| RESEARCH WORK UNIT DESCRIPTION Ref: FSM 4070 | 1. Number FS-SRS-4803 | 2. Station Southern Research Station |
|---|---|---|
| | 3. Unit Location Research Triangle Park, North Carolina | |

| 4. Research Work Unit Title |
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| Forest Health Monitoring Research |

| 5. Project Leader |
|---|
| Greg Reams, 3041 Cornwallis Road, Research Triangle Park, NC 27709 |

| 6. Area of Research Applicability | 7. Estimated Duration |
|---|---|
| All Problems: Nationwide | Five years |

**8. Mission**

To conduct a program of research to develop, demonstrate, and transfer new forest health monitoring protocols, through basic and applied approaches, for assessing the health and sustainability of forest resources nationwide. Conduct research that results in national-scale databases and reports that address forest health and sustainability, and that help to fulfill Forest Service national requirements in forest assessment and policy arenas.

| Signature | Title | Date |
|---|---|---|
| Recommended: /s/ John F. Kelly | Assistant Director for Research | 6/7/02 |
| /s/ Andrew J.R. Gillespie | Assistant to Staff Director | 6/13/02 |
| /s/ Richard W. Guldin | Staff Director (Lead Staff) | 10 June 2002 |
| /s/ Paul Dunn | Assistant to Staff Director | 1 Jul 2002 |
| /s/ Jimmy L. Reaves | Staff Director | 6-26-02 |
| /s/ Jack B. Waide | Assistant to Staff Director | 6/26/02 |
| /s/ Phil Janik | Staff Director | 6/26/02 |
| Approved: /s/ Peter J. Roussopoulos | Station Director | 7/11/02 |
| Concurred: /s/ Robert Lewis | Deputy Chief for Research | 7/16/02 |

9. Justification and Problem Selection

This document outlines the future direction of forestry research conducted by Research Work Unit (RWU) SRS-4803 of the Southern Research Station, USDA Forest Service. The unit is located at the Forestry Sciences Laboratory in Research Triangle Park, North Carolina and at the Southern Research Station Headquarters in Asheville, North Carolina.  RWU-4803 historically evolved as the National Program Office of the Forest Health Monitoring Program but is now focused on research.  This is the first research work unit description for the new research focus of the unit.

The need to monitor the health of forest ecosystems is expressed in the Forest Ecosystems and Atmospheric Pollution Research Act of 1988 (FEAPRA). This legislation requires the Secretary of Agriculture to conduct such surveys as are necessary to monitor long-term trends in the health and productivity of forest ecosystems. In addition, the United States is committed to assessing the sustainability of the Nation's forest resources in terms of criteria and indicators pursuant to the Montreal Process and the Santiago Declaration, and the Forest Service has adopted the Montreal process as a framework for assessing and reporting the health and sustainability of the nation's forests.

The majority of the data collection to fulfill those obligations is generally conducted by operational monitoring systems managed by Forest Inventory and Analysis (FIA), Forest Health Protection (FHP), and the National Forest System (NFS).  The Forest Health Monitoring (FHM) Program was organized as a national-scale, cooperative State and Federal research effort involving FIA, FHP and NFS, to address the requirements of the FEAPRA legislation, and subsequently to also address national Sustainability reporting requirements.  The FHM Program now contains both operational and research components that fit together in a logical framework for monitoring and assessing forest health. One component is detection monitoring that involves annual examination of various indicators and measurements across a grid of plots and aerial surveys.  The second component is evaluation monitoring that is designed to permit more intensive follow-up investigations of conditions observed during detection monitoring.  The third component is intensive site monitoring that is designed to answer specific cause-effect hypotheses that cannot be resolved by detection or evaluation monitoring.  The last component is research on monitoring techniques which is intended to provide a technically sound and effective basis for detection monitoring, evaluation monitoring, and intensive site monitoring.  RWU-4803 is responsible for research on monitoring techniques for FHM and conducts most research within the context of the national FHM program and its cooperators.  RWU-4803 also conducts research in cooperation with other organizations (e.g., other Federal Agencies) with similar researchable problems, depending on mutual benefits and available time and funding.

