

STIR SCIENCE SERVICES

policy – strategy – evaluation – management

National Collaborative Research Infrastructure Strategy

Report on

5.11 Development of the Terrestrial Ecosystem Research Network:

Science Case and Next Steps

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Contents

	Page
Preface	3
1. Summary and Recommendations	4
2. Introduction	7
3. National Significance of Ecosystem Research and NCRIS Investment Priorities	10
4. Context and Concept for NCRIS Investment in Research Infrastructure	18
5. Development of an Investment Plan	19
Attachment: Consultation List	22

Preface

The NCRIS Secretariat has requested development of this 'strategic planning paper' on the Terrestrial Ecosystem Network (TERN) for consideration by the NCRIS Committee on February 28th. The paper encompasses a restating of the science case as well as a proposed way forward for possible development of the capability. In preparation of this paper the following activities have been undertaken:

1. Discussion with Dr Phil McFadden FAA (NCRIS Committee member with previous oversight of TERN) and other interested parties regarding NCRIS position on TERN
2. Review of following papers:
 - Australian Ecosystem Observation Network (AEON) – Facilitation Report Volumes 1 and 2; Appendix 13 Learning from NEON and NCEAS
 - Terrestrial Ecosystem Research Network – NCRIS Committee Outcome
 - Draft NCRIS Position Paper – Terrestrial Ecosystems
 - Relevant papers, books and websites pertinent to Ecosystem Research Infrastructure
3. Preparation of draft science case, indicative infrastructure needs and way forward
4. Consultation with interested players on draft report.

A list of those provided with the consultation draft of this report and with whom discussions have been held are listed in the Attachment

1. Summary

The NCRIS Road Map for the Terrestrial Ecosystem Research Network (TERN) envisages a sea change in the way ecological research is conducted in Australia to address the long recognized need for research data, models and outcomes at a national scale to support decision-making in overcoming Australia's myriad and developing environmental problems. The concept is based upon the highly evolved ecological research network that exists in the US which has been underpinned by long term planning led by the National Science Foundation. The NCRIS aim, articulated in the TERN Roadmap, is to facilitate through infrastructure funding the development of a national perspective on ecological research to the long term benefit of the nation. In other words, it proposes to be a catalyst to change the planning and coordination of ecological research at a national level. To date the culture of long term strategic planning in ecological research in Australia has been weak. As a result there is no national framework whereby observations and measurements made at the local level can flow up to provide input to research and management questions at a regional or national level and there is no single agency that has the critical mass to address ecological research questions on a national scale.

The funds available to achieve this aim through NCRIS investment are relatively modest and time limited. Within this constraint it should be possible by carefully targeting investment to promote the collaborative behaviours and lever the formation of long lasting consortia of researchers and institutions. In this way local and regional benefits which are so important to the stakeholders can accrue whilst national needs are met, provided there is due regard for the cultural, institutional and governance arrangements that are extant in Australia. Sustaining and developing this system will be dependent upon a longer term commitment. The TERN Roadmap also gives priority to ecosystem research directed at provision of ecosystem services.

It is proposed that priorities for NCRIS investment in TERN should be:

- **A Governance System** that undertakes long term planning and research coordination with an emphasis on integrative science that serves regional and national goals.
 - This investment is fundamental to any long term capability in integrative ecosystem research on a national scale and is a prerequisite to any on-ground infrastructure investment. There is currently no national mechanism whereby the science community in conjunction with stakeholders can develop the science plans required to inform the infrastructure investments needed to support integrative research.
- **Modeling Capability** with fit for purpose models for addressing 'integrative science' questions and management scenarios **as a national service** to the ecosystem research and environmental management communities.
 - This is a key investment to promote collaborative and integrative research and to bring regional capabilities up to a common standard with benefit to regional and national reporting. There is a urgent need for a test environment to understand the data requirements for systems analysis and integrative research, and to examine scenarios.

- **Data Management System** (including interoperability) for data and information management , discovery and access:
 - This is a key investment to facilitate collaborative and integrative research and management reporting. This issue should be addressed jointly with the Australian National Data System in the Platforms of Collaboration Capability and requires engagement with other national initiatives aimed at establishing standards and interoperability in natural resource management.
- **Site Network** focused on key regionally important ecosystems services as a framework for bring efforts together and facilitate integrative research and integrated observations to nationally consistent standards
 - This is a key investment for establishment of a national framework of ecological research requiring ownership and a workable structure acceptable to the ecological research community. A start only can be made in this capability. Full establishment of this network will transcend the period of this investment.
- **Observation Network** comprising a modern national ecological network for inclusive of the network of sites outlined above :
 - the focus should be on the elements that are common to all natural and production based ecosystems: climate and energy; water; nutrient; and soil, coupled with measurements of primary production This is a connecting layer of infrastructure for the national system.
 - This investment commences the establishment and integration of national ecological observation sites for Australia based on the concepts addressed in the TERN Facilitation Report. A start only can be made in this capability. Establishment of this network will transcend the period of this investment.

The resulting system would therefore have the following characteristics:

- Facilitation of a national ecological information, data and research base from which needed ecological information can be extracted or derived as required.
- Maintenance of viability of this knowledge and resource base is maintained through long term data collection and research that transcends the political currency of particular environmental policy issues. Good strategic planning is crucial therefore to effective operation, particularly in ensuring the appropriate focus and standards of data acquisition and quality are maintained and developed at a national scale in response to research outcomes and needs.

