

# Submission

## 2016 National Research Infrastructure Roadmap

### Capability Issues Paper

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#### Summary

The Ecological Society of Australia Ltd (ESA, [www.ecolsoc.org.au](http://www.ecolsoc.org.au)) is the peak group of ecologists in Australia, with over 1200 members from all states and territories. The ESA is one of the largest professional scientific societies in Australia, with an impressive 56-year history supporting ecologists, promoting ecology and ecological research. Our members work in universities and other research institutions, government departments, NGOs, private industry and consultancies. More information about our organisation is provided in the 'Other Comments' section at the end of this submission.

As an organisation made up of the 'end-users' of the national research infrastructure, the ESA welcomes the opportunity to comment on the *National Research Infrastructure Capability Issues Paper* ('Issues Paper' from hereon). **We note that for the most part, the Issues Paper deals with high level issues and broad concepts, and so provide our response at this level.** As further plans for the National Research Infrastructure Roadmap are made, we welcome the opportunity to engage further with the Chief Scientist, Expert Panel, and others to provide feedback on detailed plans.

#### Concerns:

**The ESA notes with deep concern that there is a lack of reference to biological and ecological research within the Issues Paper.** Discussion of the 'Environment and Natural Resource Management' capability seems focussed on physical environmental research, overlooking the fact that environments and ecosystems are made up of physical and biological components and that infrastructure is needed to support research addressing *all* of these components. Indeed, a holistic approach to ecosystem research can provide us with critical insights into how ecosystems function and why they change.

We are also concerned by the focus on 'technology' as the primary outcome of national research infrastructure investment. Despite the *Issues Paper* defining infrastructure as 'assets, facilities and services to support research', subsequent discussion seems focussed on specific tools or sensors that may be implemented. In the case of ecology, national datasets (collected by skilled professionals), collaborative networks, standardised methods, models, synthesis outputs and other such 'soft' infrastructure may be the most valuable infrastructure to support innovation and excellence, but this is not currently reflected in the discussion.

#### Recommendations:

We suggest three main points for consideration in the shaping of future research infrastructure to support the 'Environment and Natural Resource Management' capability in Australia:

1. Australia needs a long-term commitment to an enduring national environmental research infrastructure that enables capture of meaningful data about all Australian ecosystems (natural and managed) and the processes within them. This must encompass biological and physical components, and employ appropriate methods at a range of spatial scales (*in situ* to landscape and continent scale).
2. Appropriate education and training for an 'infrastructure-ready' research workforce is vital to leverage the investment in the national research infrastructure to maximum benefit. This includes training to produce the specialist technicians and professionals required to operate and manage infrastructure, as well as training to develop researchers who are equipped to use the infrastructure and its outputs.
3. The existing NCRIS capabilities for environment and natural resource management have enabled significant gains in environmental research and management in Australia. Future research infrastructure investment should build upon on these existing capabilities, and encourage further collaboration and integration across the capabilities.

**Question 2: Are these governance characteristics appropriate and are there other factors that should be considered for optimal governance for national research infrastructure.**

We note 'Collaboration and Networking' as a principle of particular importance, to ensure a more effective 'whole-of-research system response' as called for in the *Issues Paper*. There are numerous public and private organisations and individuals at local, regional, and national levels working in environment and natural resource management. Existing research infrastructure capabilities have established networks that have helped to enhance coordination of activities across this community, for more effective use of resources and increased collaboration. These networks and collaborations form an important part of the research infrastructure in our field, and need to be supported and enhanced in future.

In addition, we strongly endorse 'Frameworks for accountability' and suggest that this also incorporate transparency in decision-making. In the past there was some concern within our membership about the processes by which decisions were made for past investments, and what the purpose of the investment was. In future, improved communication and transparency from the responsible Department, and the capabilities themselves, would do much to allay such concerns.

