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An evaluation of strategies used by the Landscapes and Policy Hub to achieve interdisciplinary and transdisciplinary research

Report No. 84

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Executive Summary

In today's complex world with environmental problems that seem intractable, research that engages a range of scientific and practical experiences and knowledge is regarded as an important way of finding and implementing solutions. This has led to increased efforts to establish large collaborative projects involving researchers from a range of different disciplines working in partnership with research users.

This document presents an evaluation of a national, four year, \$15 million¹ collaborative research program, the Landscapes and Policy Hub. The focus of the evaluation was for researchers to reflect on the effectiveness of strategies used by the hub to facilitate interdisciplinarity (where researchers from different disciplines work together to solve problems) and transdisciplinarity (where researchers from different disciplines work in partnership with research users to solve problems). The evaluation was commissioned in the final phase of the hub's life in the interests of improving performance of future interdisciplinary and transdisciplinary research. It was based on a number of strategies that had been implemented by the hub to encourage and facilitate interdisciplinary research occurring in partnership with research users.

In December 2014, hub researchers and staff participated in an interactive half-day evaluation workshop. Those involved included research project leaders, other researchers, postgraduate researchers and communications staff. The opportunistic nature of the evaluation meant that research users were not specifically targeted, and the evaluation therefore primarily represents researchers' perspectives.

The evaluation sought the perceptions of participants regarding the following:

1. The effectiveness of activities specifically employed by the hub to overcome barriers to interdisciplinary and transdisciplinary research.
2. The extent to which the hub adopted other activities and strategies enabling interdisciplinary and transdisciplinary research.
3. The hub's overall outcomes.

The barriers to and strategies enabling interdisciplinary and transdisciplinary research were identified from experiences of the Landscapes and Policy Hub predecessor, Landscape Logic, as well as a broader body of work over the last decade. The survey questions were based on the hub's activities as they related to these barriers and strategies.

All survey questions used a five-point scale, and the TurningPoint program was used to gather participants' responses to these questions via a hand-held keypad device. The real-time display of these results enabled respondents to discuss, clarify and/or explain their responses, and notes were taken of these discussions.

Results were later analysed to identify key themes, which formed the basis for the recommendations listed on the next page.

¹ \$6.78 million cash contribution from the Australian Government; the remainder is in-kind contributions etc.

Recommendations

1. Provide funding for the appointment of communications staff and knowledge brokers who can effectively facilitate communication among researchers and with research users.
2. Organise and support face-to-face meetings of researchers and research users to define and investigate research issues of importance to research users, and to assist research users to benefit from relevant expertise of researchers, and vice versa.
3. Facilitate engagement between researchers and research users early and often through a variety of means.
4. Ensure flexibility in the allocation of research funds expenditure to effectively respond to emerging research user priorities.
5. Emphasise the importance of long-term research funding to address the long-term, complex, intractable and 'wicked' problems facing biodiversity conservation in Australia and globally.
6. Proactively pursue the integration of social science in interdisciplinary and transdisciplinary research addressing environmental problems such as biodiversity conservation.

1. Introduction

The [Landscapes and Policy Hub](#) was one of five large research centres funded by the Australian Government under the [National Environment Research Program](#) for the period 2011-2014. It was hosted by the University of Tasmania and involved collaborative research focused on integrating biophysical and social sciences to provide guidance for policymakers on planning and management of biodiversity at a regional scale. Researchers were based at the University of Tasmania, The Australian National University, Murdoch University, the Antarctic Climate and Ecosystems Cooperative Research Centre, Griffith University and Charles Sturt University. Research expertise included climate science; landscape, freshwater, fire, plant and animal ecology; resource economics; spatial sciences; and human geography. The principal outputs from the hub are available at the [Life at Large](#) website.

This evaluation of the hub's efforts to facilitate interdisciplinary and transdisciplinary research was commissioned in the final phase of the hub's life. The aim of the evaluation was to improve performance of future interdisciplinary and transdisciplinary research, particularly that undertaken by the University of Tasmania's Centre for Environment which hosted the Landscapes and Policy Hub from January 2011 to March 2015, the Australian Government's Department of the Environment which funded the hub, and partner organisations involved in the hub's research (see Appendix 1).

The hub's objective was to develop tools, techniques and policy pathways to integrate biodiversity into regional scale planning. Researchers worked closely with a range of government and non-government agencies to identify and pursue a research agenda with practical application in two contrasting case study contexts: the Tasmanian Midlands and the Australian Alps. The practical action was directed at a landscape-scale, now widely understood as being essential for successful biodiversity conservation (Bennett et al. 2009; Hawke 2009; Benson 2012).

Working successfully at and across the landscape scale depends on knowledge from the physical, ecological and social sciences. The engagement of land managers and policy makers (i.e. 'research users') in identifying the research focus, designing and conducting the research, and implementing the findings is also essential for success – an approach that has been termed 'transdisciplinary' in the integrative research literature (Figure 1). Key research user partners included the Australian Government's Department of the Environment, Tasmanian Department of Primary Industries, Parks, Water and Environment, Parks Victoria, the NSW National Parks and Wildlife Service, and ACT Parks and Conservation. Knowledge transfer was coordinated by a science communication team consisting of the hub leader, communications manager and three knowledge brokers – one from the Australian Government's Department of the Environment, one from the Tasmanian Department of Primary Industries, Parks, Water and Environment, and one former Parks Victoria staff member who had been the Program Manager for the Australian Alps Cooperative Management Program.

The design of the hub's activities to enable an interdisciplinary and transdisciplinary research approach was heavily influenced by the findings of an evaluation of the preceding Landscape Logic research hub.

