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Supplementary Material

Challenges, solutions and research priorities for sustainable rangelands

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Table S1. Survey questions

Table S2. Summary of key challenges and potential solutions related to R&D identified in survey responses received prior to and during the conference.

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Table S1. Survey questions

Q1	How would you describe your role in rangelands? Possible answers: Practitioner; Researcher; Government; Non-government organization or charity; Industry; Other (please specify). The rationale for this question was to be able to assess potential differences in attitude among those surveyed.
Q2	How would you define your career stage (early, mid, late)? Possible answers: Early career (0-5 years in relevant role); Mid career (5-15 years in relevant role); Late career (more than 15 years in relevant role). The rationale of this question was to be able to assess possible shifts in perceived challenges / priorities according to level of insight.
Q3	How would you rate your understanding of rangelands on a scale from 1 to 5 (low to high)? The rationale of this question was to be able to assess possible shifts in perceived challenges / priorities according to level of insight.
Q4	Identify 3-5 key challenges facing rangelands that you believe are critical to prioritize to ensure long-term sustainable use of rangelands and healthy rangeland communities. The rationale of this question was to identify perceived challenges among those surveyed.
Q5	Identify, if you can, how you would address the challenges you outlined above. The rationale of this question was to identify potential solutions to the perceived challenges among those surveyed.
Q6	In your opinion, do you think we have the technological resources and political frameworks to address these challenges? Possible answers: 'Yes', 'No'. The rationale for this question was to provide insight into whether there is a need to develop new resources and/or legislation, etc.
Q7	Please identify 3-5 research questions that in your opinion should be prioritized to improve our knowledge of rangelands and how to better manage both the rangelands and their human communities. The rationale of this question was to identify potential key research priorities.

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Table S2. Summary of key challenges and potential solutions related to R&D identified in survey responses received prior to and during the conference

Colour-coding matches scaling opportunities in Figure 1

Sub-theme – issue or challenge	Proposed 'solutions'
1. Frame the Outback for the future	Promoting a whole-of-system approach promoting a positive perspective of rangelands
	Promoting a 'sustainable production/rangeland/organic' brand – "Click and tell" technology to take-home food/other products with an Outback story
	Reconnect consumers to our food and other production systems
	Learn WITH Aboriginal people as part of a shared living culture to establish and maintain resilience, connecting all people with an Aboriginal approach to belonging on the Australian landscape
2. Support policy decisions relevant to the Outback in the face of contentious complex issues	Establish an Outback commission with diverse stakeholders to help co-design relevant research that will support transformation towards a resilient Outback
	Task the Outback commission to help navigate contentious issues such as the net pros and cons of different mining activities, and other areas affecting social licence to operate
	Ensure community engagement in Outback commission activities
	Develop and fund research that is more relevant to informing outback policy, avoiding perverse incentives and supporting community resilience, across the range of policy areas such as drought management, carbon farming, etc
	Support internet connectivity in the Outback for small business and learning, and enable small communities to provide telecommuting back up for city-based businesses post-COVID 19
	Create a role for outback-savvy scientific knowledge brokers, and support them with good science communication
3. Understand and target critical changes in rangelands, identifying where they are likely to occur in a spatially explicit way	Identify key threshold levels for productive landscapes, and develop robust indicators to monitor these tipping points
	Develop an understanding of the consequences of interactions among global change drivers, to help prioritise action on systems which are made more sensitive by these interactions
	Consolidate an understanding of long-term carrying capacity for different uses in different rangelands (different livestock species, tourism, carbon farming, etc.) based on maintaining a functional system, and use to drive consistent expectations of productivity, soil carbon opportunities, etc
	Link drivers and outcomes at local, catchment, regional and national scales in the Outback, to help understand the trade-offs between scales (e.g. management of water locally vs regionally)

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4. Learn from managers of land and test promising techniques (when, where do they work)	Build on local knowledge to identify potential new / improved management techniques that can be tested scientifically, ensuring this testing is evaluated on social, environmental and not only economic grounds Support research centres in the form of local innovation hubs where university researchers work with local and traditional knowledge holders to co-produce research results Support collaboration among diverse stakeholders as well as with researchers Technology partnered with cultural perspective, supported by a cultural monitoring, evaluation and reporting framework
5. Promote a robust research & learning system for the Outback	Develop and apply new technologies and tools to support relevant monitoring (e.g. soil carbon, water, land degradation measures) with learning feedback, and stakeholder use Monitor, map, report and synthesise trends in socio-economic and biophysical state in order to identify priority areas for interventions Train both rangelands researchers and stakeholders in working together, providing new career paths, encouraging a focus on the 'big picture' rather than individual projects Reduce duplication of outback research; use Outback commission to support learning and awareness across outback researchers and innovation hubs