Review of the Prairie Cluster Prototype Long-term Ecological Monitoring Program

I. Background

Knowing the condition of natural resources in national parks is fundamental to the Service's ability to protect and manage parks. National Park managers across the country are confronted with increasingly complex and challenging issues, and managers are increasingly being asked to provide scientifically credible data to defend management actions. A long-term ecological monitoring program is necessary to enable managers to make better informed management decisions, to provide early warning of abnormal conditions in time to develop effective mitigation measures, to convince other agencies and individuals to make decisions benefiting parks, to satisfy certain legal mandates, provide a means of tracking resource condition and measuring performance, and to provide reference data for relatively pristine sites for comparison with data collected outside of parks by other agencies. The overall purpose of monitoring is to develop broadly based, scientifically sound information on the current status and long term trends in the composition, structure, and function of the park ecosystem. Use of monitoring information will increase confidence in manager's decisions and improve their ability to manage park resources.

One component of the National Park Service strategy for implementing ecological monitoring in approximately 270 parks that contain significant natural resources is a series of experimental or "prototype" long-term ecological monitoring (LTEM) programs. The prototype LTEM programs were established primarily in an attempt to learn how to design scientifically credible and cost-effective monitoring programs in ecological settings of major importance to a number of NPS units. The level of monitoring conducted by prototype programs is both more comprehensive and more intensive than what other parks will be able to undertake. Much of the design, development, and testing of monitoring protocols is conducted in prototype parks in cooperation with scientists from the U.S. Geological Survey. Prototype LTEM programs possess a wealth of experience and expertise related to the development and implementation of ecological monitoring that can greatly benefit other parks throughout the NPS. The prototype programs provide mentoring assistance to other parks undertaking long-term ecological monitoring, and provide technical assistance to staff from other parks on a wide variety of technical issues related to monitoring, including conceptual design, database management, data integration and analysis, and reporting of monitoring findings.

The tremendous variability among parks in ecological conditions, sizes, and management capabilities represent significant problems for any attempt to institutionalize ecological monitoring throughout the NPS. To develop monitoring expertise throughout this range of ecological and managerial diversity, natural resource park units were grouped into 10 major biogeographic areas or biomes, and one park from each major biome was then selected to serve as a prototype LTEM program for that biome. To address the needs of small parks, three of the prototype programs were designed as "cluster" programs, i.e., a grouping of 4-6 small parks, each of which lacked the full range of staff and resident expertise needed to conduct a long-range monitoring program on its own.

The Prairie Cluster LTEM program was the first prototype to address the problem of designing monitoring for a group of small parks. The prototype includes six relatively small parks that were established primarily to preserve historical sites: Agate Fossil Beds National Monument (AGFO), Effigy Mounds National Monument (EFMO), Homestead National Monument of America (HOME), Pipestone National Monument (PIPE), Scott's Bluff National

Monument (SCBL), and Wilson's Creek NB (WICR). Until recently, the native prairie/savanna vegetation of these parks has primarily been treated as a backdrop for interpreting each park's cultural significance. Restoration of prairie and savanna communities was undertaken mainly to recreate historic landscapes. More recently, the contribution of these remnant grasslands to regional biodiversity has been recognized. While each park has a unique mission and represents a distinctive component of regional biotic diversity, all six parks include high-quality prairie remnants, sites requiring complete restoration, and a continuum of resource conditions between these two extremes. The two most eastern parks, Wilson's Creek NB and Effigy Mounds NM, are also managing oak savanna remnants. Restoring prairie/savanna vegetation to disturbed sites and managing grassland communities with prescribed fire are common resource management priorities. The small size of the parks makes them particularly susceptible to external threats. Agricultural, residential and industrial developments are prominent land uses adjacent to these parks. Because small parks are often inadequately buffered against edge effects, invasion by exotic plant species is a pervasive problem. Water pollution may be the most urgent external threat. Because the parks are small, their springs, creeks and ground water are particularly vulnerable to external pollution sources and cannot be insulated by buffer zones or resource management inside the parks. Most of the parks must also protect unique habitats and manage state or federally listed, rare and endangered species.