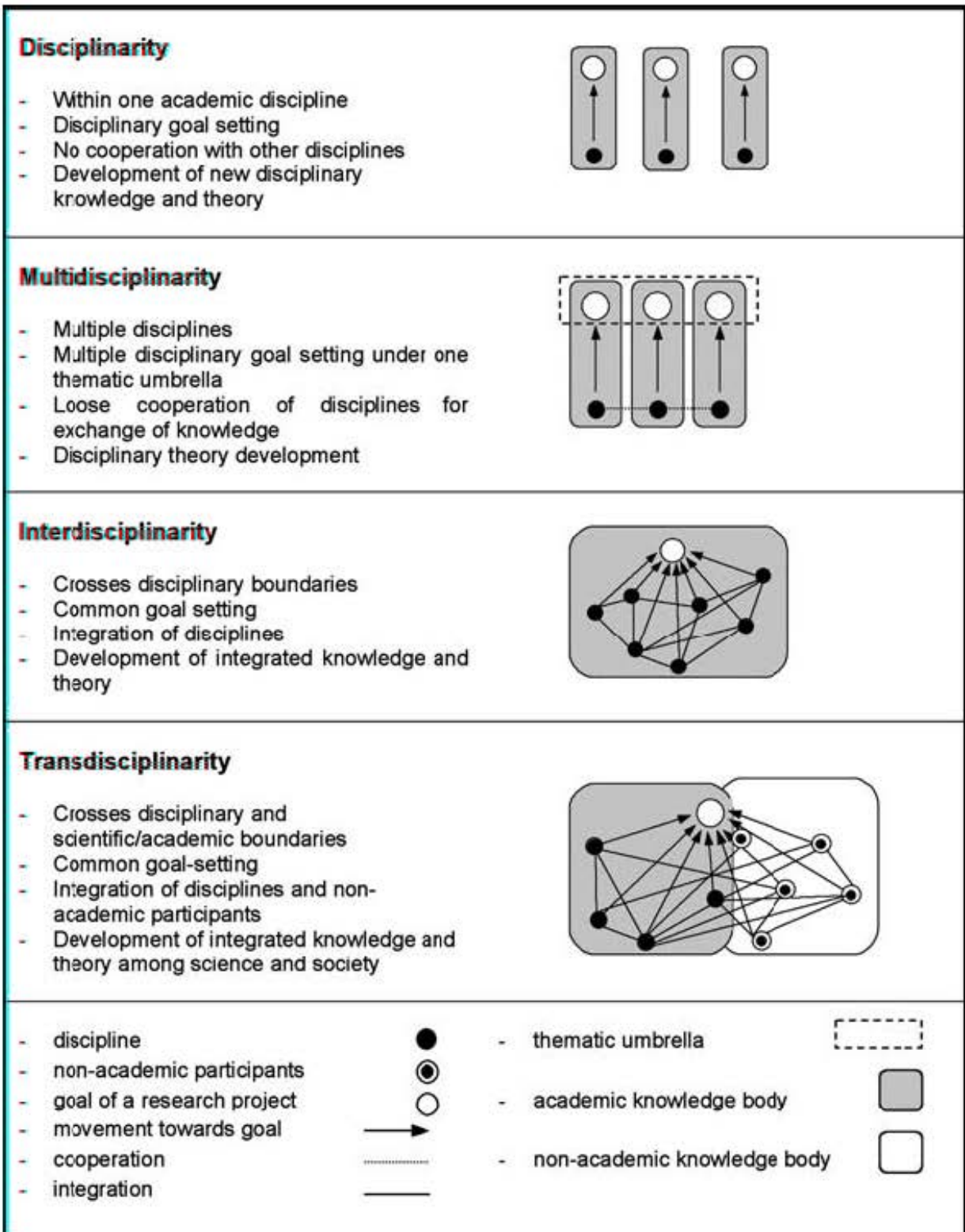


Figure 1. Different types of integrative research (Source: Tress G. et al. 2005)

Key findings from the Landscape Logic research hub were:

1. Time is needed for research teams to develop and to identify researchable questions that address problems jointly defined by researchers and research users.
2. Collaborative development of conceptual models fosters interdisciplinary research.
3. It is important to engage social and spatial scientists for the knowledge they create rather than engaging them in a 'service role' for other sciences.
4. Integration requires specific technical expertise as well as 'social' processes to overcome geographic, institutional and disciplinary barriers.
5. The dedicated employment of skilled communicators and knowledge brokers greatly enhances shared understanding and effective knowledge exchange.

(Lefroy et al. 2012; also see Roux et al. 2010).

The design of the hub's activities to enable interdisciplinary and transdisciplinary research was also influenced by a broader body of work investigating barriers to such research and how to overcome them (e.g. Tress B. et al. 2005a, 2005b; Tress G. et al. 2005, 2007; Loibl 2006; Roux et al. 2010; Lefroy et al. 2012; Allen et al. 2014; Buizer et al. 2015; Campbell et al. 2015). Barriers include physical distance between researchers, the extra time it can take to negotiate such research activities, and differences in culture, language and rules of evidence between disciplines. Factors enabling interdisciplinary research include a clear, shared recognition of the research task, and high trust and respect between disciplines. Key enabling factors for transdisciplinary research include evidence of long-term relationships with stakeholders going beyond individual projects, and researchers being able to demonstrate how their research contributes to research users' long-term goals.

A number of activities over the life of the hub were designed to address these barriers by drawing or elaborating on these strategies. Implemented activities included bus tours, regular research team meetings in Hobart (given the University of Tasmania was the hub host), targeted cross-project meetings, and a hub website. A summary of these activities and whether their purpose was progressing interdisciplinary or transdisciplinary research is indicated in Table 1, with more detail on the specific barriers each activity addressed presented as Table 2.

Table 1. Specific activities employed by the Landscapes and Policy Hub to enable interdisciplinary and/or transdisciplinary research

Activity name	Description	Frequency	Interdisciplinary research enabler	Transdisciplinary research enabler
Hobart research meetings	Roundtable meetings of researchers and students, and meetings of research leaders and the hub's steering committee (which in 2014 included all researchers) (key researcher user organisations were represented on the steering committee)	Twice a year	✓	✓
Collaborative conceptual modelling	Training in an interdisciplinary approach to systems description and hypothesis development	2 x 2-day workshops in second year of hub	✓	--
Scientific writing course	Practical training in writing for scientific journals	2 x 1-day & 1 x 3-day intensive courses in second year of hub	✓	--
Targeted cross-project meetings	Meetings specifically to develop research studies and publications involving researchers from multiple disciplines (many of these studies also involved research users)	As required; once a week on average	✓	✓
Bus tours	Introduced the researchers to the two study areas, each other, the research issues and research users	Once in each region at commencement	✓	✓
Targeted stakeholder meetings	Meetings to progress specific research studies with research users	As required	✓	✓
Australian Alps Science Management Forums	The hub was invited to co-organise two meetings as part of a series of biannual forums hosted by the Australian Alps Liaison Committee to explore collaboration between Alps managers and researchers. These forums provided an opportunity for hub researchers to identify research questions with users (2012) and then report on progress (2014).	2 x 1-day meetings (2012 and 2014)	✓	✓
Hub Happenings	Emailed newsletter of current activity sent to all researchers plus 150 recipients in research user and funder organisations	Weekly	✓	✓
Hub website	Introduced the research and team, and acted as a repository for research outputs	Continuous from second year of hub	✓	✓
Hub intranet	Provided staff with access to meeting records, evaluations, progress reports, and hosted an internal discussion page	Continuous from second year of hub	✓	--
Availability of contingency funds for new projects	Enabled research teams to commence new studies following consultation with research users	Based on collaborative proposal with research users	--	✓

Table 2: Barriers to interdisciplinary and transdisciplinary research and activities and strategies employed to overcome them (Ticks (✓) indicate degree of relevance as judged by the authors, with three (✓✓✓) being an activity or strategy of most relevance to the corresponding barrier)

Specific activities employed by the Landscapes and Policy Hub	Barriers to interdisciplinary (ID) and transdisciplinary research (TD)					
	ID Barriers				TD barriers	
	Differences in disciplinary language & culture	Differences in research methods & rules of evidence	Academic reward structures	Geographic Separation	Differences in institutional cultures	Inflexibility in structure, funding & operations
Hobart research meetings	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓	--
Collaborative conceptual modelling	✓✓✓	✓✓	--	✓	--	--
Scientific writing course	✓✓	✓	✓✓✓	✓	--	--
Targeted cross-project meetings	✓✓	✓✓	✓✓	✓✓	✓✓	--
Bus tours	✓	✓	--	✓✓	✓✓✓	--
Targeted stakeholder meetings	✓	✓	--	✓✓	✓✓✓	--
Australian Alps Science Management Forums	✓	✓	--	✓	✓✓✓	--
Hub Happenings	--	--	--	✓✓	✓✓	--
Hub website	--	--	--	✓✓	✓✓	--
Hub intranet	--	--	--	✓✓	--	--
Availability of contingency funds for new projects	--	--	--	--	--	✓✓
Other activities and strategies adopted by the hub						
Mentoring and support from hub leader and communications staff	✓✓	✓✓✓	✓✓✓	--	✓✓	✓
Mentoring and support from knowledge brokers	✓✓	--	--	--	✓✓✓	--
Understanding contribution different disciplines can make to overall shared research purpose	--	✓✓	✓✓	--	--	--
Establishing high levels of trust and respect between disciplines	✓	✓✓	✓✓	--	--	--
Allocating sufficient shared time to early joint problem definition with research users and other researchers	--	✓✓	✓✓	✓	✓✓	--
Being able to undertake research with users that also meets academic peer review publications standards	--	--	--	✓✓✓	--	--
Receiving support to be accountable to research users in the way research is conducted and communicated	--	--	✓	--	✓✓	--
Organising activities with research users (workshops, training sessions etc)	✓✓	--	--	--	✓✓✓	--

Sources: Tress B. et al. 2005a, 2005b; Tress G. et al. 2005, 2007; Loibl 2006; Roux et al. 2010; Lefroy et al. 2012; Allen et al. 2014; Buizer et al. 2015; Campbell et al. 2015

2. Methods

Landscapes and Policy Hub researchers and staff were surveyed as part of a workshop session at the final meeting of researchers involved in the hub on Tuesday 9 December 2014 in Hobart. As this survey was undertaken at the end of this research program, it contributed to a summative evaluation (an evaluation at project's end). The hub also had a commitment to formative evaluation (learning to improve during the project), with the results of questionnaire surveys conducted at the end of every hub activity being used to improve, modify and/or add activities. For example, the designs of the collaborative modelling and scientific writing workshops evolved from suggestions provided by researchers who completed these surveys early in the hub life. This report focuses on analysing the results of the final summative evaluation.