Both of the above characteristics would be enhanced by establishing infrastructure capabilities as part of independent bodies, or as standalone bodies. Existing arrangements involving complex partnerships amongst university and other institutions are perceived to be confusing, non-transparent, and potentially leading to conflicts of interest between the host-institution's needs and the needs of the infrastructure providers and users.

**Question 5: Should research workforce skills be considered a research infrastructure issue?**

Yes, we believe that workforce skills should be considered in conjunction with future infrastructure plans to ensure that we are maximising the usage of national infrastructure and therefore gaining the most value from the investment. There are three facets to this work:

- (1) ensuring there is an appropriately trained and skilled workforce to manage and operate national research infrastructure. Within environment and natural resource management,

this includes such professions as field technicians, project coordinators, data librarians and managers, knowledge brokers, and science communicators;

- (2) ensuring that researchers have the appropriate training and support to use the national research infrastructure and its outputs; and
- (3) ensuring that Australia retains its investment in education and training of this skilled workforce.

**Question 6: How can national research infrastructure assist in training and skills development?**

- Allocation of dedicated resources within the NCRIS budget or budget of the funded capabilities to support capacity building activities.
- Incentives for research institutions to support training and skills development for national research infrastructure.
- Value the training activities appropriately in the evaluation process and when tallying up the return on investment.
- Provide a more stable funding model so that there can be less 'casualisation' of the professional workforce required to deliver and use the infrastructure.

**Question 7: What responsibility should research institutions have in supporting the development of infrastructure ready researchers and technical specialists?**

Research institutions should be educating and training students and staff for a future career in the sector, and that should include training them to utilise the opportunities awaiting them, including the use of national research infrastructure.

There is an increasing need for properly trained and equipped professional staff and technical specialists to operate national research infrastructure and this should be promoted and supported as a valid career path with appropriate training pathways. This includes such careers as field technicians in a range of specialties, data librarians, science communicators, knowledge brokers and program coordinators.

**Question 8: What principles should be applied for access to national research infrastructure, and are there situations when these should not apply?**

In general, we believe that access to publicly-funded national research infrastructure should be free for merit-based purposes. Fees are a disincentive for uptake, reinforce the inequities of the already well-established research institutions, and do not give researchers at regional institutions the same access to the national collaborative infrastructure.

**Environment and Natural Resource Management**

**Question 18: Are the identified emerging directions and research infrastructure capabilities for Environment and Natural Resource Management right? Are there any missing or additional needed?**

There are two emerging directions identified: 'Integration' and 'Climate and water resources'. We comment on each of these here:

- Integration

The *Issues Paper* focuses on ‘smart data’ and ‘big data’ methods in this section. We agree that these are key parts of the future research landscape, but this direction should go further to address the actual needs of the environment and natural resource management research capability. In order to apply data methods there needs to be appropriate datasets, and so ***there is a need for widespread and well-considered national data collection on Australian environments to generate long time-series of meaningful environmental data.***

We agree that operational data from agencies such as the Bureau of Meteorology and Geoscience Australia provide useful inputs to the environmental research community. However the data arising from these agencies is limited in scope to the physical components of the environment. ***Added to these must be appropriate biological and ecological datasets at the national scale.*** Only by integrating across the full suite of ecosystem data can we undertake the modelling alluded to in the *Issues Paper* that will strengthen our standing as a world leader in ecology, and enable an ability to forecast future trends and events.

***Existing NCRIS capabilities have done a great deal to address the need for national ecological data,*** for example through the extensive ecosystem surveillance monitoring plots (over 500 nationwide) established under the AusPlots initiative of TERN to address critical knowledge gaps in our Rangelands’ ecosystems. We are just starting to see the benefits of these and other initiatives in the existing NCRIS suite, and continuation of such work will only generate more value over time as consistent time-series of data are built up nationwide.

The nation’s museums and herbaria are also critical data inputs and require appropriate resourcing to ensure their continued operation.