There are technical barriers to full compliance with legislative and administrative reporting requirements at national scale, and the mission of RWU-4803 is to conduct the research that is needed to overcome those barriers and improve the quality of monitoring information for assessments.  The problem areas addressed by RWU-4803 recognize the needs to identify and overcome technical barriers in data collection and analysis systems, to improve our abilities to interpret the information, to demonstrate results through research manuscripts and reports, to transfer new technology to operational monitoring systems, and to transfer information about forest health and sustainability to the public.  RWU-4803 provides leadership in national reporting of certain forest health and sustainability indicators, and in developing certain parts of the national monitoring and assessment infrastructure for the Forest Service.

The primary clients are the FHM program including State cooperators, Forest Inventory and Analysis (FIA), Forest Health Protection (FHP), the National Forest System (NFS), and the RPA assessment staff.  A client needs assessment was performed during a Technical Assistance Visit involving approximately 50 stakeholders in September 2001.  The clients identified four priority research problems to support operational monitoring systems in FHM, FIA, FHP, and NFS, and one mission problem to support Forest Service national assessment teams:

1. Develop key elements needed to improve existing systems (e.g., FIA, Aerial Survey, intensive site monitoring, and rapid detection monitoring), and develop new sampling and survey designs, measurement techniques, and estimation procedures
2. Develop protocols to integrate data, models, and interpretation techniques to assess forest health and conduct risk analyses at multiple scales.
3. Develop protocols to utilize spatial analyses and principles of landscape ecology in forest health monitoring.
4. Develop protocols to utilize data from long-term comprehensive monitoring of key ecosystem processes and components in forest health assessments.
5. Improve forest health and sustainability reports for national and international assessments (mission problem).

10. Approach to Problem Solution

The research priorities for RWU-4803 are generally decided within the context of the Forest Service goal to monitor and periodically assess a defined set of forest sustainability criteria and indicators.  The approach involves RWU-4803 scientists continuing to work in close cooperation with others (FHM, FIA, FHP, NFS, and others) so that client research needs are more easily identified, and research results more readily transferred.  For example, RWU-4803 scientists serve on clients' technical workgroups and committees, and Forest Service assessment teams, to identify critical research needs and to ensure timely transfer of research results and databases.

No single RWU can possible solve all of the research questions that limit the Forest Service's ability to fully assess the health and sustainability of forest resources nationwide.  Therefore, the research is typically conducted in close cooperation with others.  Based on expertise and interest, individual scientists in RWU-4803 have developed research agendas to address particular client needs, and coordinate their research with other Research Work Units, with operational monitoring systems, and with national assessment teams.  Extramural grants and cooperative agreements are an important element of the approach and are funded as appropriate to supplement the research and reporting capabilities of RWU-4803.  In addition to specific accomplishments planned for each problem area, RWU-4803 prepares research manuscripts and other products to meet GPRA, Forest Service, and Southern Research Station productivity and reporting goals.

Problem 1 –Develop key elements needed to improve existing systems (e.g., FIA, Aerial Survey, intensive site monitoring, and rapid detection monitoring), and develop new sampling and survey designs, measurement techniques, and estimation procedures.

Element A – Develop new measurements and data systems for deployment in existing plot-based monitoring systems.

Improvements to existing monitoring systems are needed to increase their efficiency, and to enhance their utility for addressing new forest health issues.  The integration of the plot component of FHM with FIA continues to be a focus area for the RWU following the consolidation of field plot measurements into FIA.  The FIA program now manages new plot-based measurements that are implemented in forestland.  FIA has dedicated a 1/16 subset of the ground plots in its sampling network for the additional measurements.  FIA is currently in the process of nationalizing a core set of data collection, estimation, processing, storage, and reporting protocols.  Sample design, estimation, and data processing protocols for the new measurements must be compatible with FIA sample design and information management systems.  At the same time, FIA protocols must be consistent with FHM requirements.

RWU-4803 scientists will continue to cooperate with FIA Work Units and others to integrate the plot component of FHM with FIA.  Both programs are working to converge on a consistent annual inventory and monitoring system that satisfies the objectives of both programs.  The expertise of scientists in RWU-4803 is needed to review existing and proposed intensive measurements to evaluate their reliability, efficiency, and utility, to set priorities where needed, and to eliminate gaps and overlaps among protocols following the field plot consolidation. Over the next five years, RWU-4803 scientists will:
1. Develop and pilot test new measurements, procedures, and analysis techniques according to national needs.
2. Develop statistical and analytical procedures for a quality assurance/quality control program.
3. Provide technical expertise on field measurements and data characteristics for the FIA Oracle-based data processing and storage systems.
4. Specify core statistical summaries and other standard program outputs for selected measurements on field plots.