The TurningPoint program was used at this workshop to gather responses to a series of evaluation questions. This program enables real-time display of results to each multiple choice question (described below). Respondents used a hand-held keypad to provide their responses which were instantly conveyed to a computer displaying the results to all workshop participants as part of a PowerPoint display. The program also stores the quantitative data as collected from respondents for future analysis, including against initial test questions (to make sure that the keypad and TurningPoint software are working) that categorised respondents into male and female, and types of positions held. The immediate display of results (see graphs in Appendix 2), enabled respondents to discuss, clarify and/or explain their responses, and notes were taken of these discussions.

Participant selection was opportunistic, with respondents being those present at this December 2014 workshop. As this December event was primarily for researchers, the evaluation focuses on the hub's efforts to facilitate interdisciplinarity and transdisciplinarity from the perspective of the research team, and research users were not specifically targeted. Researchers involved in the hub include research project leaders, other researchers, postgraduate researchers, and communications staff. More than half of each of these cohorts was included in this survey (Table 3).

Table 3: Categorisation of survey respondents

Cohort ¹	No. of respondents	Total in cohort (2011-2014) ²	Proportion
Research project leaders ³	5	8	63%
Other researchers	12	22	55%
Postgraduate researchers	2	3 ⁴	67%
Communications team staff (and 2 others) ⁵	4 (6)	6	67%

¹ As determined by respondents' self-selection at the start of the workshop

² Excluding staff employed on a short-term basis (< 6 months) or on projects under separate contracts

³ Excluding the hub leader, who was a member of the communications team

⁴ Excluding 4 Masters and 4 Honours students, almost all of whom were engaged with the hub for <12 months

⁵ Including the hub leader and knowledge brokers. The 2 others were a steering committee member and a representative from the funding agency who were excluded from the calculation of cohort proportion.

Three broad sets of questions were asked of workshop participants. These were:

1. Effectiveness of activities employed to overcome barriers to interdisciplinary and transdisciplinary research.
2. Extent the hub adopted other activities and strategies enabling interdisciplinary and transdisciplinary research.
3. Overall outcomes of the hub.

The order of the survey questions aimed to ease respondents through the key issues involved in pursuing interdisciplinary research. So, for example, the first barrier to interdisciplinary research is 'overcoming difference in disciplinary language and culture', followed by 'differences in research methods and rules of evidence'. The survey design was also heavily influenced by the short time available, meaning that only those activities and strategies deemed most relevant to the barriers highlighted would be addressed (i.e. those with two ticks or more in Table 2).

All questions used a 5-point scale, with respondents able to choose 'ineffective'; 'somewhat effective'; 'effective'; 'very effective' or 'extremely effective' regarding each activity employed by the hub. For the other activities and strategies that may have been adopted, respondents were given statements with which they could 'strongly disagree'; 'disagree'; 'neither agree or disagree'; 'agree' or 'strongly agree'. Overall outcomes were evaluated in terms of being 'not at all' met; 'somewhat' met; 'mostly' met; 'completely' met; or 'my expectations were exceeded'.

Data analysis included:

1. Identifying questions that elicited a broad consensus in response and those eliciting divergent responses, and then further investigating data associated with divergent responses to identify explanatory trends in how different participants responded.
2. Compiling responses to present aggregate data for each question from which key results could be readily identified.
3. Consideration of additional themes arising from the notes taken of the workshop discussion in response to the presentation of the results to each question.

The aggregate data enabled key results to be readily identified, with these key results further categorised into themes, and supplemented by a review of the notes taken during the workshop discussion. Several of these themes related to the results from similar research, such as the value of engaging knowledge brokers, and the value of face-to-face meetings to overcome geographic separation of researchers. These themes formed the basis for identifying a set of six key results and associated recommendations.

3. Results

Detailed results for each question are provided in graphic form in Appendix 2. Summarised results for each question are provided in Tables 4-7, and form the basis for the recommendations concluding this report.

3.1 Effectiveness of activities employed to overcome barriers to interdisciplinary and transdisciplinary research

It is important to highlight that the results in this first section relate to the effectiveness of activities in overcoming barriers to interdisciplinary and/or transdisciplinary research, and not whether the activities were effective per se. For example, one participant noted that the scientific writing workshop was a very effective activity, but not for the purpose of enabling interdisciplinary research.

Overcoming barriers to interdisciplinary research

Q1: In terms of overcoming the differences in language and culture between disciplines, face-to-face meetings were perceived as being the most effective activity used by the hub, with 72% of respondents identifying the Hobart research meetings and the same percentage identifying the targeted cross-project meetings as effective, very effective or extremely effective (see Table 4).

Table 4. Activities to overcome barriers to interdisciplinary research

(showing % of respondents recorded as identifying each activity as effective, very effective or extremely effective in overcoming the barrier)

	Activities								
	Hobart research meetings	Collaborative conceptual modelling	Scientific writing course	Targeted cross-project meetings	Bus tours	Targeted stakeholder meetings	Hub Happenings	Hub website	Hub intranet
Q1. Overcoming <i>differences in disciplinary language and culture</i>	72	54	36	72	--	--	--	--	--
Q2. Overcoming <i>differences in research methods and rules of evidence between disciplines</i>	46	18	--	43	--	--	--	--	--
Q3. Overcoming the constraint, particularly for early career researchers, of <i>the pressure and need to publish in single discipline, peer-reviewed journals</i>	30	--	39	69	--	--	--	--	--
Q4. Overcoming the <i>geographic separation of the hub researchers</i>	96	--	--	94	100	90	75	17	0

Cells with grey fill are those where >2/3 of respondents judged the activity as effective, very effective or extremely effective.

Q2: By contrast, most felt that the three methods employed to overcome the interdisciplinary barrier of differences in research methods and rules of evidence between disciplines were less than effective. Around 20-30% considered each of these methods as ineffective (see Appendix 2 results).

Q3: More than two thirds of respondents thought that working together through targeted cross-project meetings was an effective activity to overcome the barrier of reward structures related to academic publications (69% considered this activity effective or better than effective compared with 39% for the writing course and 30% for the Hobart research meetings). One participant commented that these meetings became 'a very effective way to get papers out the door.' Several others struggled with this question as they did not see the pressure to publish as a barrier; one emphasised that the interdisciplinary nature of the hub resulted in a vibrant culture for publishing, as different researchers could take the lead on different papers (also see discussion of results to Q11).

Q4: The bus tours (100%) and other face-to-face meetings (>90%) were viewed as being effective activities to overcome the barrier of geographical separation of the research team. The Hub Happenings newsletter was also viewed as being an effective activity by 75% of respondents. It is worth noting that the hub was established to have a strong base in one place (Hobart, at the University of Tasmania) to reduce the negative effects of geographic separation. Even so, it is clear that face-to-face meetings were not just valued by those who were geographically remote, but were also valued by those who were physically separated from each other within the University of Tasmania as opportunities for meeting and discussing together.

Overcoming barriers to transdisciplinary research

Q5: Face-to-face meetings were also effective in overcoming differences in institutional culture between participating research and research user organisations (Table 5). In particular, all respondents considered the two Alps Science Management Forums as effective activities to overcome institutional cultural differences, with almost half considering the forums extremely effective. Most respondents also saw the bus tours and targeted stakeholder meetings as very or extremely effective, and thought the Hub Happenings newsletter was at least somewhat effective. Active engagement with steering committee members at the Hobart meetings was particularly appreciated. The active engagement of steering committee members was seen as providing further strength to underpin collaboration between researchers and significant research users.

Q6: Having contingency funds available was seen as very or extremely effective in overcoming the barrier of inflexibility by 70% of respondents (who were project leaders only for this question).

Before moving to the next stage of the survey, participants were invited to provide more general comments. Several of these comments related to *the need to frame research problems jointly with research users* (also see discussion of results for Q10). One noted the need for special circumstances for joint problem framing to occur, especially as there is not much capacity for agencies to engage with academics. A good example was the special circumstances through which problems were jointly framed for the Australian Alps, resulting in Tasmanian-based researchers working in the Alps on problems that the agencies really valued (e.g. managing wild horses), and opening up new opportunities. Another noted the need to engage research users early in problem framing, suggesting that it started a bit late with the Alps. A third person noted that policymakers also need to be part of the journey of joint problem framing and solving.