II. Objectives of the Review

The proposal for the prairie cluster prototype program was written in 1993, and partial funding was first received in 1994. Most of the protocol development work to date has been conducted by USGS scientists, and all of those protocols have been completed, peer-reviewed, and provided to the NPS for implementation. The NPS has recently hired several permanent staff to implement the monitoring program. Thus, the program is at a transition of moving from a planning and design phase that included a large research component associated with protocol development, to an operation phase with most of the work conducted by permanent NPS staff.

This review by a panel of NPS and USGS scientists was undertaken to provide constructive recommendations for improvements to the program at this time of transition to the operational phase. The various protocols developed by USGS scientists had already been formally peer-reviewed through the review process of the Northern Prairie Science Center, and the panel members therefore did not review the protocols themselves. Instead, the focus was on the implementation of the program by NPS staff, and whether the parks were receiving scientifically credible, relevant data that addressed their high-priority needs and helped them manage the parks.

The scientific review panel was comprised of six members:

Dr. Steven Fancy	NPS, National Monitoring Coordinator
Dr. Paul Geissler	USGS, Statistician and USGS Coordinator of the LTEM program
Dr. David Graber	NPS, Science Advisor, Sequoia –King's Canyon NP
Dr. Ron Hiebert	NPS, Colorado Plateau Cooperative Ecosystems Studies Unit
Dr. Kurt Jenkins	USGS, Research Scientist, Olympic NP Field Station
Dr. Kirk Lohman	NPS, Regional Science Advisor, Alaska Region

The review panel members were provided with two documents prepared by the NPS staff of the prairie cluster prototype: "Conceptual framework, monitoring components and implementation of a NPS long-term ecological monitoring program", and the "Data Management Plan". Panel members read these documents prior to the site visit in November 2001. For each of the protocols developed by USGS, binders were available to the panel that contained the original work plan, draft

protocol, references, peer and management review comments, response to review comments, protocol approval, metadata, additional products advisory board notes, and the final protocol. Panel members attended a 3-day site visit on November 14-16 2001 at Wilson's Creek NB that was attended by superintendents and resource managers from the six parks, NPS staff of the prairie cluster prototype, USGS staff and cooperators that were involved in some of the protocol development, regional office personnel, and several additional guests (Table 1). The first day of the review involved presentations by USGS and NPS staff involved in designing the monitoring program. On the second day, the panel met with superintendents and resource staff from the six parks to obtain their input and assessment of the program and whether it was meeting each park's needs. An open discussion period and a meeting between the panel and NPS staff based at Wilson's Creek NB also occurred on the second day. On the morning of the third day, panel members met to discuss their assessments of the monitoring program and to begin developing recommendations.

III. Overall Assessment of the Monitoring Program

All review panel members felt that the program overall was very well designed and operated, and noted the high professionalism and dedication of the staff, the strong and positive support for the program by the superintendents and resource managers of the six parks, and the sound approach to data management. The following strengths of the program were noted:

- Parsimony: The program has done a good job identifying a manageable number of indicators of system health (variables) and computed metrics. The focus on simplicity will help to ensure long-term sustainability of the program.
- Relevance: The program balances the needs for long-term studies of sustainability with studies of applied management actions, resulting in a high degree of relevance and utility to park managers. All the park managers spoke highly of the relevance of the LTEM program and expressed undiluted support for its continuance. Several examples were given of the direct application of monitoring projects to park management.
- Staff Professionalism: The LTEM staff of the Prairie Cluster consistently demonstrates the highest level of professionalism. The professionalism is seen in the high regards the staff is held by the superintendents and resource managers for the six prototype parks and Tallgrass Prairie National Preserve. The team communicates well with park staffs and among its working group. The leadership of the parks commended the LTEM staff for their hard work and dedication, sensitivity to park needs, willingness to discuss LTEM programs and park management issues with park staffs, timely response to park requests for data summaries and information, and the high level of cooperation between LTEM staff and Inventory and Monitoring Networks.
- Inter-Park Cooperation: All of the park managers of parks in the Prairie Cluster demonstrated a strong willingness to cooperate in a spirit of sharing both staff and resources. Several of the superintendents talked about the limited resources of small parks and the need to cooperate. There were no concerns raised over the disproportionate share of monitoring support provided to any one park. The Prairie Cluster has demonstrated that parks can equitably share resources. It is an excellent role model for the networks to follow.
- Staffing: The Prairie Cluster prototype program has built a critical mass of disciplinary expertise allowing the program to flourish in certain topic areas, particularly plant population and communities studies and data management. The approach of basing team members at

one location, as opposed to dispersing staff among the different parks, has contributed to the success of the program and has been shown to have a number of advantages, including facilitating communication and cooperation and the sharing of equipment and other resources.