- Relevance is maintained by developing a database and software environment for integrative research and decision support systems based on ecological principles. This will facilitate the provision of ecosystem input to management decisions at all levels throughout the nation.

These characteristics in concert with the NCRIS principles and the TERN Roadmap lead to suggested 'Purpose, Requirements and Principles' to guide the development of TERN and its implementation.

Purpose: *Information and Research Capability for Sustainability of Ecosystem Services.* The real value of TERN will only emerge if systematic repeated data collection continues for a long time to see the full range of responses of ecosystems to natural and anthropogenic change. Sustained streams of data are integrally related to conservation and provision of ecosystem services.

Requirement: Within the landscape and climate context (geo-context), enable and encourage long term synoptic observations and their integration to the benefit of researchers and managers.

Principles:

- Service – TERN is a national system and will provide a service that strategically plans the support for ecosystem research to maximize the contributions of R&D to economic development, national security, social well being and environmental sustainability.
- Modeling and Data Management Capability – TERN modeling and data management capability will be provided as infrastructure to facilitate collaborative and integrative research at all scales of ecosystems.
- Data-streams – Data provided through TERN will be delivered freely, openly in a timely manner. Where practical new and previously established data streams will be provided in near real time. Success will be measured in terms of the quality and quantity of research results produced with TERN data.
- Integration – where appropriate, TERN will deploy observing infrastructure to take advantage of synergies with existing infrastructure in order to contribute to a comprehensive measurement of ecosystems of relevance to national and international programs

Given these principles any TERN investment plan must cover 5 years in order to command the attention of potential participants. However, effectively there will be 3 years remaining of the NCRIS program from any decision to invest. To achieve a 5 year planning period would require NCRIS investment to be predominant in the first 3 years with a co-investment being predominant in the last 2 years.

Providing the priorities and principles outlined in this report are accepted by the ecological research community and the legacy from previous disappointments are overcome it should be possible to develop an investment plan by mid-year 2008. It will

be necessary for a version of this report to accompany the Committee decision as a basis for picking up the facilitation and promulgating the next steps. However there remain significant risks as to whether the level of commitment will be forthcoming to champion the activity and sustain the required activity into the longer term

2. Introduction

The NCRIS Roadmap for the Terrestrial Ecosystem Research Network (TERN) (2006) has summarized the rationale for NCRIS investment in TERN as follows:

Australia's terrestrial ecosystems provide the foundation for our wealth and well-being. These ecosystems have been subjected to human influence from the first arrival of indigenous people. European settlement has led to the substantial expansion of water capture, land-clearing, grazing and agriculture and these have in turn impacted significantly on our ecosystems.

The National Research Priorities reflect the significant environmental challenges facing Australia. Our ecosystems are changing rapidly and are subject to a wide range of processes that could significantly alter their composition and ability to provide critical services. There is an urgent need to further understand the structure and function of ecosystems, and to monitor and predict the impact of management and change including interactions between key drivers of change such as climate change, land-use and habitat change.

While considerable effort is being invested in understanding the natural environment and our relationship to it, existing information remains fragmented in space, time and by discipline. This is limiting the nation's ability to discern and respond to changes in land, water, coasts and biodiversity. Significant gains could be achieved through investment in infrastructure that facilitates the development of an holistic ecosystem perspective that integrates physical, biological and social understanding. State of Environment reporting has also highlighted the shortage of current and long term data and appropriate data infrastructure.

In short, the NCRIS Road Map envisages a sea change in the way ecological research is conducted in Australia to address the long recognized need for research data, models and outcomes at a national scale to support decision-making in overcoming Australia's myriad and developing environmental problems - see Lindenmeyer 2007¹ for recent summary of the issues.

The conceptual framework envisages a nationally coordinated effort comprising:

- hubs to act as the foci for access to infrastructure;
- ecosystem observatories to provide long-term integrated monitoring sites to collect baseline information regarding ecosystem components and enable multi-disciplinary and collaborative research of key sites across Australia;

¹ Lindenmeyer, D. (2007) On Borrowed Time – Australia's Environmental Crisis, Penguin Books in association with CSIRO Publishing 138p

- monitoring networks linked to ecosystem observatories to understand ecosystem responses over a broader scale, and
- a system through the hubs for the collection, preservation and access to both legacy and new data that enables and encourages integrated analysis of ecosystem components

Both the Roadmap and the Facilitation Report 'Australian Ecosystem Observation' Network (AEON) - which presents an idealized, integrated and fully developed system - are based upon the highly developed US system for ecological research which is the product of three decades of work. It is briefly worth considering the US system to provide a context to the actions necessary to commence implementation of an Australian System.

The extract taken from the US Decadal Plan for Long-term Ecological Research² in the accompanying box emphasizes the national coordination and infrastructure funded by the National Science Foundation (NSF) that has been necessary to deliver the US system.

A key feature of the US system is that ecological research has developed under long term strategies developed by the research community in response to the requirements of the major funding body, the NSF.

In Australia this national strategic framework for ecological research does not exist and hence the culture of long term strategic planning for ecological research at the national scale by the research community is weak. Indeed, ecological research is funded by a variety of mechanisms including research grant and environmental program funding by institutions and management agencies at both Commonwealth and State level. This situation has inevitably led to a fragmented approach and a focus on meeting immediate and or regional needs. Under Australia's federal system, state governments have the primary governance responsibility for land management and hence have a significant stake in ecological research driven by the immediate and specific needs of environmental management.