Table 5. Activities to overcome barriers to transdisciplinary research

(showing % of respondents recorded as identifying each activity as effective, very effective or extremely effective in overcoming the barrier)

	Activities							
	Hobart research meetings	Targeted cross-project meetings	Bus tours	Targeted stakeholder meetings	Alps Science Management Forums	Hub Happenings	Hub website	Contingency funds
Q5. Overcoming <i>differences in institutional cultures between participating organisations</i>	71	60	93	86	100*	40	9	--
Q6. Overcoming <i>inflexibility in structure, funding and operations</i>	--	--	--	--	--	--	--	90

Cells with grey fill are those where >2/3 of respondents judged the activity as effective, very effective or extremely effective.

*43% Extremely Effective

3.2 Extent the hub adopted other activities and strategies enabling interdisciplinary and transdisciplinary research

There was a high level of appreciation for most of the additional strategies enabling interdisciplinary and transdisciplinary research included in the survey, as shown by the grey shading in Table 6. However, some of the statements in this part of the survey resulted in divergent responses (Q10 and Q11) and responses that were mostly non-committal (Q9). We therefore include the full range of responses in Table 6.

Q7a and 7b: Most respondents agreed they received adequate mentoring and support from the hub leader, communication and other support staff (Q7a), and the knowledge brokers (Q7b) to undertake interdisciplinary and transdisciplinary research (both statements acquiring 84% agreement).

Q8 and 9: While most respondents also agreed they had acquired a good knowledge of where different disciplines could contribute to landscape-level conservation of biodiversity by the end of the hub (81% agreement), there was considerable ambivalence concerning whether high trust and respect between disciplines was a characteristic of the hub, with 54% neither agreeing or disagreeing with the statement. Of those who did offer an opinion, around half agreed with the statement; the other half disagreed. There was no discernible difference across cohorts in their responses to this statement. Reasons offered by participants for being unable to offer a decisive opinion included that trust and respect levels were variable over the life of the hub, and that trust and respect were seen as sentiments between individuals, not disciplines. Two participants suggested that interdisciplinary research does not necessarily rely on trust and respect, one adding that ‘respect is allowing other disciplines to get on and do their jobs without trying to do it for them.’

Table 6. Evaluation of the perceptions of researchers regarding other activities and strategies employed to facilitate interdisciplinary (ID) and transdisciplinary (TD) research

Statement	% of respondents according to their response to the statement*				
	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Q7a. I felt I received adequate mentoring and support from hub leader, communications and other support staff to undertake ID/TD research	6	6	6	56	28
Q7b. I felt I received adequate mentoring and support from the hub knowledge brokers to undertake ID/TD research	8	0	8	46	38
Q8. By the end of this hub I have a good knowledge of where different disciplines can contribute to landscape-level conservation of biodiversity	0	4	4	58	33
Q9. High trust and respect between disciplines was a characteristic of this hub	0	21	54	21	4
Q10. Sufficient time was allocated, as a hub, to an early joint problem definition stage with end users and other researchers	33	29	5	19	14
Q11. It was challenging for me to undertake research with end users as my professional rewards are based on publishing in high impact peer reviewed journals	25	38	0	13	25
Q12. I felt the hub supported me to be accountable to end users in the way I conducted my research and reported my research findings	11	0	0	42	47
Q13. Activities with research users including briefings, workshops, training sessions and manuals helped me undertake TD research	6	0	6	41	47

* Totals may not add up to 100 due to rounding effects.

Combined cells with grey fill are those where >2/3 of respondents agreed or strongly agreed with the statement.

Discussion of Q9 results highlighted a theme raised several times during the workshop concerning collaboration between biophysical and social scientists. One biophysical researcher participant perceived a lack of collaboration between social and biophysical researchers, especially in the early stages, and that collaboration between non social science research project teams had worked well. Such a view links back to comments made earlier that differences between the biophysical and social sciences increased the difficulty of collaboration to a much higher order of magnitude (as compared to much smaller differences within the biophysical sciences and scientists, many of whom were 'ecologists'). Other biophysical researchers noted how the hub had enabled their appreciation of the value of social research, with one adding that the hub's pursuit of transdisciplinary research was far more effective than any of the other National Environment Research Program research hubs.

Strongly divergent positions were held on the next two statements (Q10 and Q11).

Q10: Almost all respondents (95%) had an opinion on whether sufficient time was allocated to early joint problem definition among research users and other researchers, with 33% of respondents agreeing that sufficient time was allocated whereas 62% disagreed, 33% strongly so. Project leaders held the most strongly contrasting positions, while all of the communications team cohort disagreed with the statement.

One of the survey participants who strongly disagreed said that identification of research questions with research users did not occur at an early stage at all. One of those who strongly agreed with the statement did so because they had spent a lot of time thinking about a joint problem definition at the beginning.

Another noted that the lack of a shared vision to integrate research across the hub had been an issue raised at the outset by the steering committee. Indeed, the need for a common overarching research question had been raised by researchers at a Hobart-based meeting in August 2012, midway through the hub, and prior to the first Alps Science Management Forum. One participant expressed disappointment with the short-term contractual approach to research funding, which constrains continuity of research pursuits over consecutive contracts. There is limited incentive provided to researchers to build future research from learnings and outcomes of prior projects.

Q11: All respondents had an opinion on whether it was challenging for them to undertake research with research users because their professional rewards are based on publishing in high impact peer reviewed journals, with 62% agreeing and 38% disagreeing. A closer examination of the breakdown of respondents suggests this is a challenge primarily affecting early career researchers as both postgraduate researchers strongly agreed, with other (mostly early career) researchers holding mixed opinions, and most project leaders disagreeing with the statement. Researchers who found this not to be a challenge noted that having research users actively involved as co-authors made it easier as well as enjoyable, and that their research could not have been achieved without active engagement of research users. Another noted that the challenge was primarily the extra time required.

Q12 and Q13: Finally, most respondents agreed that the hub had supported them to be accountable to research users in the way they conducted their research (89% agreement) and that activities with research users helped them undertake transdisciplinary research (88% agreement).

3.3 Overall outcomes of the hub

Some respondents had difficulty with the phrasing of the questions used for this part of the survey. Participants were asked to think back to their expectations at the beginning of the hub, and then assess the extent those expectations had been met. The problem was that a number of participants found it difficult to make such comparisons, arguing that they did not have any strong or high expectations at the start. They suggested their responses would be different if they were considering whether their overall expectations had been met. In spite of these concerns, there were some decisively favourable responses to the first three questions (see Table 7).

These decisive results were:

- *To what extent were your expectations met in terms of the quantity and quality of research outputs?* (53% felt expectations had mostly been met; becomes 71% when combined with completely met and expectations exceeded).
- *To what extent were your expectations met in terms of the acquisition of new knowledge and skills?* (46% felt expectations had mostly been met; becomes 83% when combined with completely met and expectations exceeded).
- *To what extent were your expectations met in terms of your overall level of personal and professional satisfaction?* (52% felt expectations had mostly been met; becomes 78% when combined with completely met and expectations exceeded).

Table 7. Evaluation of the extent expectations were met regarding hub outputs and outcomes

	% of respondents according to degree their expectations had been met*				
	Not at all	Somewhat	Mostly	Completely	Exceeded
Q14. Outputs/outcomes from the hub					
Quantity and quality of research outputs	0	29	53	6	12
Acquisition of new knowledge and skills	0	17	46	29	8
Overall level of personal and professional satisfaction	0	22	52	13	13
Your research making a difference to biodiversity conservation	12	59	12	12	6
The hub creating new opportunities for future research	19	29	5	24	24

* Totals may not add up to 100 due to rounding effects.

Combined cells with grey fill are those where >2/3 of respondents judged their expectations to have been mostly or completely met, or had been exceeded.

However, opinions were less favourable concerning expectations met in terms of the research making a difference to biodiversity conservation. Most respondents (59%) thought their expectation had only somewhat been met, with the rest split across all other responses, and with no clear pattern across cohorts. Explanations for responses included that it was too soon to tell if the research had made a difference, and that there were too many other factors influencing biodiversity outcomes.