- Data Management: The Prairie Cluster has done an exemplary job in the development of data management procedures and database design, and is providing leadership to parks and networks of parks throughout the Service. The program follows a cooperative approach to data management that includes a high level of participation of both data management specialists and ecologists. The cooperative approach to data management helps to ensure that databases are of consistently sound design, integrated and that high quality control/assurance guidelines are met. The data management plan was very well-written and makes several important points including:
  - ✓ Ownership of the data collected by others. Some researchers are reluctant to release data until it has been peer reviewed and published, but a park may require the information immediately to make management decisions.
  - ✓ Annual deadlines for data entry, data verification, and reporting. These activities may be easily postponed if specific deadlines are not specified.
  - ✓ The automation of routine reports and database interface to Arcview makes the data much accessible and useful.
  - ✓ Observer comments and trip reports are stored with the data. This is important because they are often separated and there is no way to check on unusual observations that may be discovered years later during an analysis.
- Conceptual Planning: The Prairie Cluster LTEM staff, under the leadership of Lisa Thomas, has provided national leadership in describing the importance and contribution of conceptual modeling to program design. The document "*Conceptual Frameworks, Monitoring Components and Implementation of a NPS Long-term Ecological Monitoring Program*" that was prepared for the program review deserves special commendation for both its clarity and depth of knowledge.
- Protocol Review: The USGS staff are commended for their comprehensive protocol review and documentation. Especially important inclusions were the documentation of all review comments and the response to those comments, approvals, metadata, and references and ancillary products.

IV. Recommendations

1. Parks included within the Prairie Cluster LTEM program

   <u>*Background*</u>: The six parks included in the Prairie Cluster LTEM program were selected in 1993 prior to the establishment of the new network strategy for implementing monitoring throughout the NPS, and prior to the establishment of Tallgrass Prairie National Preserve. Scott's Bluff NM and Agate Fossil Beds NM are ecologically more similar to parks in the Northern Great Plains network, and were included in that network when the network strategy was developed. Those two parks, located in northwestern Nebraska, require more than an 8-hour drive from Wilson's Creek NB to do field sampling, and thus present a number of logistical difficulties for the staff based at Wilson's Creek. Meanwhile, there is considerable support to include the newly formed Tallgrass Prairie within the Prairie Cluster LTEM

program, and some initial sampling at TAPR by the LTEM staff has already been accomplished. TAPR is the only NPS unit established specifically to preserve remnant tall grass prairie, and it probably would have been included in the Prairie Cluster prototype proposal had it existed in 1993 when that proposal was written. Conceptually, inclusion of TAPR within the program makes sense because of the opportunity to monitor the effects of grazing on grassland systems. Grazing was identified in the conceptual models as one of the primary drivers of grassland systems, and yet the other parks in the program do not provide an opportunity to learn about grazing impacts.

Recommendations:

- For both ecological and logistical/feasibility reasons, the monitoring effort at SCBL and AGFO should in the long-term be coordinated and administered by the Northern Great Plains network. However, the panel recommends that SCBL and AGFO continue to receive the same level of support for monitoring, and the same sampling protocols and intensity of monitoring should be continued at those two parks to develop long-term data sets, regardless of who actually collects, analyzes and reports the data.
- If Congress provides additional funding through the Natural Resource Challenge to fund vital signs monitoring within the Northern Great Plains network, personnel from that network will eventually be able to conduct field work at SCBL and AGFO and do the routine data management, data analysis and reporting now being conducted by the staff based at WICR. A portion of the funding for the prairie cluster prototype will eventually need to be transferred to the Northern Great Plains network to support the higher level of sampling now being conducted at SCBL and AGFO. Until such time as the Northern Great Plains network is able to assume the monitoring effort at those two parks, the panel recommends that the prairie cluster staff based at WICR continue to sample at SCBL and AGFO.
- For scientific reasons, the panel recommends that Tallgrass Prairie National Preserve be included within the Prairie Cluster LTEM program, provided that additional funding can be obtained to bring the level of sampling at TAPR to the level being conducted at the other six parks without affecting the quantity and quality of monitoring currently being conducted at the six parks. One scenario would be for the Heartland network to transfer funding to the Prairie Cluster program budget that would otherwise be used by network staff to conduct monitoring at TAPR. However, additional funding (the panel estimates approximately $30-40K annually) would need to be obtained from base funds at TAPR or from the Servicewide I&M Program to allow sampling at TAPR to be conducted at the level of intensity of a prototype park. Negotiations with the Heartland network should also include discussions about how vital signs monitoring at George Washington Carver NM (GWCA) and Herbert Hoover NHS (HEHO) will be conducted. Logistically, it makes sense for the staff based at WICR to conduct the fieldwork and do the data management and analysis for those two small parks, although the panel recommends that the level of sampling at those two parks be at the network level of intensity (less frequent sampling of fewer indicators). Thus, the scenario envisioned by the panel would be for the Prairie Cluster staff based at WICR, within additional funding from the Heartland network and some other source, to do sampling at seven prototype parks (the six current parks plus TAPR), plus less intensive and frequent monitoring at GWCA and HEHO. If and when the Northern Great Plains network receives funding for vital signs monitoring, the Prairie Cluster prototype would include 5 parks since

monitoring at SCBL and AGFO would then be done by staff from the Northern Great Plains network.

2. Objectives and Sampling Frame issues

Background: One of the most important tasks in developing a monitoring program is that of clearly defining the specific, measurable objectives of the monitoring. It is also important when designing a monitoring program to make the difficult decision of selecting a few things that are monitored at an intensity and frequency that allows the high-priority questions to be answered, as opposed to trying to monitor too many things and not doing any of them well. The panel felt that the Prairie Cluster LTEM program has done a good job initially of selecting a few things to monitor and establishing credible designs and procedures for monitoring, but there is a concern that some of the objectives are not specific enough and that in many cases there are dual objectives that require very different approaches for design and sampling to address them. The panel was asked several technical questions pertaining to sampling frames and frequency of sampling that related to unclear or overly general objectives for the monitoring. For example, both the Central Monitoring Question identified in the conceptual design document and the specific monitoring objectives for grassland plant communities identify a focus on monitoring long-term sustainability and health of both remnant and restored prairie ecosystems. However, it seems that the monitoring program has dual objectives: (a) monitoring long-term sustainability and health of remnant native prairie patches, and (b) monitoring effectiveness of prairie restoration activities. The objectives and relative weights given to these two broad objectives vary among the 6 park units in this cluster—which is not necessarily a problem so long as it is explicit. Questions of sampling frame, sampling sufficiency, and sampling frequency depend upon the relative importance these two objectives.

Recommendations:

- Each of the monitoring protocols should be reviewed by the LTEM staff and the objectives for each park should be more explicitly stated as specific, measurable objectives. Develop specific objectives for each park unit that identify the need to monitor the overall sustainability and health of remnant prairie patches and/or the specific restoration activities to be monitored.
- After more clearly stating the objectives of the monitoring, develop an appropriate sampling frame and sampling frequency for the monitoring. This is expected to differ among parks. For example, the decision on whether to include sample near edges (boundaries) depends on whether the objective is to monitor core interior prairie areas or to monitor the remnants that exist in the parks including their edges.
- For new monitoring being designed for TAPR, there is an opportunity to design the work to allow park-wide inferences and to account for future, unexpected changes in how the park is managed. A systematic sampling design where sampling plots for different components of the monitoring are collocated is recommended. To allow for long-term monitoring, potential sampling locations could be laid out on a systematic grid independent of any current land use or management considerations (e.g., do not stratify by grazed versus ungrazed pastures), and data from these locations could later be post-stratified to investigate changes relative to changes in grazing, fire and other driving variables. A systematic sample is likely to miss or

under sample less common habitat types and small areas that may be critically important or especially vulnerable. For that reason, the systematic sample should be at an intensity appropriate for the most common habitat types and should be augmented by systematic or random samples of important areas that are under sampled using stratification or unequal probability sampling.