² The Decadal Plan for LTER - Integrative Science for Society and the Environment: A Plan for research, Education and Cyberinfrastructure in the US Long Term Ecological Research Network.
www.lternet.edu/decadalplan/

SUMMARY OF HISTORICAL CHANGE IN US ECOLOGICAL RESEARCH

Ecological research has also changed considerably over this period. Initially, ecological investigations were focused on short-term observations in relatively pristine systems. During the 1960s, the International Biological Program (IBP), modeled on the IGY, moved ecological research into the realm of “big science” (McIntosh 1985) (Figure 1). IBP and other research efforts enabled ecology’s conceptual shift away from

the “balance of nature” to a “dynamic equilibrium” paradigm. The shift was driven, in part, by greater recognition of the importance of natural disturbances and disturbance regimes (Pickett and White 1985, Wu and Loucks 1995). During this phase, the ecological sciences became more integrative, interdisciplinary, and collaborative; the questions being addressed became more complex; and ecological research moved away from its historical focus on what were perceived to be pristine systems (McIntosh 1985, Golley 1993). Larger efforts motivated by the scientific community, such as the LTER program and the National Center for Ecological Analysis and Synthesis (NCEAS), also played key roles in the transition from single-investigator, single-site studies to collaboration, integration and synthesis.

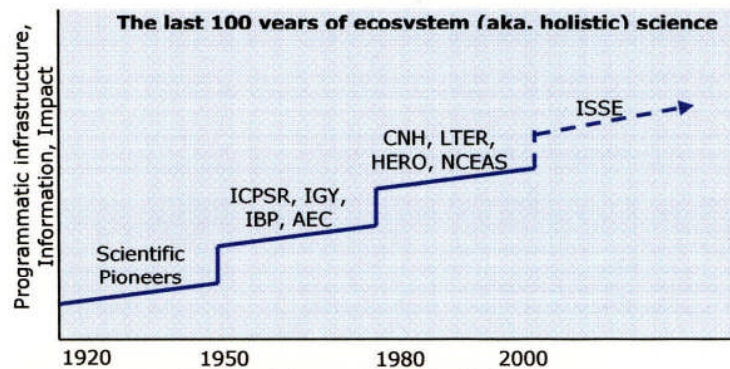


Figure 1. Evolution of the socio-ecological sciences to increasing holism through funding opportunities that led to greater integration within and among disciplines. We envision that the development of the Integrative Science for Society and Environment (ISSE) will be transformative because it will move socio-ecological research to a new level of synthesis and integration.

As has been noted in the TERN Roadmap, the proposed NCRIS investment is relatively modest and short term compared with other funding activities and the long term need.

The NCRIS aim articulated in the TERN Roadmap, is to facilitate through infrastructure funding, the development of a national perspective on ecological research to the long term benefit of the nation. In other words, it proposes to be a catalyst to change the planning and coordination of ecological research at a national level. As has been noted by Lindenmayer¹ in other disciplines this is achieved by national institutions such as Geoscience Australia and the Bureau of Meteorology. To achieve this aim investment has to be carefully targeted to both promote the requisite behaviours and the formation of long lasting consortia of researchers and institutions through which local and regional benefits accrue whilst national needs are met. In so doing it must have due regard for the cultural, institutional and governance arrangements that are extant in Australia.

Whilst this situation represents an opportunity and niche for NCRIS investment, it also represents a threat to successful implementation because the frameworks or design principles, culture and institutions for large scale collaborative science appear not well

established in the Australian ecosystem research community. This contrasts with NCRIS Integrated Marine Observing System (IMOS) and Structure and Evolution of the Continent (AusScope) programs where the design principles for data acquisition and modeling and the pre-disposition to national scale collaboration, data provision and collaborative science existed before the NCRIS program in the major research institutions and research community. NCRIS investment crystallised this pre-disposition and turned them into implementable programs. A key question for the NCRIS Committee and this report follows:

Can an NCRIS investment set the ecosystem research community on a sustainable road to large scale integrated collaborative science?

By focusing on the key investment areas this report considers it is achievable provided the long term institutional commitment is made to sustain the development of the proposed system in the longer term.

3. National Significance of Ecosystem Research and NCRIS Investment Priorities

Ecological research by its nature is place-based and has a hierarchy of scales from site to local to regional to continent-wide (Fig 1) with ecosystem structure and processes being operative and capable of investigation at all scales, provided the access regimes and flow of data and information is structured to allow this to occur. It follows that research and research infrastructure is required at all scales.

This is where a significant gap exists in Australia's research capability and operational frameworks. Only by systematically planning how local data, observations and research results can be cascaded upward as inputs to research, decision-support and reporting at smaller and indeed national scales can maximum benefit be derived from ecosystem research. This further requires agreement as to the sites that form the core of the system and the common monitoring and reporting protocols and standards whilst allowing for additional sites to contribute to the overall system.

NCRIS is explicitly about major, multi-institutional infrastructure and much research and some infrastructure that would be required in such a system is not covered. The NCRIS investment must therefore encourage the integrative aspects of ecological research, but should not attempt to substitute for other funding mechanisms that support or provide the infrastructure for the local or even some regional placed based research.