Opinions were strongly divided concerning whether expectations had been met in terms of the hub creating new opportunities for future research. Almost half (48%) felt their expectations had been completely met or had been exceeded, while 19% thought their expectations had not been met at all, and 29% thought their expectations had only somewhat been met. This question had also been rephrased so as to not refer to expectations at the start. Those respondents who felt their expectations had not been met at all were all from the cohorts of other researchers and postgraduate researchers, but there was an equal number from these two cohorts who felt their expectations had been exceeded.

3.4 Summary of key results

A summary of the key results appears in Table 8. These results support the six recommendations in the final section of this report. Each is sourced back to the survey responses and/or ensuing discussion, as well as to the published results and/or recommendations of other researchers who have pursued similar investigations.

Table 8. Summary of key results

Key results	Source from survey results and supporting literature	Supports
A strength of the hub was having knowledge brokers, communication staff, and a leader with skills, experience and enthusiasm for transdisciplinary research.	Q7 and 12 results; Tress B. et al. 2005a; Roux et al. 2010; Lefroy et al. 2012; Buizer et al. 2015; Campbell et al. 2015	Recommendation 1
Face-to-face meetings were effective in helping to overcome physical separation, differences in disciplinary language and culture, and differences in culture between researcher and research user institutions.	Q1, 4 and 5 results; Tress B. et al. 2005a; Buizer et al. 2015	Recommendation 2
All respondents considered the two Alps Science Management Forums to be effective, with many considering them extremely effective. Activities at the first forum were highly valued as a means of identifying research objectives that could meet the needs of both researchers and research users. However, many also felt that insufficient time was spent early in the life of the hub on such joint problem definition activities.	Q5 and 10 results; Tress B. et al. 2005a; Tress G. et al. 2007; Lefroy et al. 2012; Allen et al. 2014	Recommendation 3
Almost all project leaders thought the availability of contingency funds for new research projects was very effective in overcoming the barrier of inflexibility in research funding and operations.	Q6 result; Loibl 2006; Campbell et al. 2015	Recommendation 4
The two main areas where researchers' expectations could have been improved relate to the research making an overall difference to biodiversity conservation and creating new opportunities for future research. Short-term funding constrains the achievement of both.	Q14d and 14e results; Discussion of Q10 results; Allen et al. 2014; Buizer et al. 2015; Campbell et al. 2015;	Recommendation 5
The timing and effectiveness of integrating social science research with other disciplines (for this hub the biophysical sciences) remains a challenge.	A strong theme from participants' discussion of results – see Q9	Recommendation 6

4. Recommendations

Building from the results presented (Table 8), all of the following recommendations are directed towards the achievement of effective interdisciplinary and transdisciplinary research.

Recommendation 1. *Provide funding for the appointment of communications staff and knowledge brokers who can effectively facilitate communication among researchers and with research users.*

Dedicated engagement of communications staff and knowledge brokers working closely with a hub leader (i.e. research director), all of whom had skills and experience in building transdisciplinary teams, enabled the use of key strategies supporting interdisciplinary and transdisciplinary research. Particularly effective, and made possible with the design and guidance of these staff, were regular meetings of researchers in a common location (twice a year in Hobart), bus tours of study sites (once each to the Tasmanian Midlands and Australian Alps), *ad hoc* cross-project meetings (>300 over the life of the hub), and a weekly web-based newsletter for researchers and research users (Hub Happenings). Face-to-face meetings and the newsletter were particularly effective in overcoming the ‘tyranny’ of distance that often detracts from the effectiveness of interdisciplinary research where those involved are physically separated from each other.

Recommendation 2. *Organise and support face-to-face meetings of researchers and research users to define and investigate research issues of importance to research users, and to assist research users to benefit from relevant expertise of researchers, and vice versa.*

Face-to-face meetings were vitally important for ensuring effective interdisciplinary and transdisciplinary research, helping to overcome the barrier of differences in institutional culture between participating organisations. Particular efforts were made to communicate across projects to build understanding and possibilities for cross-project synergies. Researchers regarded the *ad hoc* meetings and *ad hoc* exchanges associated with the formal meetings as just as valuable (if not more so) than the formal meetings themselves. These targeted meetings also helped improve the pursuit of fundamental, high quality and publishable research with practical, applied outcomes.

Recommendation 3. *Facilitate engagement between researchers and research users early and often through a variety of means.*

Research users were engaged by multiple means, including guidance throughout the life of the hub by: a steering committee with research user membership; knowledge brokers associated with three key research user agencies (Department of Primary Industries, Parks, Water and Environment, Australian Alps Liaison Committee and Department of the Environment); two forums between researchers and Australian Alps managers to identify research objectives and evaluate outcomes; and targeted interaction on specific projects, as detailed below. Guidance by research users was provided on selection of the case study regions, the choice of issues (e.g. fire management in the Australian Alps), and on the tools that would be helpful for managers (e.g. a method for evaluating stream health in the Tasmanian Midlands). Other activities employed and regarded as highly effective were targeted cross-project meetings (e.g. meetings on vegetation condition in the Tasmanian Midlands grasslands) and forums held with Australian Alps managers to design and

undertake research (e.g. on bogs, wild horses). Bus tours attended by researchers and research users were also identified as highly effective. Researchers felt that collectively, these activities helped them be more accountable to research users in the way they conducted their research and reported their findings. Again, the delivery of these activities was enhanced by communications staff.

Recommendation 4. *Ensure flexibility in the allocation of research funds expenditure to effectively respond to emerging research user priorities.*

Providing flexibility in how funds are allocated allowed issues that emerged through working with research users to be addressed. This ensured a continued focus on issues of concern to research users, ensuring the relevance of findings to research users, and commitment by all to the uptake of these findings. An essential accompaniment to flexibility in expenditure is being able to modify and/or add research outcomes and associated performance criteria as part of fully transparent accountability and reporting arrangements.

Recommendation 5. *Emphasise the importance of long-term research funding to address the long-term, complex, intractable and 'wicked' problems facing biodiversity conservation in Australia and globally.*

Researchers identified the short-term funding cycle for environmental research (i.e. four years of funding for this hub and then its termination) as problematic for addressing concerns such as biodiversity loss. Short-term funding cycles result in the loss of knowledge and social capital as researchers move institutions and even countries to find new research opportunities. They also end the productive relationships between researchers and research users that could enable ongoing and/or future problems to be further defined, researched and solutions developed.

Recommendation 6. *Proactively pursue the integration of social science in interdisciplinary and transdisciplinary research addressing environmental problems such as biodiversity conservation.*

Collaboration between the social and biophysical sciences was identified as problematic by some researchers involved in the evaluation. The short time frame allowed for preparation of the hub funding application precluded collaborative identification of key research questions or the development of shared conceptual frameworks. In the early stages of the hub, efforts by researchers to establish common ground for working across the social and biophysical sciences were of limited success, and subsequent attempts proved equally challenging. For a hub to work effectively across these fields, and to ensure the work meets the needs of research users, we recommend that effort be devoted from the outset to collaborative formulation of research questions and agreement on conceptual frameworks involving researchers from different disciplines and research users. This collaborative effort should be directed at two objectives; (1) to enable researchers to identify where their discipline-specific contributions can most effectively contribute to the overall project goals; and (2) provide a foundation for interdisciplinary and transdisciplinary projects. In the first instance, given that collaborative enterprises are part of their disciplinary expertise, social science researchers are well-suited to facilitating such efforts. This can then be followed by inclusion of a recurring agenda item, at all subsequent face-to-face meetings of the research group, of revisiting and evaluating the salience and effectiveness of the research questions and integration efforts, and making adjustments as required.