- In cases where the factors regulating the monitoring variable are not well understood, seek funds for additional research to establish those relationships. It is almost always simpler and cheaper to monitor discrete elements of a mechanistic model than those of a black box.

3. Protocol Revision and Augmentation

Background: Protocols are works in progress. It is only natural that when protocols are implemented in the field, those most familiar with that implementation will develop ideas for augmentation or revision of standard protocols to improve efficiency or effectiveness. Furthermore, there is often interest to develop new protocols as new park units are added to the cluster, parks revise their boundaries, or unmet monitoring needs are identified. This process of continual self-examination and adaptation is both healthy and natural. However, it is imperative that adjustments, revisions, or additions of new protocols not jeopardize the long-term value of data sets or otherwise compromise integrity of the program.

All protocols developed to date by the USGS staff have been peer-reviewed. Several examples were given by the Prairie Cluster LTEM staff of their efforts to improve or add protocols to the existing program. Examples include:

- ✓ Examination of alternative sampling frames to improve efficiency of monitoring change in populations of Missouri bladderpod (adaptive sampling).
- ✓ Monitoring vertical structure of prairie vegetation to monitor grazing effects in TAPR.
- ✓ Monitoring plant basal area in TAPR.
- ✓ Development of bird monitoring protocols.
- ✓ Examination of optimal plot size for monitoring changes in plant frequency.
- ✓ Monitoring populations of Topeka shiner.

Recommendations:

- Develop a formal process for developing new protocols, adjusting existing protocols, and accepting modifications to improve responsiveness of LTEM program to changing needs.
- The process should include a procedure for documenting the need for changes and for identifying when a study plan and peer review is necessary (e.g., changes to sampling frame, changes in monitoring objectives that require development of new sampling frame or procedures). Documentation should identify the need for modification or development of new protocols, the proposed sampling frame, duration of the study, collaborators, and peer review schedule.
- Before beginning any new work on protocol development, such as the pilot sampling and protocol development work for monitoring breeding birds, grazing effects in TAPR, and Topeka Shiner (fish communities), the program should require a study plan that undergoes peer review.
- There is a need to develop a procedure for changing protocols and archiving previous versions of a protocol. The NPS has developed a recommended format for what should be

included in a protocol, and this recommended format would include a Standard Operating Procedure (SOP) for changing the protocol.

- When a change is made to a protocol, it is essential that the continuity of the data be preserved so that the situation before the change can be compared with the situation after the change. Often this will require that the new and old protocols be used for a few years so that the differences can be estimated.
- Any protocols developed in the future should follow the outline and recommendations in the document "Characteristics of a good monitoring protocol" available at http://www.nature.nps.gov/im/monitor. Those recommendations and the outline are based largely on work done at the prairie cluster prototype LTEM program.
- In the relational Access database, there should be a field added as part of the Events table that documents which version of a protocol was used to collect the data set, and electronic versions of the various versions of the protocol should be easily accessible so that anyone analyzing the data can see how the data were collected.

4. Staffing

Recommendations:

- The strategy of basing a professional staff at one location, traveling to the various parks to conduct the sampling, and then have a centralized location for data management and report generation is a major factor in the success of the program. There seems to be a certain critical mass in terms of staff size and expertise to allow this level of high-quality monitoring to occur. This strategy should be continued, as opposed to dispersing staff among the parks in the cluster.
- Addition of an aquatic ecologist or fisheries biologist to the staff, although not a necessity, would strengthen the program. All of the parks have an interest in some form of aquatic monitoring, as evidenced by the macroinvertebrate and Topeka shiner projects, but there is no one on the staff with a strong aquatic background. Covering the broad range of ecological concerns with a small staff is obviously difficult and the panel would not recommend diluting the terrestrial expertise. Should an opportunity to add staff occur in the future, however, an aquatic person would be a good choice. In the meantime, the Cluster might consider sharing a position with the Heartland Network to fill this void.
- There was concern among the panel that professional staff were involved in tasks that could better be accomplished using technicians. It is not efficient for professional staff to be conducting regular rote monitoring tasks or entering data in a database when those tasks could be accomplished more cheaply by supervised seasonal or temporary biological technicians (GS-401-5/6/7) following explicit written instructions after training. The best use of professional staff is establishing the monitoring and finalizing sampling and data-collection protocols, supervision, QA/QC, data analysis, and reporting. The argument that a particular monitoring program requires a specific professional intimately familiar with the topic is worrisome, because long-term monitoring will, of necessity, require regular changes of personnel. If sampling cannot be replicated by others, the sustainability of the entire effort is in question.
- One of the roles of the prototype monitoring parks within the new Servicewide strategy for vital signs monitoring is that of mentoring and technical assistance. Prairie Cluster staff have already made an important contribution to initial planning by the Heartland network, and

staff should be given the time and resources to provide technical support to the Northern Great Plains network as well as to the Heartland network.

5. Technical Assistance

Background: The LTEM staff presented the network with several Design and Analysis Issues attesting to their need for continued access to technical assistance and professional expertise. Implementation of a formal procedure for modifying protocols (described above) would also require additional resources for technical assistance.

Recommendations:

- Explore abilities of the Regional Office, CESU, and USGS Research Centers in the region to provide continual support for Prairie Cluster LTEM Program.
- Allocate budget each year out of LTEM to support costs of technical assistance. For example, a small budget could be allocated each year to bring suitable subject matter experts together to visit a high priority design or analysis issue. The exact amount to be budgeted might differ each year, but often $5-10K is suitable for assembling a panel of subject matter experts.

6. Information Transfer

Background: To insure sustained support for the National Park Service's Inventory and Monitoring program, program goals and monitoring results and their implications must be shared with all staff within the NPS, park visitors and general public, and the scientific community. The National Park Advisory Board, in their July 2001 report "Rethinking the National Parks for the 21st Century" stated, "*A sophisticated knowledge of resources and their condition is essential. The Service must gain this knowledge through extensive collaboration with other agencies and academia, and its findings must be communicated to the public. For is the broader public that will decide the fate of these resources.*"

The park superintendents and several other review participants emphasized the need to enhance the exchange of monitoring information with other park staff to increase their understanding and support and for interpreters to incorporate monitoring information in interpretive programs. The review panel also recognized the need to involve scientists from other agencies and academia to participate in the program and to make data readily available for their review and analysis.

Recommendations:

- The review panel concurs that better integration of monitoring results with interpretation is needed. It is a joint shared responsibility of both the LTEM staff and park staffs to discuss and interpret the values of LTEM monitoring data. Monitoring professionals are usually not trained to write reports for the public, but the LTEM staff should continue to strive for relevance and effective communication of monitoring results. The superintendents stressed the need for more products for diverse audiences that would communicate the status and trends of natural resources, demonstrate how NPS is being a good steward of those resources entrusted to them, and explain actions that are being taken to protect them. The LTEM staff

should take the lead in developing draft reports, which could be refined by a professional editor or park interpretation staff.

- Some avenues for communication might include travelling presentations or 'road shows' to parks, or perhaps developing LTEM annual newsletters or a website. Such approaches to communication might focus on interesting stories emerging from interpretation of the raw data, contributions of LTEM monitoring to management issues (meeting the Mission), or any unusual scientific discoveries. Any approach that puts park employees in touch with new discoveries, applications and the people doing the work will benefit the parks, the LTEM program, and many constituents of parks.
- An intranet web site that provides raw data tables, simple data summaries, and short commentaries by investigators on progress and problems of both fieldwork and data collected can be very beneficial and help others in the cluster/network feel "in the loop". Done properly, such a site could also bring in park interpreters who could then incorporate this new information in public presentations.
- Peer Reviewed protocols, annual reports, quality assured data, and LTEM staff contact information should be shared with the scientific community via an Internet site. The intranet and Internet sites could be one and the same with the intranet requiring passwords for access.