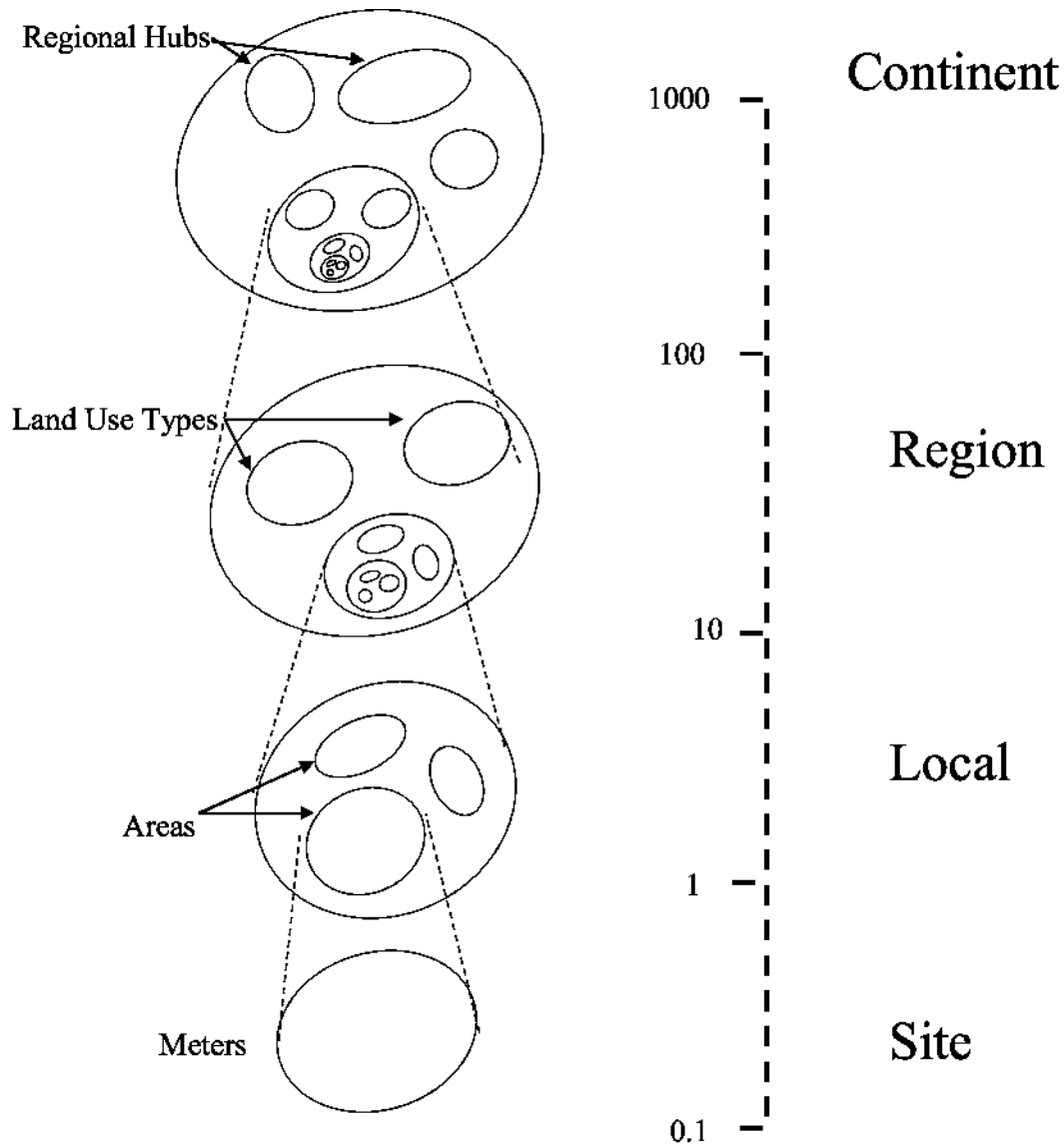


Figure 1. Diagram illustrating the nested hierarchy of patches typical of ecosystems.

(From Gwane et al. TERN Expression of Interest No 11, Australian Ecosystem Observation Network Facilitation Report Volume 2, 16 October 2007.)

It is axiomatic that Australia's natural environment is undergoing severe degradation and that many of its ecosystems are evolving to a different state with unpredictable consequences— see Lindenmayer (2007)¹ for a comprehensive summary. A key feature of the rationale for TERN is the importance given to ecosystem services and the capacity of the environment in the face of this degradation to continue to provide these services to the benefit of the Australian people. So what are 'Ecosystem Services'?

The US Decadal Plan for Long-term Ecological Research² defines 'Ecosystem Services' as the *ecological foundations of society's wealth* comprising the following:

- *Provisioning ecosystem services are the products that people obtain from ecosystems, such as food, fuel, fibre, fresh water, natural biochemicals and genetic resources.*
- *Regulating services are benefits that people obtain from natural regulation of air quality, climate erosion, disease, soil and water quality.*
- *Cultural services are nonmaterial benefits that people obtain from aesthetic, educational, recreational and spiritual aspects of ecosystems.*

Ecosystem services directly support components of human well-being including security, basic material for a good life, health, good social relations, and freedom of choice and action.

Ecosystems services represent therefore the 'environmental capital' of the nation which, if not maintained through investment erodes the foundations of the society's wealth.