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Appendix 1: Landscapes and Policy Hub's partners, collaborators and research users

Australian Government partners, collaborators and research users

Antarctic Climate and Ecosystems Cooperative Research Centre
Australian Alps Liaison Committee
Australian Alps Liaison Committee Reference Groups: Natural Resource Management; Feral Horse Subgroup; Water and Catchments Sub-Committee; Climate Change Committee; Australian Alps Traditional Owners Reference Group (AATORG)
Australian Alps national parks Program
Australian Bureau of Agriculture, Resource Economics and Science
Australian National Botanical Gardens
Bureau of Meteorology
Bush Heritage Australia
CSIRO
Department of Agriculture, Fisheries and Forestry (federal)
Environmental Consultants: Roger Good, Jenny Pope (Integral Sustainability), Fiona Coates (Woods to Water), Anita Wild (Wild Ecology), Rod Knight (Natural Resources Planning), Steve Carter (Environmental Dynamics), Stuart Cowell (private consultant/CEO of Karrkad-Kanjdi Trust), Owen Bassett (Forest Solutions)
Department of the Environment (federal) — Office of Environmental Science and Economics; Biodiversity Conservation Division; Climate Change and Renewal Energy Division; Parks Australia Division; Wildlife Heritage and Marine Division; Regulatory Reform Taskforce; Caring for our Country; Commonwealth Environmental Water Office; Environment Assessment and Compliance Division, Environmental Information and Monitoring; EPBC Act Assessments; Environmental Resources and Information Network (ERIN); Heritage Management; Indigenous Policy; Regional Sustainability Planning; State of Environment reporting; Strategic Assessments; Sustainability Policy; Water for our Future Program;
Geoscience Australia;
Greening Australia
IUCN WCPA
Murray-Darling Basin Authority
National Environment Research Program Environmental Decisions Hub
Parks Australia

Other partners, collaborators and research users

ACT Environment and Sustainable Development
ACT Parks and Conservation
Alpine Resorts Coordinating Council
Alpine Shire Council
Antarctic Climate and Ecosystems Cooperative Research Centre
Arthur Rylah Institute of Environmental Research

Other partners, collaborators and research users, cont.,

Aurora Energy
Australian National University ANU Fenner School of Environment and Society
Bureau of Meteorology
Bush Heritage
Charles Sturt University
Conservation Landholders Tasmania
CSIRO
Falls Creek Alpine Resort
Fenner
Forest Practices Authority
Forestry Tasmania
Griffith University
Healthy Landscapes Group
Hunter and Central Coast Regional Environmental Management Strategy
Hydro Tasmania
Indigenous groups (Aboriginal Heritage Tasmania, Tasmanian Aboriginal Centre, Australian Alps Traditional Owners Reference Group, Victorian Alps & East Gippsland Traditional Owners Reference Group)
James Cook University
La Trobe University
Lake Macquarie Council
Landcare – Tasmania
Macquarie University
MONA – Museum of Old and New Art
Mt Buller/Mt Stirling Resort
Murdoch University
National Parks Associations (NSW and Vic)
North-East CMA
Northern Midlands Council
NRM and catchment groups
NSW Department of Planning and Infrastructure
NSW National Parks Association
NSW Office of Environment and Heritage (NPWS & Hunter Central Coast Region)
Parks Victoria
Protected Areas Learning Centre
RMIT University
Snowy River Shire Council (NSW)
Southern Midlands Council
Southern Slopes Climate Change Adaptation Research Partnership (SCARP) project
State Fire Management Council (Tasmania)
Tasmania Fire Service
Tasmania Tourism Council

Other partners, collaborators and research users, cont.,

Tasmanian based NRM groups: NRM North, NRM South, Cradle Coast Authority, Tamar NRM (Tas)

Tasmania Climate Change Office

Tasmanian Department of Premier and Cabinet (emergency coordination unit)

Tasmanian Department of Primary Industries, Parks, Water and Environment (Water Assessments, Sustainable Landscapes, Agricultural Policy, Land Conservation Branch, World Heritage Area)

Tasmanian Farmers and Graziers Association

Tasmanian Healthy Landscapes Group

Tasmanian Inland Fisheries Service

Tasmanian Institute of Agriculture

Tasmanian Irrigation

Tasmanian Land Conservancy

Tasmanian Midlands Coordination Group

Tasmanian Midlands Landholders

Tasmanian Planning Commission

Tasmanian Rangelands Group

Tasmanian Tourism Council

University of Melbourne

University of Tasmania

University of Western Australia

University of Wollongong

Victorian Alps & East Gippsland Traditional Owners Reference Group

Victorian Department of Environment and Primary Industries

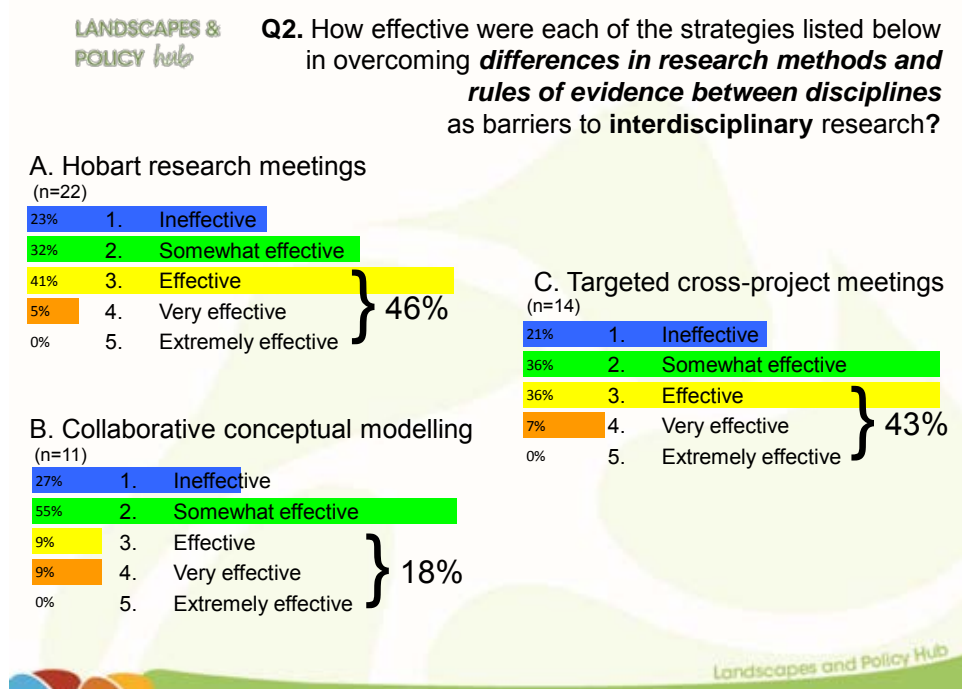
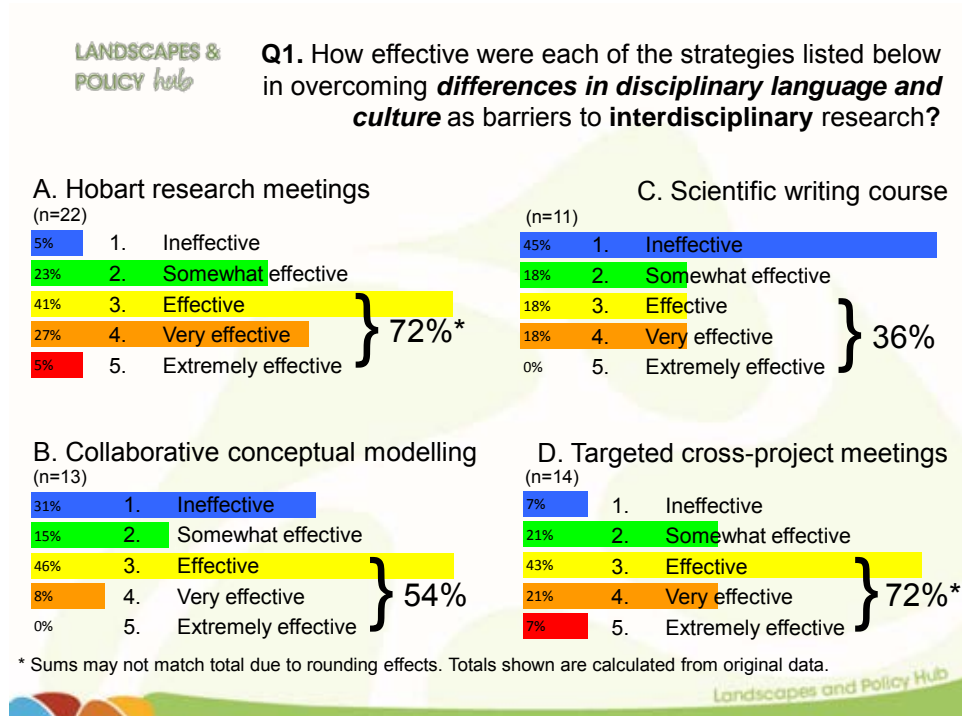
Victorian Department of Environment, Land, Water and Planning

