developing PEAs and SEAs would have to be based on the appropriate organisms (or focal species) to be preserved in each region, assuring that hubs and corridors intended for use by target organisms are actually used by those organisms. EPA Regions often encompass a broad range of ecosystems and criteria used in each Region will need to encompass the appropriate ecological diversity.

Supporting EPA Goals and Programs

Charge Question 5: What modification might be made to increase the utility of the approach as a decision support tool in meeting EPA's program activities and GPRA goals?

Charge Question 6: Discuss what linkages between various indicators and EPA programs or control authorities may help to elevate the use of the SEF as a decision support tool?

The EPA Region 4 can use the SEF in its current form to incorporate landscape analysis into implementation of its traditional programs to better achieve the Agency's mission. Direct applications include NEPA reviews (wherein, for example, the Agency can retroactively and prospectively analyze preferred placement of roads or federal facilities, for example) and reviews of wetland mitigation banking proposals (where wetland siting can enhance the value of other wetland or upland habitats in the region by creating a more optimal pattern of connected habitats in the region). Indirect applications include the protection of drinking water sources (by preferentially directing federal and private resources towards habitat protection in drinking water source areas) and implementation of the current Executive Order on neotropical migrant bird populations[11] (e.g., by helping the Agency to identify, then help direct resources to preservation of, necessary habitat).

In order to expand the utility of the SEF to the Agency and/or increase its effectiveness as a "decision support tool" in its current applications (both within and outside Region 4), the Agency can:

a) refine the SEF as recommended above (see Charge Questions 1-4) and obtain further, more detailed peer review on the choice of individual data layers to

reflect focal species as well as review of the suite of data layers and software for its ability to characterize ecological integrity;

b) improve the ease of access and ease of use of the tools so that others readily can tailor SEF outputs to specific uses;

c) create and maintain high-quality GIS capability within regional offices;

d) simplify linkage of these tools to other GIS databases; and

e) add data layers specifically targeted to other EPA program responsibilities.

Examples of these adaptations are discussed below.

A shortfall of previous efforts of this sort (e.g., the Southern Appalachian Assessment) was the complexity of the GIS tools; ease of access and flexibility of software and processing capabilities probably remain critical elements in the potential for wide-spread utilization of the SEF approach. Ideally, a web-based interface without additional software requirements would make these types of data most readily available to the various user communities. Additionally, it would be useful to increase the flexibility in defining elements of the model to provide for a rapid turnaround in the consequences of those decisions for the PEAs identified.

One means of enhancing the utility and relevance of the SEF indicators to Agency programs would be to link the SEF data base to other spatial data developed within the Agency (e.g., from environmental monitoring and remote sensing). For example, the value of the SEF might be elevated if surface water quality data or airshed data were linked to determine if PEAs were associated with particular areas of concern or, conversely, were well suited to preserve ecological integrity in light of high air and water quality. The SEF document mentions how the SEF could be used in defining the response of ecosystems in the future. There is likely no more timely topic than the potential consequences of climate change on ecological integrity or the character of ecosystems as we know them in recent history. The authors should consider explicitly how the SEF approach might be used to inventory and define PEAs and predict their response to a warming climate with shifts in precipitation.

Several linkages to other existing GIS databases and new data layers created for site-specific applications could be used by the Agency to more effectively implement its current programs. For example, a data layer could be developed on potential or existing habitat and corridor requirements for an aquatic focal species (or a group of species) that is sensitive to sedimentation. Then the SEF could be queried for specific information relating to sedimentation (once EPA formulates its new clean sediment strategy). Similarly, existing GIS databases that show nitrogen concentrations could be used in combination with SEF information on optimal riparian corridors to more effectively target agricultural nonpoint pollution control efforts (e.g., to improve pesticide labeling).

Although the potential exists to expand use of the SEF in several new applications, it may be that the greatest current benefit of the SEF is its demonstration that use of GIS tools and landscape analysis is an effective method for optimizing implementation of a surprising variety of Agency activities, particularly those in the regional offices. Similarly, spatial mapping and landscape analysis also are effective methods to coordinate routine activities of several federal agencies so that their independent activities maintain landscape patterns that help maintain biodiversity.

In conclusion, the Panel applauds the designers of the Southeastern Ecological Framework for an important effort. We recommend that the Agency consider additional enhancements and peer review of the product to further improve its utility to Agency decisions in EPA Region 4. In addition, the Agency may wish to encourage development of similar networks of ecologically important lands in other regions of the country, and ultimately to integrate the regional maps into a composite national map of connected natural lands. We look forward to your response to our review.

Sincerely,

/ Signed /

Dr. William Glaze, Chair
EPA Science Advisory Board

/ Signed /

Dr. Terry F. Young, Chair
Ecological Processes and
Effects Committee
EPA Science Advisory Board

/ Signed /

Dr. Virginia H. Dale, Chair
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Notes

1. Hoctor, T.S., M.H. Carr, and P.D. Zwick. 2000. Identifying a Linked Reserve System Using a Regional Landscape Approach: the Florida Ecological Network. Conservation Biology 14:984-1000.

2. Southeastern Ecological Framework: EPA Science Advisory Board Review Materials. 65p.

3. For further discussion of essential ecological attributes that define condition, see *A Framework for Assessing and Reporting on Ecological Condition* (EPA-SAB-EPEC-02-009).

4. Karr, J.R. and D.R. Dudley. 1981. Ecological perspective on water quality goals. Environmental Management 5:55-68.

5. Noss (2000) notes that ecological integrity is closely linked to the concept of native biodiversity, and may be thought of as "a condition of completeness for a given biogeographic and temporal setting and is closely associated with natural, relatively unaltered ecosystems containing a full suite of native species." (Noss, R.F. 2000. High-risk ecosystems as foci for considering biodiversity and ecological integrity in ecological risk assessments. Environmental Science and Policy 3:321-332).

6. Lambeck, R.J. 1997. Focal species: a multi-species umbrella for nature conservation. Conservation Biology 11:849-856.

7.Committee of Scientists. 1999. Sustaining the people's lands: recommendations for stewardship of the national forests and grasslands into the next century. U.S. Department of Agriculture, Washington, DC. (Http://www.fs.fed.us/news/science)

8. Noon, B.R. and V.H. Dale. 2002. Broad scale ecological science and its applications. Pp.34-52 In, K. Gutzwiller (Ed): Applying Landscape Ecology in Biological Conservation. Springer-Verlag, New York..

9. Dale, V.H. and S.C. Beyeler. 2001. Challenges in the development and use of ecological indicators. Ecological Indicators 1:3-10.

10. Iverson, L.R. and A.M. Prasad. 2001. Potential changes in tree species richness and forest community types following climate change. Ecosystems 4:186-199.

11. Executive Order 13186 of January 10, 2001. Responsibilities of Federal Agencies to Protect Migratory Birds.

U.S. Environmental Protection Agency
EPA Science Advisory Board
Ecological Processes and Effects Committee
SEF Review Panel

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NOTICE

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