Element B – Develop new sampling designs, measurement techniques, and estimation procedures for non-traditional target populations (e.g., urban and riparian forests), for special surveys (e.g., sudden oak death) and for other environmental conditions that might threaten forest health (e.g., climate, pollution).

This RWU cooperates with other RWUs that are working to develop and deploy new monitoring systems in urban and riparian forests. New sampling designs and estimation procedures are needed to quantify health and sustainability indicators for these systems. The urban forest target population is not currently sampled by existing systems, and simple extension of existing protocols to this population is inefficient because of its unique characteristics. Supplemental procedures are required to sample the urban forest in a way that addresses unique concerns, and permits aggregation of the results with estimates from populations sampled by the other grid and plot designs. The riparian forest is currently sampled by existing systems, but the sample design is inefficient because riparian forests are relatively rare and have a linear shape. In addition, concerns that are unique to riparian forests call for new measurements in this target population. The research needs are similar to those for urban forests.

There is an occasional need by others for expert assistance in developing sampling and survey designs, and in resolving other technical issues, for National surveys of specific pests and pathogens. These needs are usually not predictable, but are urgent when they do arise. For example, RWU-4803 scientists are currently engaged in developing a sample and survey design for a National survey of sudden oak death, and will be called upon later to assess the effectiveness of the survey and to assist in analyzing data.

The approach will be to continue to cooperate with FHP, FIA, and NFS scientists to develop the statistical aspects of these supplemental systems according to needs, and as time and funding permits. In some cases other Federal and State agencies will be clients or cooperators in the research. Over the next five years, RWU-4803 scientists have specific roles in this cooperative research effort that will help to:
1. Provide theoretical and applied statistical support with regard to sample designs and the development of new measurements (for example, in urban and riparian forests).
2. Provide technical expertise as needed and as funding permits to assist in the development of range/grassland monitoring, sudden oak death surveys, Asian longhorn beetle surveys, and other new initiatives.
3. Provide technical expertise as needed and as funding permits to assist in the development of monitoring and analysis procedures for other environmental conditions that threaten forest health, for example climate and pollution.
4. Provide technical expertise as needed and as funding permits to assist in the development of monitoring and analysis procedures for wildlife and invasive species.

Accomplishments planned for Problem 1 over the next five years include:
1. Prepare sampling designs and evaluate their utility (after pilot tests) for urban and riparian forest monitoring systems.
2. Develop sample and survey designs for oak forests at risk to sudden oak death, and other surveys as determined by national needs and available funding.

Problem 2 – Develop protocols to integrate data, models, and interpretation techniques to assess forest health and conduct risk analyses at multiple scales.

To address most forest health and sustainability issues, data must be converted into information by integrating databases, applying models and other analytical tools, and interpreting the results. The problem is complicated not only because of the variety of sample designs, measurement scales, and other features of existing systems, but also because of an inability to interpret existing information with respect to specific criteria and indicators of forest health and sustainability. Solution of this problem will help clients to more fully assess forest health, to better evaluate the causes of changing forest health, and to more accurately predict impacts on the sustainability of

forest resources.

The approach to Problem 2 will be to continue to work through the FHM program to overcome key technical barriers that prevent interpretation and reporting of forest health information at national scale. The results will be applied in forest health and sustainability assessment prepared by RWU-4803 scientists. Over the next five years, RWU-4803 scientists will help to:

1. Develop ecologically relevant thresholds and other interpretive aids that can be used to summarize information about individual indicators in policy-relevant ways.
2. Develop protocols to analyze aerial and ground survey data from FHP.
3. Integrate climate, air pollution, and other information from outside the Forest Service into the analytical capability of FHM.
4. Develop composite indicators of forest condition that combine information from several measurements.
5. Apply advanced modeling techniques to test the significance of observed changes and trends in forest health indicators, and of the differences in indicator status among ecoregions and other large-area assessment units.
6. Develop methods to evaluate data quality and the influence of measurement error on forest health indicators.
7. Develop methods to statistically integrate information from sets of forest health indicators in order to characterize overall condition of ecoregions and other large-area assessment units.

Accomplishments planned for Problem 2 over the next five years include:

1. Develop ways to integrate, analyze, and interpret air quality, soil, land use, and climate data in relation to plot-based and aerial and ground survey databases at National scale.
2. Develop response thresholds for tree crown measurements, and other health indicators as funding permits.
3. Develop a composite crown indicator, and other composite indicators as funding permits.
4. Evaluate alternative methods of estimating crown diameters.
5. Modify published risk models for application to plot and survey data and develop or revise risk maps for insects and pathogens, exotic plants, and other key forest health issues.
6. Provide technical approaches and models that can be used to integrate information from all indicators in national health and sustainability reports and assessments.