Figure 2 from the US Decadal Plan shows the framework for higher level research questions that link traditional ecological research – analysis of community structure and change and the understanding of the functioning of ecosystems - through ecosystems services to human outcomes and human behaviour, which in turn impact upon the structure and function of ecosystems and their evolution. In this construct, humans are ecological agents acting within the system rather than externalities divorced from the system.

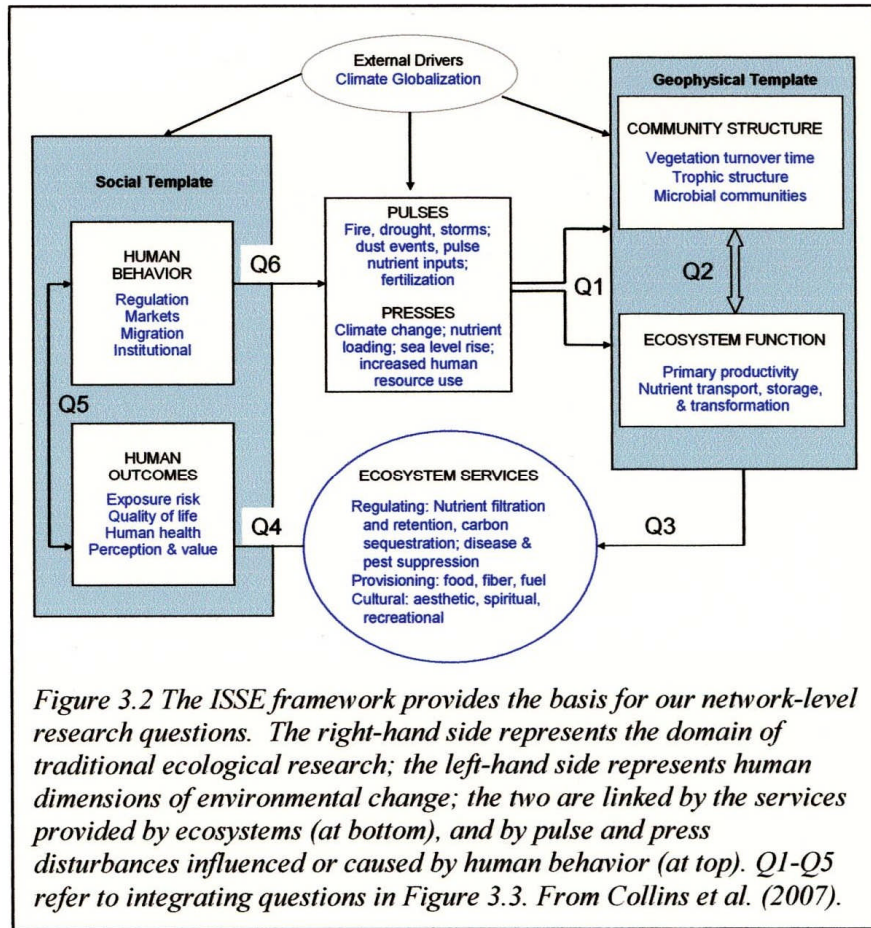
Historically humans have both unconsciously or consciously taken actions that degrade environmental capital – changing the system to their long term detriment. Figure 2 describes the impact of human activities as Pulses – short to medium term events and Presses - long term events that affect Community Structure and Ecosystem Function.

The science that engages in these issues is 'complex systems science' which speaks to natural systems and particularly to ecological, social and economic scales and their interactions³ (Fig 2). The development and application of this science is at an early stage.

The modern management challenge is to take actions that enhance environmental capital – managing for the long term benefit derived from ecosystem services. This framework, suitably adapted for Australian circumstance⁴, underpins the vision that TERN investment is trying to achieve through a higher level of integrative research. However, science that informs management at a regional level is where most impact will be felt.

³ Harris, G. 2007 Seeking Sustainability in an Age of Complexity, Cambridge University Press, 374p.

⁴ Australian environments are quite different from those faced in the US with additional major anthropological impacts due to land clearing, introduced feral animals and changed fire regimes¹



- Q1:** How do long-term press disturbances and short-term pulse disturbances **interact** to alter ecosystem structure and function?
 - Q2:** How can biotic structure be both a **cause and consequence** of ecological fluxes of energy & matter?
 - Q3:** How do altered ecosystem dynamics affect ecosystem services?
 - Q4:** How do changes in vital ecosystem services alter human outcomes?
 - Q5:** How do perceptions and outcomes affect human behavior?
 - Q6:** Which human actions influence the frequency, magnitude, or form of press and pulse disturbance regimes across ecosystems, and what determines these human actions?
- Figure 3.3.** Framework questions; see Fig. 3.2.

Fig 2 Conceptual framework from the US Decadal Plan for Long-term Ecological Research² showing the links between traditional ecological research and the human dimensions of environmental change and associated network questions. The plan shows how this concept can be used to frame questions in all aspects of environmental impacts e.g. Land and Water Use Change

In the past decade there has been a substantial management response to the emerging environmental issues. Investment at the Commonwealth and State level has occurred in a range of programs aimed at assessment and remedial measures, but with no corresponding systematic investment in the science to underpin, assess and measure on a large scale the success, or otherwise, of remedial measures¹. As a result, and as stated in the TERN Roadmap (see Introduction), the information base to assess the state of the environment is significantly incomplete. Much Australian ecological research is focused on the mitigation of degradation and the maintenance of ecosystem services with particular application to environmental management.