7. Data Management and Reporting

Recommendations:

- The overall approach followed by the Prairie Cluster LTEM program for data management, analysis and reporting is excellent, and is a model for parks throughout the NPS. The LTEM staff has been working closely with staff from the Servicewide I&M program and has provided leadership and technical assistance to parks throughout the country. LTEM staff should be provided with the time and resources to continue this mentoring and technical assistance role outside of the Prairie Cluster program.
- The draft Data Management Plan is very well done and provides an excellent overview of the data management system, including database design, the procedures for entering and quality checking the data, hardware and software, and staff responsibilities for analyzing and reporting data from the various monitoring components. The Data Management Plan is a working document that will need to be continually revised to reflect changes in technology and improvements in procedures. The review panel recommends that future revisions of the DMP be made to bring it into the format being recommended for Servicewide use by the NPS Servicewide I&M Program. The new recommended format, which was not available when the prairie cluster began developing their DMP, integrates the needs for a GIS plan and a data management plan, and has a modular design that will make it easier to update and keep current. It is anticipated that parks throughout the NPS will be able to share sections of their DMP with other parks, resulting in a number of efficiencies.
- It is likely that long-term monitoring data will be of considerable interest in the future to researchers, university professors, graduate students, and other cooperators and partners for sophisticated data analysis, synthesis and modeling. The data management plan should incorporate plans and procedures for making data and its associated metadata available to others so that they can assist the parks with improved understanding of their natural resources and their management. One possibility is to make data available over the Internet, or to at

least provide a summary of data sets that are available to others and contact information on how to obtain them.

- The routine reporting interval is 3-5 years for birds and 4 years for plant communities. There should be annual analysis and reporting to provide timely management information.
- To facilitate annual reporting, a database interface should be developed for a statistical package (e.g., SYSTAT) similar to the one they have developed for Arcview. This will allow the automation of statistical analyses, similar to the automation of summary information in Access. Note that after 3 to 5 years it will be difficult to remember how to do the analyses, even with good documentation.
- The excellent Access queries for summarizing data should be web enabled so that parks can access current data. Duplicating and distributing the database to each park will inevitably result in parks using data that has not been updated. Although the LTEM staff should continue to provide summaries, the parks should have the ability to explore and understand their own data.

8. Water Quality and Macroinvertebrate monitoring

Background: There are concerns by managers, regional office personnel, and others that monitoring of macroinvertebrates was not the most appropriate indicator of water quality and was not addressing the most critical management needs of the parks relative to water quality.

Recommendations:

- The Heartland network has received funding from the NPS Water Resources Division through the Natural Resource Challenge to develop a water quality monitoring program. Some of those funds are available to conduct sampling at WICR, HOME, EFMO and PIPE. The Prairie Cluster staff should work closely with the Heartland network during the planning and design of the water quality monitoring program to see if some of the water quality monitoring concerns can be addressed through this new effort.
- The macroinvertebrate protocol itself seems to be fundamentally sound and well-designed to provide long-term assessments, but may not address some of the short-term questions that parks are interested in, such as levels of fecal coliform. 'Real-time' assessments of water quality would require a different approach and are perhaps not the most appropriate focus of a long-term monitoring program. The macroinvertebrate protocol could be broadened to include a few more direct indices of water quality. If the primary threat to water quality is sewage treatment effluent, then it might make sense to measure nitrogen and phosphorus concentrations, as well as conservative ions like chloride or sulfate that provide some index of sewage pollution. Some measure of periphyton biomass or the frequency of nuisance algal conditions would also be helpful. Nutrient measurements would also be informative in streams affected by agriculture, as might turbidity or suspended solid data. This kind of water chemistry could provide a more direct assessment of stream quality and could provide additional context for interpreting the macroinvertebrate data. However, macroinvertebrate monitoring may be important as part of monitoring the stream ecosystem, as well as an indicator of water quality. It should be coordinated with fish community monitoring to assess overall integrity of the stream ecosystem.