Problem 3 – Develop protocols to utilize spatial analyses and principles of landscape ecology in forest health monitoring and assessment.

While the science of landscape ecology developed in North America from the recognition of the need for ecosystem ecology to directly address processes operating in the spatial domain, the phrase is sometimes applied to any approach that adopts a larger-scale, longer-term, or more encompassing perspective than is usually considered by ecologists. Both considerations are part of the RWU-4803 research problem. Increased understanding of how to measure and interpret spatial patterns, and interactions between natural and anthropogenic patterns and processes at large spatial scales, directly contribute to national-scale assessments of biodiversity, climate change, water quality, hydrologic analysis and flooding, and economic and land use change. The production and distribution of national databases of landscape pattern indicators directly contributes to forest health and sustainability assessments, and encourages cooperative research to examine the implications of landscape change on specific forest resources.

The research in this problem area is focused on identifying, developing, and testing new indicators of spatial pattern that are related to ecological processes at multiple spatial scales. The approach emphasizes cooperative research with others, and primarily uses existing spatial databases (for example, satellite imagery, land-cover maps, and road maps) that are supplied at

little or no cost by others.  The research yields new indicators, databases and analyses that directly contribute to national FHM assessments and Forest Service Sustainability reports.  The databases are also distributed to the public and other researchers for additional uses.  All research in this Problem area is coordinated with other Agencies, non-government entities, and University researchers as described in Section 11.

Accomplishments planned for Problem 3 in the next five years include:
1. Produce and interpret forest fragmentation and other landscape pattern indicators for all National-scale FHM, RPA, and Sustainability Assessments, and for selected regional and national assessment efforts by other Agencies and non-profit groups as time and funding permits.
2. Develop and demonstrate landscape pattern indicators to address wildlife habitat availability and suitability, including distance measures, hierarchical scaling measures, and others, in support of the Forest Service requirement to report on the sustainability of biodiversity in forested ecosystems.
3. Develop and demonstrate models to evaluate relationships between forest patterns and the sensitivity or vulnerability of forest health to future natural and anthropogenic disturbances and stresses.
4. Continue to produce, maintain, and distribute the National Land-Cover Pattern Database, including (a) updating the Database using the NLCD 2000 National land-cover maps that are being produced by an Interagency Consortium, and (b) producing new maps of forest fragmentation indicators that incorporate information from National road maps and other information.

Problem 4 – Develop protocols to utilize data from long-term comprehensive monitoring of key ecosystem processes and components in forest health assessments.

FHM and other monitoring systems will sometimes identify health problems that have no apparent cause, and/or will be unable to resolve the practical importance of observed changes through follow-up evaluations and investigations.  In that case, research will be needed, and intensive monitoring of key ecosystem components and processes is often helpful for understanding the detail mechanisms of forest health.  The FHM strategy includes intensive monitoring of representative sites to help resolve these kinds of research questions.  In addition, process-based monitoring can provide data to address certain aspects of Problems 1 and 2, for example, the development of mechanistic models and analytical techniques, the identification of measurement thresholds and appropriate measurement scales for forest health indicators, and the identification of integrative processes in ecosystems that might warrant additional measurements in operational systems.

Scientists from RWU-4803 help FHM in research planning including establishing criteria for the selection of monitoring sites, deciding variables to be recorded and frequency of measurement, and coordinating research among participants.  The concept is now being tested in the Delaware River Basin where a field test is attempting to link all phases, intensities, and purposes of monitoring in a relatively small area.  In this study, total carbon, calcium export to streams, net primary productivity, and hemlock wooly adelgid risk are being evaluated for three physiographic regions.   The Delaware River Basin Study is also a test of the framework for ecological research established by the Committee on Environment and Natural Resources (the CENR framework) and involves the Northeast Research Station, the U.S. Geological Survey, and the National Park Service.  RWU-4803 will assist in developing the FHM research strategy for intensive site monitoring, and will cooperate with others to expand intensive site monitoring to other geographic locations as time and funding permits.