A key national requirement is for science to move from merely documenting the demise of the natural environment to providing robust assessments of ecosystem status based on rule – based and climate change models. These can help inform directed management interventions and predictions as to likely outcomes. Catchment Management Authorities and Natural Resource Management Agencies are actively seeking such an approach.

A further important requirement is to progressively engage the very disparate ecological research community and government bodies. This has two purposes. Firstly to expose more of the ecological research and data collection being done within tertiary institutions and government agencies and enable a better understanding of changes and function of Australian ecosystems. Secondly to progressively improve standards and awareness of the requirements for data collection and requirements of integrative research to address ecosystem function at local, regional and national scales.

Given the national significance of these issues, NCRIS investment should give priority to the institutional arrangements, processes and the science infrastructure necessary to initiate a national system for the longer term. These observations and those in the Introduction, in concert with the NCRIS Principles, lead to priorities for NCRIS investment with the following characteristics:

- **A governance system that:**
 - undertakes long term planning and research coordination with an emphasis on integrative science that serves regional and national goals.
 - promotes participation in acquisition and access to regionally and nationally significant data sets to appropriate standards
 - includes appropriate advisory arrangements involving key stakeholders at Commonwealth and State level and engages existing national and regional networks and institutional arrangements.

This investment is fundamental to any long term capability in integrative ecosystem research on a national scale and is a prerequisite to any on-ground infrastructure investment. There is currently no national mechanism whereby the science community in conjunction with stakeholders can develop the science plans required to inform the investments needed to support integrative research.

- **Modeling Capability** with fit for purpose models for addressing 'integrative science' questions and management scenarios **as a national service** to the ecosystem research and environmental management communities.
 - to provide a collaborative environment and infrastructure for modeling ecological systems at a range of scales including management scenarios and cost benefit analysis;

This is a key investment to promote collaborative and integrative research and to bring regional capabilities up to a common standard with benefit to regional and national reporting. There is an urgent need for a test environment to understand the data requirements for systems analysis and integrative research and to examine scenarios.

- **Data Management System** (including interoperability) for data and information management , discovery and access:
 - to provide systems and standards to allow integration and reporting of ecological data including quantitative and qualitative data at appropriate scales.
 - to provide mechanisms for access and brokering access to data. Could include elements of data management already proposed.

This is a key investment to facilitate collaborative and integrative research and management reporting. This issue should be addressed jointly with the Australian National Data System in the Platforms of Collaboration Capability and requires engagement with various national committees working in establishing standards for natural resources data management and state of the environment reporting. There are some synergies with the Integrated Marine Observing System in the handling of qualitative and photographic/video records and in access to remotely sensed data.

- **Site Network** focused on key regionally important ecosystems services as a framework for bring efforts together and facilitate integrative research and integrated observations to nationally consistent standards
 - to provide an environment for integrative natural resources science at agreed nationally significant sites, both informing data needs and making use of data.
 - Informs data needs and makes use of data.
 - Such a network of sites could comprise primary and secondary sites and expand with time.

This is a key investment for establishment of a national framework of ecological research requiring ownership and a workable structure acceptable to the ecological research community. Such a network could include sites identified in the facilitation process, such as the Lower Murray- Soil, water; SE Queensland -

Peri-Urban Pressure; SE Australia-Forests, clean water; SW Western Australia – farmed fragmented systems, salinity; Alice Springs Darwin Transect – a natural climatic gradient and existing Long Term Ecological Research Sites. The national purpose of such sites requires further debate. A start only can be made in this capability. Full establishment of this network will transcend the period of this investment.

- **Observation Network** comprising a modern national ecological network (Fig 3 for example) inclusive of the network of sites outlined above :
 - the aim is to build on pre-existing capability to provide infrastructure for provision of data streams that facilitates integrative research and research outcomes at the regional and national scale in response to the national needs. The infrastructure is whatever is required to produce the data stream – hardware, software and operational support.
 - the focus should be on the elements that are common to all natural and production based ecosystems: climate and energy; water; nutrient; and soil, coupled with measurements of primary production due to its importance to ecosystem services. This is a connecting layer of infrastructure for the national system.
 - the design and resource requirements of individual observation sites will require extensive work.

This investment commences the establishment and integration of national ecological observation sites for Australia based on the concepts addressed in the TERN Facilitation Report. A start only can be made in this capability. Establishment of this network will transcend the period of this investment.