Victorian National Parks Association

Appendix 2: Results in detail

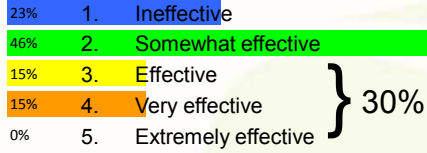
1. Effectiveness of activities employed to overcome barriers to interdisciplinary and transdisciplinary research

Overcoming barriers to *interdisciplinary* research



Q3. How effective were each of the strategies listed below in overcoming the constraint to **interdisciplinary** research, particularly for early career researchers, of **the pressure and need to publish in single discipline, peer-reviewed journals?**

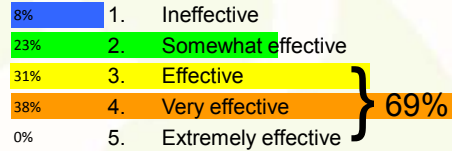
A. Hobart research meetings
(n=13)



B. Scientific writing course
(n=8)

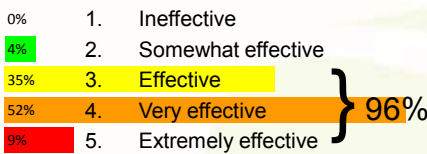


C. Targeted cross-project meetings
(n=13)

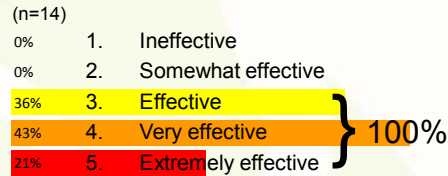


Q4. How effective were each of the strategies listed below in overcoming the **geographic separation of the Hub researchers** as a barrier to **interdisciplinary** research?

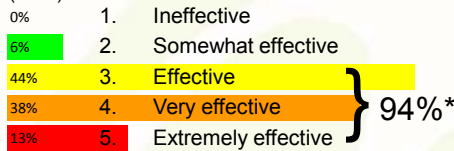
A. Hobart research meetings
(n=23)



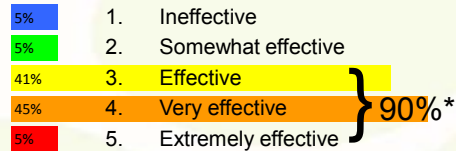
C. Bus tours
(n=14)



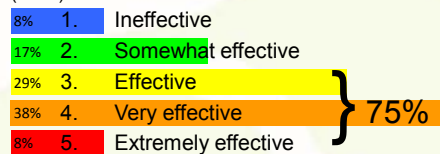
B. Targeted cross-project meetings
(n=16)



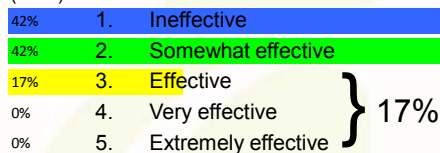
D. Targeted stakeholder meetings
(n=22)



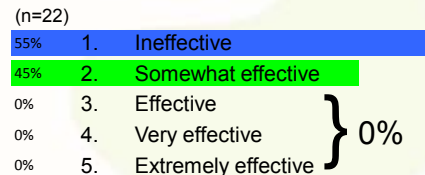
E. Hub Happenings
(n=24)



F. Hub website
(n=24)



G. Hub intranet
(n=22)



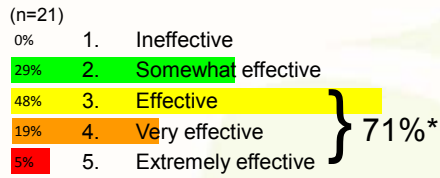
* Sums may not match total due to rounding effects. Totals shown are calculated from original data.

Overcoming barriers to **transdisciplinary** research

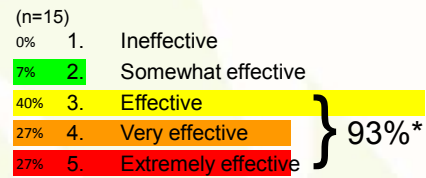
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Q5. How effective were each of the strategies listed below in overcoming **differences in institutional cultures between participating organisations** as barriers to **transdisciplinary** research?

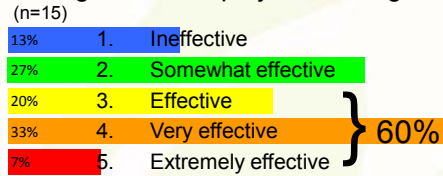
A. Hobart research meetings



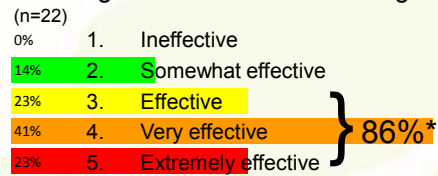
C. Bus tours



B. Targeted cross-project meetings

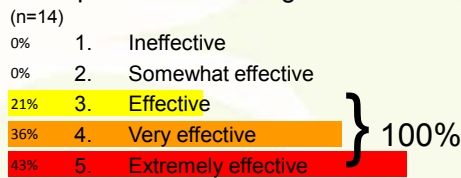


D. Targeted stakeholder meetings

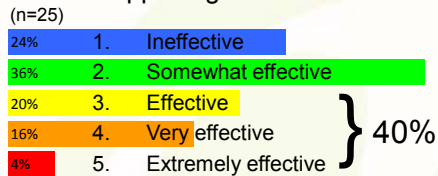


* Sums may not match total due to rounding effects. Totals shown are calculated from original data.