Accomplishments planned for the next five years include:
1. Complete the Delaware River Basin study and evaluate the results as a proof-of-concept for FHM intensive monitoring.
2. Prepare a research strategy for future FHM intensive monitoring in other geographic

locations.
3. Conduct additional pilot tests or technology transfer projects as funding permits.

Mission Problem.  Improve forest health and sustainability reports for national and international assessments.

The United States is committed to assessing the health of the Nation's forest resources in terms of 7 criteria and 67 indicators pursuant to the Montreal Process and the Santiago Declaration. The Forest Service has adopted the Montreal process as a framework for assessing and reporting the health of the nation's forests.  As a result, FHM national technical reports are organized to address those criteria and indicators for which FHM data are applicable, and the research conducted by RWU-4803 is designed to improve that reporting capability.  A consistent set of indicators and format for presenting status and change information is needed so that FHM data can be used for many other reports.  In this way FHM information will not only contribute to Forest Service national and international assessments, but will also be made available to other State and federal clients that have adopted the agreed-upon indicators.

The Mission Problem provides guidance for research projects in each of the other four Problem areas, and there are two parts to achieving this: (a) identify gaps (e.g., new types of measurements, new ways of analyzing data) for specific criteria and indicators of forest health and sustainability, and; (b) demonstrate effective means to present and communicate research and assessment results.  Whereas all of the research problems described earlier are about collecting and analyzing data to address different aspects of forest health and sustainability once the indicators have been decided, the Mission must also consider which criteria and indicators should be considered at all, and how the research results can be better interpreted and communicated with respect to Forest Service health and sustainability reporting requirements.

RWU-4803 is currently focused on two Montreal process criteria -- Conservation of Biodiversity, and Maintenance of Forest Ecosystem Health and Vitality – and has a leadership role for those criteria and for several indicators that support those criteria.  Other criteria and indicators are being addressed according to national needs and available funding, including the criterion of Conservation and Maintenance of Soil and Water Resources and related indicators.

Accomplishments planned for the next five years include:
1. Coordination tasks as necessary for Forest Service national reports on two Montreal process criteria (Biodiversity and Forest Health).
2. Data analysis and interpretation as necessary for National sustainability reports of five specific indicators: (a) forest types in different types of protected status, (b) fragmentation of forest types, (c) forests affected by processes or agents beyond the range of historic variation, and (d) forest land subjected to levels of specific air pollutants, and (e) forest land with diminished biological components indicative of changes in fundamental ecological processes.
3. Identify and prioritize indicators and data sources to fill gaps and improve existing capability to address criteria and indicators of biodiversity and forest health.
4. Produce National Reports on Forest Health as a product of the FHM Program.
5. Produce additional National or Regional reports as required and funded in response to National needs.

Environmental Consideration:  Research is generally conducted in an office environment, is expected to have no impact on soil stability, water quality, or sensitive resource values, and is therefore covered under FSH 1909.15 Section 31.1 categorical exclusion as outlined in the WO Amendment dated September 21, 1992.  If a particular study involves fieldwork then environmental concerns will be evaluated within individual study plans.  If needed, Environmental

Assessments or Environmental Impact Statements will be prepared with and approved by cooperating District or Forest Staffs.

11. Staffing

Scientists from RWU-4803 typically cooperate with other Forest Service personnel to complete the research and assessment tasks. The reasons are that the research problems addressed by the RWU are usually large and complicated, and closely linked to operational monitoring and assessment systems, and as a result they cannot reasonably be solved in isolation from other researchers or clients. Research issues and strategies are coordinated with other entities that have national scope including FHM, FIA, FHP, RPA, and NFS. Research pertaining to specific pilot tests is coordinated with the other entities involved in those tests. For example, research related to the urban forest pilot test is coordinated with the Northeast Area of FHP and RWU-4952 (NE), the riparian pilot test is coordinated with NFS Region 1, the Delaware River Basin study is coordinated with the Northern Global Change Research Program (NE), and all research pertaining to plot-based measurements and data systems is coordinated with FIA work units nationwide. Assessments are coordinated with the RPA assessment staff (WO). National reports on sustainability are coordinated with the RPA assessment specialist workgroup (all regions), with FHTET (Forest Health and Vitality) and with RMRS (Biodiversity). National forest health reports involve coordination with and contributions from FHM, FIA, and FHP specialists nationwide. Technical assistance is often provided to Research Work Units and others nationwide for specific and short term needs.