In addition to these public datastreams, we are aware of the large body of environmental data collected by private companies, for example biological survey data from environmental impact assessments. Such data could greatly add to the value of the nation’s environmental data collections, if support and incentives were provided for sharing and publication of this data.

The *Issues Paper* refers to predictive modelling to support better decision-making and management of environments. This is commendable and needed, but with appropriate resourcing and planning the nation’s research infrastructure could enable more than this. With expanded investment the national environment and natural resource management research infrastructure could enable measurement and forecast of ecosystem change and vulnerabilities. The move towards such a capability could be first addressed through expanded and ongoing collection of nationally consistent and meaningful environmental data (biological and physical). This data not only enables improved modelling, but effective evaluation of interventions, and continuous improvement of both modelling and management.

- Climate and water resources

It is unclear what is actually being proposed in this section, and there seems to be confusion between what is needed to underpin national research efforts in this area compared to information needed by operational and management bodies to make decisions about, for example, water supply. Like the remainder of the document, this discussion also ***overlooks the need for research into***

**biological and ecological components of the environment, in order to effectively undertake this work.** Our climate and water systems do not exist independent from the living biological world, and there are ongoing interactions and feedbacks between the two.

It is encouraging to see specific mention of coastal ecosystems as part of the emerging directions. As far as we are aware, infrastructure investment so far has enabled collation of existing data resources relating to Australian coastal ecosystems, but has not enabled new data collection or effective integration and use of existing data sets. It would seem that the existing efforts of capabilities such as IMOS could provide a foundation for expansion of national research infrastructure focussing on coastal ecosystems that enables direct collection of *new* data in a consistent manner nationwide to enable research to better understand and manage coastal ecosystems.

We respond to the 'Emerging capability needs' (section 6.2) in the *Issues Paper* here:

The *Issues Paper* specifically mentions alpine, tropical, and desert ecosystems as 'gaps' in the current infrastructure capabilities. We do not support this statement, as these ecosystems are represented in the current infrastructure capabilities, notably through the work of TERN. They are not adequately covered, but neither are any other terrestrial ecosystems due to the chronic under-investment in this capability. ***Alternatively, freshwater ecosystems have been almost entirely overlooked in the research infrastructure investments to date and do represent a significant gap.***

Within this section, the *Issues Paper* highlights Australia's world leadership in marine research yet omits our world leadership in terrestrial ecosystem research as well. This is disappointing and we hope does not represent a bias. As an organisation that represents researchers and practitioners working in all environments – terrestrial, aquatic, marine – we know that our global excellence and leadership applies equally across all of these areas.

***The ESA agrees that the integration of data representing all components of ecosystems (physical and biological) is a critical need moving forward, however as noted above this still requires the collection of relevant and meaningful data on an ongoing basis.*** Indeed, ecology is the study of living things and their interaction with all things around them in an ecosystem, so such capability is fundamental to support ecology research in Australia! We observe that existing NCRIS capabilities are just now maturing to the point of enabling such integration work, and so it is important that their work is continued to enable this emerging direction to be fulfilled.

The *Issues Paper* refers to the development of 'essential environmental variables' (page 23). Many efforts have been made in the past to agree on such concepts, and the Commonwealth Department of the Environment is currently implementing a program entitled 'Essential Environmental Measures for Australia'<sup>1</sup> to advance such a cause. There must be realistic expectations about any such activity, as it is unlikely to ever achieve full consensus on such a set of variables, and a 'one-size-fits-all' approach can only go so far in delivering meaningful environmental data, due to the wide variation in ecosystems in Australia. What is appropriate and meaningful to measure in one ecosystem, can be meaningless in another. The value of 'fit-for-purpose' data collection activities can be seen in outcomes such as the IUCN Risk Assessment of Ecosystems using a process developed and tested by

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<sup>1</sup> See: <https://www.environment.gov.au/science/essential-environmental-measures-australia>

Australian ecological researchers with data from the Long-Term Ecological Research Network of TERN<sup>2</sup>.