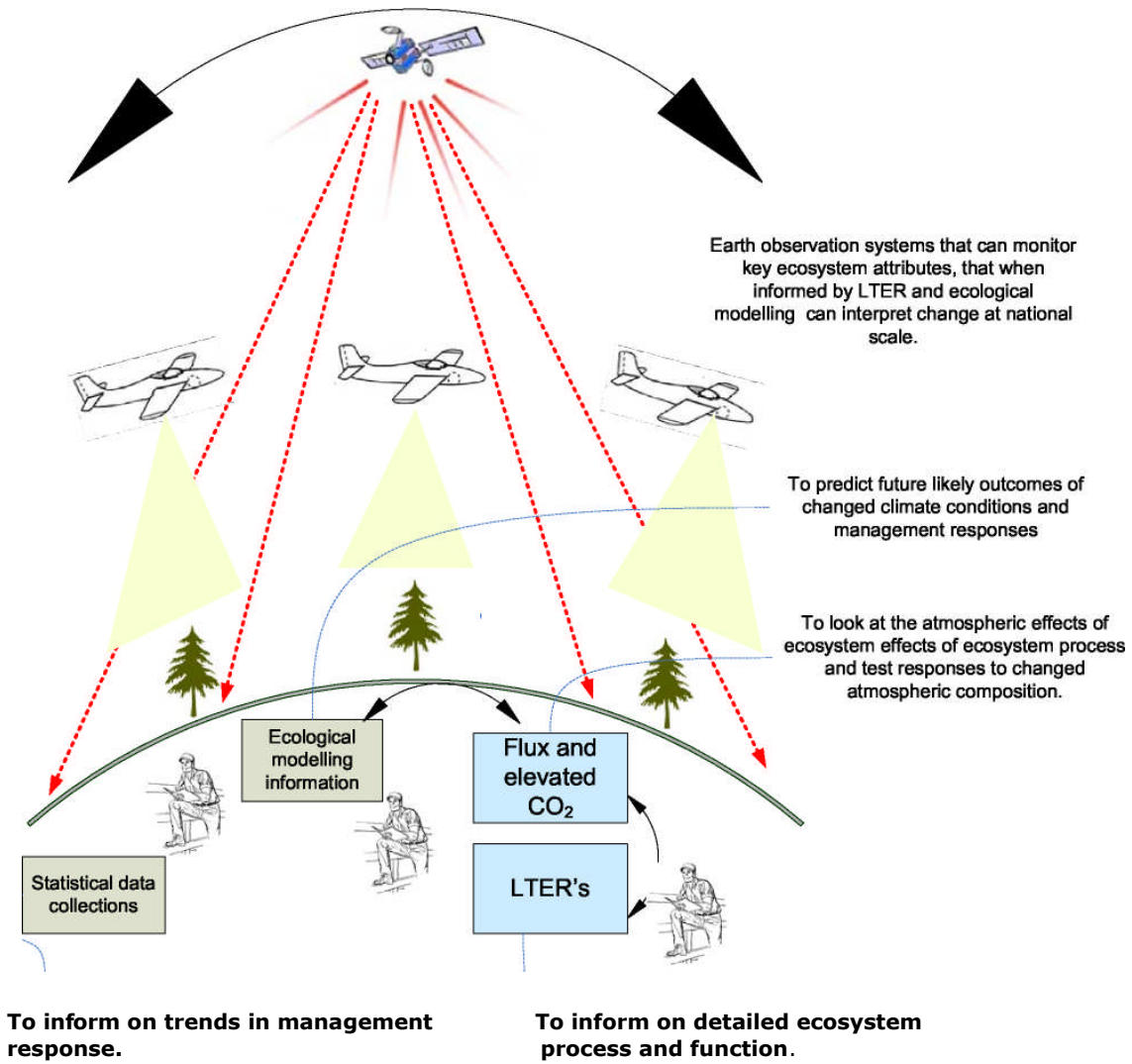


Figure 3. A schematic representation of the data sources that could be housed within TERN to position Australia to respond to climate change. (from comments on TERN Facilitation Report, January 2008, Department of Climate Change)

4. Context and Concept for NCRIS Investment in Research Infrastructure

As mentioned in the Introduction the aim of NCRIS investment in TERN is to facilitate, through infrastructure funding, the development of a national perspective on ecological research to the long term benefit of the nation. The resulting system would therefore have the following characteristics:

- Facilitation of a national ecological information, data and research base from which needed ecological information can be extracted or derived as required both for research and management.
 - it is necessarily a long term endeavour to follow the evolution of ecosystems and responses through time.
 - ecological information 'has both local and universal significance. It pertains to a specific place in a specific country, as well as to the global corpus of scientific knowledge. It is part of the knowledge base concerning the nature and present state of the country'⁵
- Maintenance of viability of this knowledge and resource base is maintained through long term data collection and research that transcends the political currency of particular environmental policy issues. Good strategic planning is crucial therefore to effective operation particularly in ensuring the appropriate focus and standards of data acquisition and quality are maintained and developed at a national scale in response to research outcomes and needs.
- Relevance is maintained by developing an a database and software environment for integrative research and decision support systems based on ecological principles to facilitate the provision of ecosystem input to management decisions at all levels throughout the nation.

These characteristics in concert with the NCRIS principles, the TERN Roadmap lead to a suggested Purpose, Requirements and Principles to guide the development of TERN and its implementation.

Purpose: *Information and Research Capability for Sustainability of Ecosystem Services.* The real value of TERN will only emerge if systematic repeated data collection continues for a long time to see the full range of responses of ecosystems to natural and anthropogenic change. Sustained streams of data are integrally related to conservation and provision of ecosystem services.

Requirement: Within the landscape and climate context (geo-context), enable and encourage long term synoptic observations and their integration to the benefit of researchers and managers.

⁵ This statement is adapted from part of an article by Price RA (1992) National geological surveys: their present and future roles. Episodes 15(2) 98-100..

Principles:

- Service – TERN is a national system and will provide a service that strategically plans the support for ecosystem research to maximize the contributions of R&D to economic development, national security, social well being and environmental sustainability.
- Modeling and Data Management Capability – TERN modeling and data management capability will be provided as infrastructure to facilitate collaborative and integrative research at all scale of ecosystems.
- Data-streams – Data provided through TERN will be delivered freely, openly in a timely manner. Where practical new and previously established data streams will be provided in near real time. Success will be measured in terms of the quality and quantity of research results produced with TERN data.
- Integration – where appropriate, TERN will deploy observing infrastructure to take advantage of synergies with existing infrastructure in order to contribute to a comprehensive measurement of ecosystems of relevance to national and international programs

Given these principles any TERN investment plan must cover 5 years in order to command the attention of potential participants. However, effectively there will be 3 years remaining of the NCRIS program from any decision to invest. To achieve a 5 year planning period would require NCRIS investment to be predominant in the first 3 years with a co-investment being predominant in the last 2 years.