Extramural cooperation with other Federal Agencies, non-governmental organizations, States, and University researchers is also an important element of the research approach. RWU-4803 hosts a significant research presence from North Carolina State University, through a Cooperative Agreement. The University group works with RWU-4803 scientists to produce National reports of forest health, drawing on databases such as FIA, FHM, FHP, and extramural sources. Both FHM and FHP rely on the group as the mechanism for obtaining national reports of particular interest to them. The University group also contributes assessment reports to meet Forest Service sustainability reporting requirements for four of the five indicators listed in the Mission Problem. The co-location of University personnel has enhanced the research atmosphere surrounding RWU-4803, and facilitates training students in the field of forest health monitoring and assessment.

RWU-4803 also engages in more specific and shorter-term Cooperative Agreements with Universities as necessary to solve specific problems. For example, a Cooperative Agreement with Virginia Polytechnic Institute and State University is designed to facilitate process modeling to support the establishment of threshold indicator values for some plot-based mensuration measures.

The Landscape Ecology research problem is closely coordinated with other Federal Agencies, particularly the Environmental Protection Agency, and University researchers. RWU-4803 currently receives funding from the EPA to develop spatial pattern indicators (e.g., distance measures of forest fragmentation) that benefit Forest Service reports as well as EPA's National reporting requirements. A RWU scientist is a member of the core research team of the EPA Regional Vulnerability Assessment Project that is developing and testing over a dozen data integration methods. A related Cooperative Agreement with North Carolina State University is pilot-testing urban landscape indicators and the efficacy of urban forest reserves in sustaining biodiversity. RWU-4803 scientists have a leadership role in the Interagency Center for Landscape Pattern Analysis, an informal consortium and discussion group in the Research Triangle Park area that also includes members from US Geological Survey, EPA, and NC State University. Through this mechanism, scientists from RWU-4803 participate in, and receive the benefits of, research that covers a wide range of topics that are of interest to forest health and sustainability assessments, e.g., interaction of spatial pattern and atmospheric dynamics and air pollution, the relationship of water quality to forest fragmentation in watershed-based

assessments, the effects of measurement error on the reliability of landscape pattern measurements, the role of landscape position in disturbance ecology, and urban forest landscape characterization.

RWU-4803 currently has five FTEs, one of which is an administrative support FTE. The base FY02-03 research budget of $1100K is supplemented in 2002 by FHM and other sources to support co-located university scientists and other extramural research. $800K of the base research budget supports the five staff members, and $300K supports additional research projects such as process level monitoring. The following table shows the breakdowns of scientist years and base research budget by problem area for the next five years.

The base budget increases to $1460K in FY04-06 if two FTEs are added. One new FTE would be focused on improving national assessments (Problem Area 5) and the second new FTE would be focused on improving the interpretation of forest health data (Problem Area 2). The additions would more equitably distribute lead responsibility for problem areas among available scientists.

The following information is provided about current and future staff expertise:
William Bechtold, Research Forester, Mensuration and data systems.
William Smith, Quantitative Ecologist, Statistics and modeling.
Kenneth Stolte, Ecologist, Interdisciplinary ecology.
Kurt Riitters, Ecologist, Landscape and quantitative ecology.
Future FTE #1, Assessment science.
Future FTE #2, Spatial statistics and modeling.

Future personnel requirements above FS FTE limits will be met through graduate students, temporary post-doctoral positions, and expansion and/or addition of Cooperative Agreements with Universities. Temporary technician positions may be required on occasion depending on the specific needs of research clients.

Distribution of FS scientist years by problem area, and RWU base budget through the five-year term.

| Research Problem Area And Lead Scientists | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|
| P1 (A) Improve existing monitoring systems Bechtold | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| P1 (B) Sampling and survey design Smith | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| P2 – Databases, models, analyses, interpretation Smith (until 2004) | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| P3 – Landscape ecology Riitters | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| P4 – Intensive site monitoring Stolte | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Mission – Improve national assessments Riitters (until 2004) | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| Total FTE | 4 | 4 | 6 | 6 | 6 |
| Scientist cost at $180K per FTE ($K) | 720 | 720 | 1080 | 1080 | 1080 |
| Support cost, 1 FTE ($K) | 80 | 80 | 80 | 80 | 80 |
| Total RWU staff cost ($K) | 800 | 800 | 1160 | 1160 | 1160 |
| Research project funding ($K) | 300 | 300 | 300 | 300 | 300 |
| Total RWU budget ($K) | 1100 | 1100 | 1460 | 1460 | 1460 |