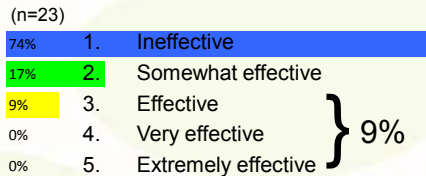
E. Alps Science Management Forums



F. Hub Happenings



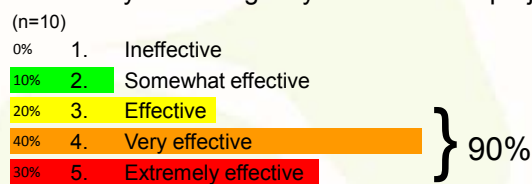
G. Hub website



LANDSCAPES & POLICY hub

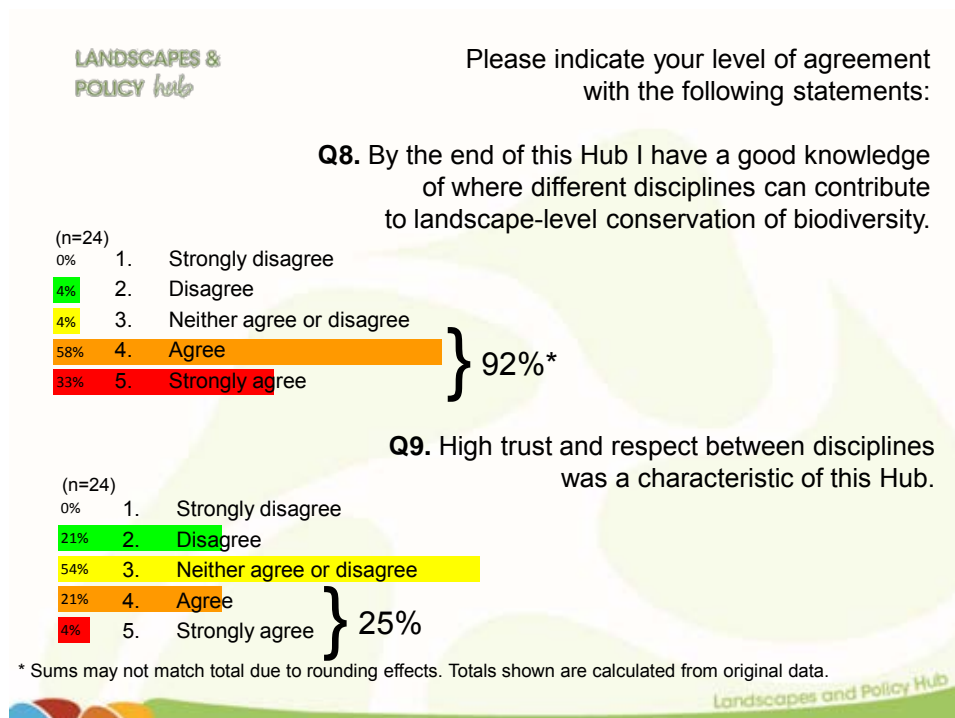
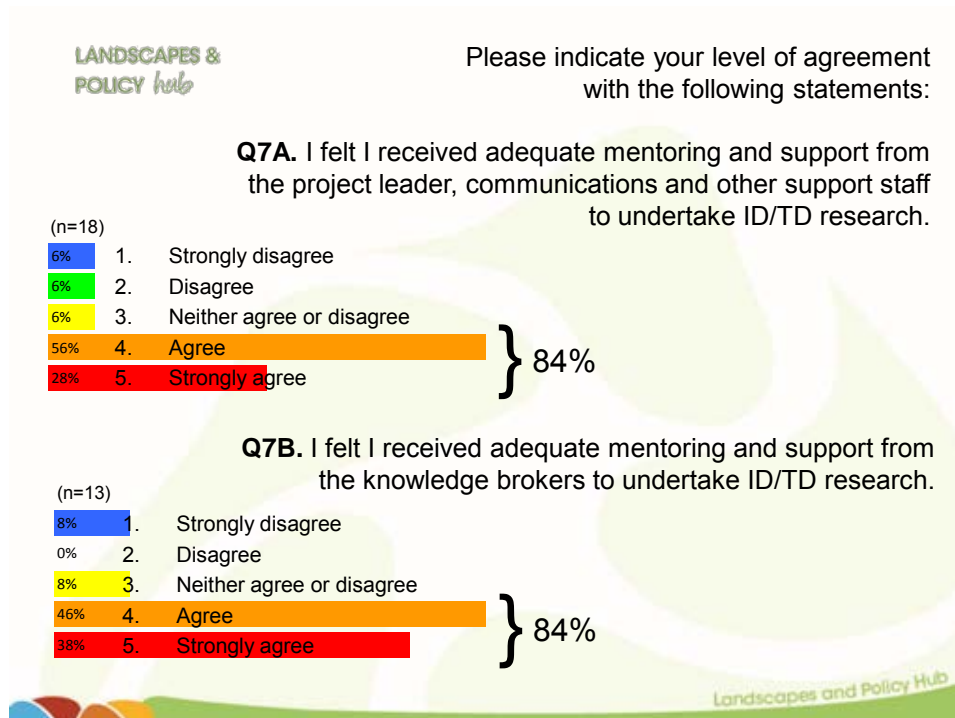
Q6. How effective was the strategy listed below in overcoming **inflexibility in structure, funding and operations** as a barrier to **transdisciplinary** research?*

Availability of contingency funds for new projects



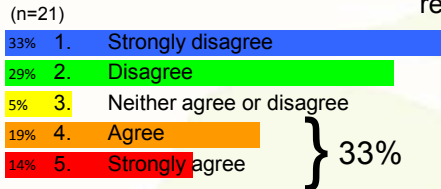
* This question was addressed to project leaders only.

2. Extent the hub adopted other activities and strategies enabling interdisciplinary and transdisciplinary research

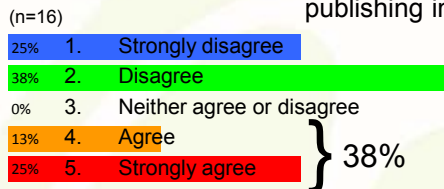


Please indicate your level of agreement with the following statements:

Q10. Sufficient time was allocated, as a Hub, to an early joint problem definition stage with research users and other researchers.

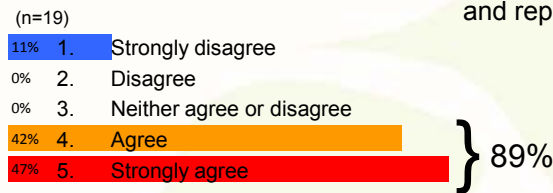


Q11. It was challenging for me to undertake research with research users as my professional rewards are based on publishing in high impact peer reviewed journals.

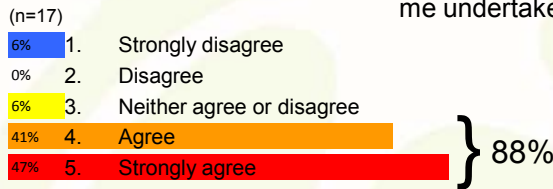


Please indicate your level of agreement with the following statements:

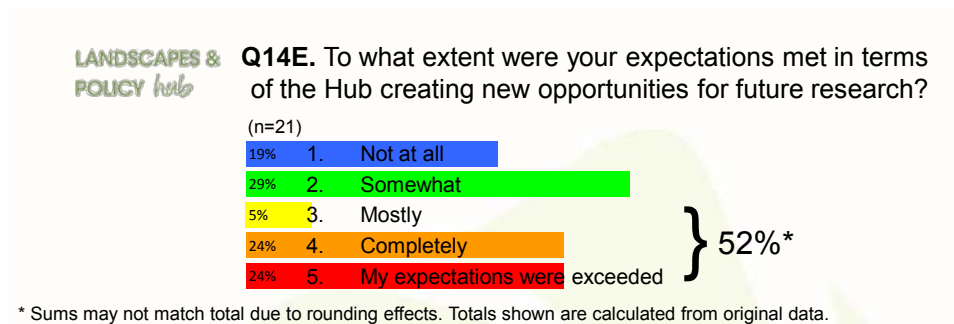
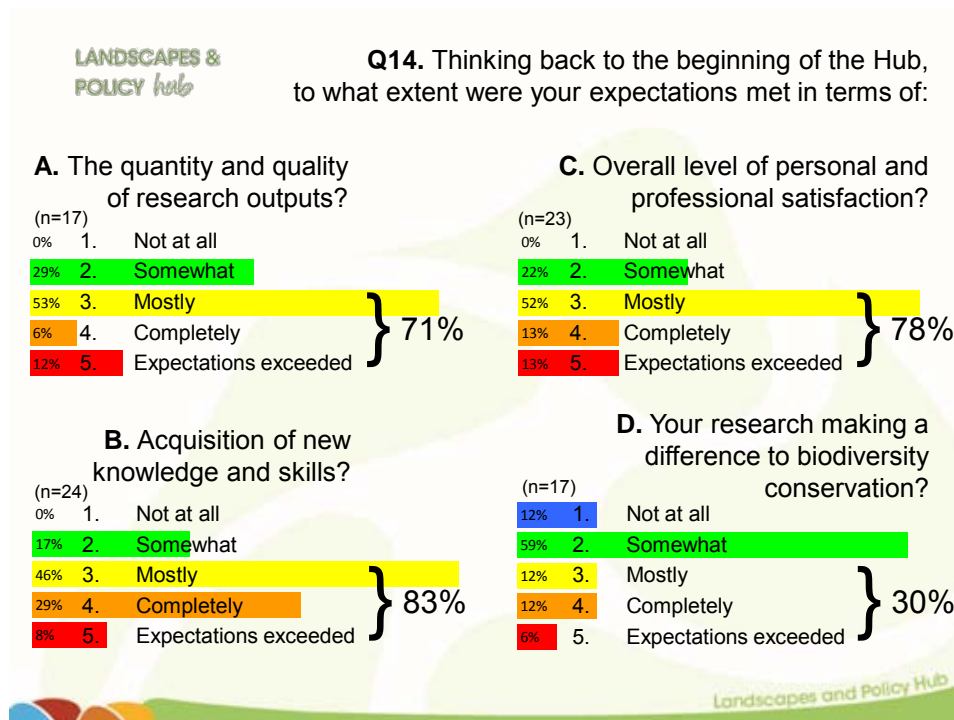
Q12. I felt the hub supported me to be accountable to research users in the way I conducted my research and reported my research findings.



Q13. Activities with research users including briefings, workshops, training sessions and manuals helped me undertake transdisciplinary research.



3. Overall outcomes of the hub





research for a sustainable future

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