However, it will be essential to obtain Commonwealth /State/Territory buy-in early in the development of an investment plan to ensure institutional commitment for at least the first 5 years and with the intention of commitment for the longer term.

5. Development of an Investment Plan

The limited consultation that has accompanied the development of this report has revealed a significant degree of frustration amongst the research community regarding the progress of the TERN Facilitation and the lack of a tangible outcome, given the time and effort devoted to forming hub proposals. Nonetheless there remains a significant level of enthusiasm in a core group individuals amongst those consulted and indeed the conceptual framework outlined here has its antecedents in discussions held earlier in the facilitation process. However, whilst the governance and data and modeling capabilities are key aspects, there is also a need to ensure researcher engagement through site based support at some level.

It is also clear that there has been in the past a poor understanding of the principles that NCRIS has developed to guide investment decisions. Any further processes undertaken to develop an investment plan must be timely and quickly establish an understanding of the priorities for investment to secure the necessary institutional engagement and regain the confidence of the community at large. There remain significant risks to the development and implementation of TERN.

It is therefore recommended that if the NCRIS Committee agrees to proceed along the lines outlined, a version of this report should accompany the Committee decision as a basis for picking up the facilitation and promulgating the next steps as follows:

- Consultation with Key Researchers only and Federal and State Government agencies to brief them on status and identify potential participants.
 - consultation will be focused on individuals and institutions associated with proposals in the Facilitation Report that best identify with the agreed framework along with government stakeholders. This will be done collectively through the putative hub arrangements.
 - it will also be important to identify potential championing individuals and institutions and other potential participants.
 - it will also be necessary that these activities be transparent to the research community as a whole and provide mechanisms for engagement of interested individuals and institutions.

- Meeting of potential TERN participants to establish an **Investment Framework**
 - requirements of **Governance System** and overall business model including champions (institutional and individual).
 - nature of **Modeling Capability** and **Data Management System**
 - nature of **Site Network** including possible implementation stages and requirements
 - nature of **Observation Network** including possible implementation stages and requirements
 - investment envelopes as a guide for proposals including timing of investment.
 - For example it might be appropriate to delay decisions on investment in the Site and Observation Networks pending initial planning in the Governance System. Alternatively some investments might well be appropriate immediately if the science rationale is sufficiently advanced.

The existing Facilitation Report, Proposals and Inventory of Existing Infrastructure will inform the development of the Investment Framework

- Preparation of investment proposals including co-investments and responsible agencies and individuals against the Investment Framework. This would also need an investment proposal for the Governance System. reconciliation to funds available.

Final 22 Feb 2008

- Finalisation of Governance model and principal players
- Reconciliation to funds available, finalization of Governance Model and completion of Investment Plan
- Consideration by NCRIS Committee.

ATTACHMENT:

**LIST OF RESEARCHERS AND STAKEHOLDERS TO WHOM CONSULTATION
DRAFT WAS DISTRIBUTED AND DIALOGUE HELD**

(Bold denotes where dialogue occurred; italics denotes where feed back was indicated but did not materialise)

ACT

Professor David Lindenmayer – Fenner School of the Environment ANU

**Dr Sally Troy. Ag Assistant Secretary, Environment Research and Information
Branch
Department of Environment, Water Heritage and the Arts.**

**Dr Gary Richards Principal Scientist, Land Management and Special Programmes
Group, Department of Climate Change**

**Ms Jo Mummery Assistant Secretary, Adaption and Science Branch Department of
Climate Change**

Dr Michael Raupach, CSIRO Marine & Atmospheric Research 1

Professor Will Steffen, Fenner School of the Environment ANU

Dr Chris Pigram, Deputy CEO Geoscience Australia

**Dr Roger Gifford; Chair National Committee for Earth Systems Science, Australian
Academy of Sciences**

Dr Neil Mckenzie - Chief CSIRO Land and Water

Queensland

**Professor Peter Grace, Director Institute for Sustainable Resources Queensland
University of Technology**

Professor Hugh Possingham, Director Ecology Centre, University of Queensland,.

Professor Stuart Bunn, Director Australian Rivers Institute Griffiths University,

South Australia

Professor Wayne Meyer, Natural Resources Centre, University of Adelaide

Professor Andrew Lowe, Institute for Climate Change, University of Adelaide

Professor Andrew Parfitt, Pro –Vice Chancellor IT, Uni of South Australia,

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**Professor Mark Adams, School of Biological, Earth and Environmental Sciences
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Dr Ben Gwane, Murray Darling Freshwater Research Centre, Albury

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**Ass/Professor Jason Beringer, School of Geographical and Environmental
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Dr Richard Silberstein, CSIRO Land and Water

A/ Professor Mervyn Lynch, Remote Sensing Centre, Curtin University of Technology

Dr Kingsley Dixon, BPGA WA Government

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Professor Helen Garnett, Vice – Chancellor Charles Darwin University

Dr Lindsay Hutley, Charles Darwin University