***The existing NCRIS capabilities in this field have established data collection programs that reflect the data needs of a large portion of the research community, and finding ways to build upon these efforts should be prioritised over the complete redesign of national environmental data collection activities.***

We respond to the ‘Desirable new capabilities’ (section 6.3) in the *Issues Paper* here:

This section focuses on ‘technology’ – e.g. national sensor networks – in contradiction to the *Issues Paper*’s definition of infrastructure as incorporating assets, facilities and services. While we recognise the opportunities afforded by new technologies – for example camera traps and bioacoustic monitoring of fauna - the proposals here are missing the point of much of what is still needed for environment and natural resource management work in Australia. Much of what we measure in the natural environment still needs to be measured by skilled technicians in the field. While in future some of these functions may be fulfilled through new technologies – once they have been thoroughly tested and verified – there will still always be a need for skilled technicians to undertake field-based data collection, and for skilled technicians to curate data that is collected via sensors and other technology. Ecology is still one field where a world-leading breakthrough can be made by a person with a tape measure<sup>3</sup> and the needs of our research community are not adequately represented by the ‘national sensor networks’ mentioned in the *Issues Paper*.

***The ESA strongly commends Foundations for the future: a long-term plan for Australian ecosystem science<sup>4</sup> as a basis for a national strategic plan for future environmental research capabilities as proposed in the Issues Paper*** (p 24). The ESA and a multitude of other professional bodies, organisations, and individuals were involved in development of this plan that engaged ecosystem scientists and users of ecosystem science from government, university, industry, and NGOs nationwide, working in atmospheric, marine, aquatic, and terrestrial systems. The recommendations of this plan should be integrated into the future planning for national research infrastructure.

**Question 19: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

We are aware of a number of research infrastructure capabilities and projects internationally who have both informal and formal collaboration opportunities. To the best of our knowledge there are existing links between Australia and many (if not all) of these programs, often with the links facilitated by existing NCRIS capabilities:

- Analysis and Experimentation on Ecosystems (AnaEE), Europe
- Chinese Ecosystem Research Network (CERN)
- Committee on Earth Observation Satellites (CEOS)
- COOP+

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<sup>2</sup> See *Austral Ecology* Volume 40 Issue 4, Special Issue on Ecosystem Risk Assessment:

<http://onlinelibrary.wiley.com/doi/10.1111/aec.2015.40.issue-4/issuetoc>

<sup>3</sup> Prof Angela Moles, ‘The future of ecology’, 30 Sept 2015: <http://riaus.org.au/articles/the-future-ecology>

<sup>4</sup> See: [www.ecosystemscienceplan.org.au](http://www.ecosystemscienceplan.org.au)

- DataONE, USA
- European Space Agency
- Fluxnet
- Future Earth
- Global Earth Observation System of Systems (GEOSS)
- Global Ocean Observing System
- Group on Earth Observations Biodiversity Observation Network (GEO BON)
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
- International Long-Term Ecological Research (ILTER)
- IUCN risk assessment of ecosystems
- Japan Aerospace Exploration Agency (JAXA)
- NASA
- National Ecological Observatory Network (NEON), USA
- South African Environmental Observation Network (SAEON)
- UN-FAO
- UN Sustainable Development Goals

**Question 20: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Environment and Natural Resource Management capability area?**

***Australia needs a world-leading environment and natural resource management research capability to ensure our future prosperity and wellbeing. The benefits of such a capability go beyond any one sector of the economy, or innovation pathway, or commercialisation process – they underpin every facet of our future growth and prosperity.***

For example:

- We know (as noted in Appendix 3 of the *Issues Paper*) that the environment and natural resource management capability area underpins at least four of the national research priorities (food, soil and water, resources, and environmental change) and is **the only capability area to do so**, other than the actual underpinning infrastructures.
- Environment and natural resource management features in the nation's Rural Research Priorities<sup>5</sup>, and multiple industry and peak bodies have identified critical future needs for environmental information and research to enable improved business planning and decision-making, especially in response to a changing climate<sup>6</sup>.
- At least the last three National Defence White Papers have identified the changing climate as a key threat that will impact our national security, calling for improved capacity to forecast and plan for coming change and extreme events<sup>7</sup>.
- Leading public health researchers and organisations are calling for improved environmental forecasting to enable better understanding of future climate scenarios and how they will change spread of disease, incidence of extreme events such as heatwaves, and more<sup>8</sup>.