9. Topeka Shiner monitoring

Recommendation: The Topeka shiner protocol could be recast as a stream fish protocol. If the entire stream fish community is being sampled, it makes sense to describe the protocol broadly and to emphasize that the entire fish community is being monitored, not just the endangered shiner. The fish community data may be prove more interesting and more valuable in the long run than the shiner data.

10. Butterfly monitoring

Recommendation: A protocol for monitoring butterfly communities as an indicator of prairie health was developed by the USGS, but has not been implemented by the NPS staff because of inadequate funding and staffing and logistical concerns. Although the panel did not conduct a detailed review of the protocol, several panel members expressed concerns about the interpretation of the results because of potential problems with detectibility of butterflies and influence of other factors such as wind, air temperature, and timing of plant phenology on the numbers of butterflies counted. The panel recommends that the protocol not be implemented until someone can conduct additional R&D work on detectibility and work out some of the logistics problems resulting from multiple trips to each park that would be needed to determine the timing of annual sampling relative to plant phenology.

11. Grassland bird monitoring

Recommendation: The panel has concerns about the approach being taken to develop a protocol for sampling grassland birds in at least two of the parks. Steven Fancy has offered to assist in the development of a protocol for monitoring grassland birds that could be used by the Prairie Cluster, but that would also serve as an example of the recommended format, content and database design of a protocol for use by other parks in the NPS. The specific, measurable objectives of the proposed bird monitoring work need to be developed, and no additional field sampling should be conducted until additional technical assistance and peer review of the initial sampling plan has been conducted.

12. Invasive Plant monitoring

Recommendation: The original proposal included plans to develop a protocol for monitoring exotic plants, but this was not done for the reason that "there was not enough time". All of the parks indicated that an exotic plant protocol is needed, and efforts should be made by the NPS staff to develop a protocol for exotic plants. However, because this is a nationwide issue that is being addressed by several agencies, any work on an exotic plant protocol by prototype staff should be a cooperative effort done in conjunction with other NPS vital signs networks and scientists from other agencies or universities working on this same problem.

13. Fire Effects monitoring

Recommendation: Additional efforts should be made to integrate the prototype monitoring effort with the fire effects monitoring program, since both programs collect much of the same data. Several meetings have already occurred, and additional efforts should be made.

List of Participants in the Prairie Cluster LTEM Program Review

Park Superintendents and Resource Managers:

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Denise Germann	Supervisory Park Ranger, Homestead NM
Ruthann Knudson	Superintendent, Agate Fossil Beds NM
Jim LaRock	Superintendent, Pipestone NM
Richard Lusardi	Superintendent, Wilson's Creek NB
Steve Miller	Superintendent, Tallgrass Prairie NPres
Kristen Legg	Natural Resource Manager, Pipestone NM
Rodney Rovang	Natural Resource Manager, Effigy Mounds NM
Gary Sullivan	Natural Resource Manager, Wilson's Creek NB

USGS and university cooperators involved in protocol development:

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Michael Kelrick	Truman State University
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NPS Midwest Regional Office and Heartland Network staff:

Steve Cinnamon	Supervisory Biologist, Midwest Region
Phyllis Adams	Midwest Region I&M Coordinator
Janet Eckhoff	Heartland Network I&M Coordinator

NPS Prairie Cluster LTEM program staff:

Lisa Thomas	Ecologist, Program Coordinator
David Peitz	Wildlife Ecologist
Mike DeBacker	Botanist
Brian Witcher	Data Boy
John Boetsch	Plant Ecologist
Corolla ?	

Honored Guests:

Susan Boudreau	Monitoring Program Manager, Denali NP&P
Gary Williams	Program Manager, Servicewide I&M Program

Review Panel Members:

Steven Fancy	NPS, National Monitoring Coordinator
Paul Geissler	USGS, Statistician and USGS Coordinator for LTEM program
David Graber	NPS, Science Advisor, Sequoia –King's Canyon NP
Ron Hiebert	NPS, Colorado Plateau Cooperative Ecosystems Studies Unit
Kurt Jenkins	USGS, Research Scientist, Olympic NP Field Station
Kirk Lohman	NPS, Regional Science Advisor, Alaska Region