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<sup>5</sup> <http://www.agriculture.gov.au/ag-farm-food/innovation/priorities>

<sup>6</sup> e.g. <http://www.dairyaustralia.com.au/Industry-information/Research-and-development.aspx>, <http://www.mla.com.au/research-and-development/Environment-sustainability/>

<sup>7</sup> <http://www.defence.gov.au/WhitePaper/>

- Numerous UN-led initiatives call for improved data, knowledge, and forecasting capability to understand and respond to ecosystem processes and change, including the Sustainable Development Goals, Convention to Combat Desertification, and Convention on Biological Diversity.

***Even at a glance, this uncomprehensive list shows that the environment and natural resource management research capability is a non-negotiable pillar to uphold the nation's future growth and prosperity.***

***We also know that Australia has the 'brains trust' to deliver on the environment and natural resource management research needs of the future.*** For example, in the 2015 Excellence in Research Australia rankings 26 out of 34 units of assessment under the two-digit 'Environmental Sciences' field of research were ranked as above or well-above world standard, while 49 out of 53 four-digit UoE's were ranked as above or well-above world standard<sup>9</sup>. For the four-digit 'Ecology' field of research, 19 out of 24 UoE's were ranked as above or well-above world standard<sup>10</sup>. In addition, we know that Australian researchers in the fields of environment and ecology are highly-cited globally, making up 8.3% of the world's highly-cited authors in these fields (cf 3.8% for Engineering, or 0.0% for Physics)<sup>11</sup>.

***The need is real, and we have the talent to take up the challenge. What remains is for the nation to institute the right systems and processes to leverage this human capital into benefits for the future. The nation's research infrastructure – encompassing assets, facilities, and services – is a key foundation in that process.***

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<sup>8</sup> e.g. <https://www.science.org.au/supporting-science/science-sector-analysis/reports-and-publications/climate-change-challenges-health>

<sup>9</sup> See: <http://www.arc.gov.au/era-reports>

<sup>10</sup> See: <http://www.arc.gov.au/era-reports>

<sup>11</sup> Summary data: <https://mickresearch.wordpress.com/2015/12/04/ecology-and-environmental-sciences-star-in-era15/>, raw data: <http://hcr.stateofinnovation.thomsonreuters.com/>



## **National Security**

### **Question 29: Is there anything else that needs to be included or considered in the 2016 Roadmap for the National Security capability area?**

At least the last three National Defence White Papers have identified the changing climate as a key threat that will impact our national security, calling for improved capacity to forecast and plan for coming change and extreme events. The need for an enhanced environmental and natural resource management capability should be considered as part of the research needs for national security.

### **Other comments**

Further information about the ESA:

### **Aims of the ESA:**

The Ecological Society of Australia aims to:

- To promote the scientific study of all organisms in relation to their environment.
- To promote the application of ecological principles in the development, use and conservation of Australia's natural resources.
- To advise governmental and other agencies in matters where the application of ecological principles may be of assistance.
- To foster the conservation and ecological management of native biota, their diversity, ecological function, and interaction with the environment.
- To facilitate the dissemination and exchange of ideas and information about ecology both among ecologists, with other professional disciplines and the public; and encourage high professional and ethical standards among our members and other ecologists.

### **DISCLAIMER**

The Ecological Society of Australia has prepared this submission in consultation with members in response to the *National Research Infrastructure Review Issues Paper*. However, this submission may not necessarily reflect the views of all individual ESA members.