General Resilience

A discussion paper based on insights from a catchment management area workshop in south eastern Australia

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Abstract

In using resilience theory to inform natural resource management planning the focus so far has been primarily on specified resilience, with general resilience less well addressed. This report presents the outcome of a workshop that addressed general resilience in five catchments in south eastern Australia by asking: What are the components of general resilience? How can you assess it? How, where, and when can you (or should you) influence it?

Twelve components were eventually identified, at one of two levels of confidence. The findings on how to assess and what to do about the components are necessarily (and admittedly) subjective, but offer a useful starting point for those considering undertaking this kind of assessment at a range of scales. Nine suggestions are made for how to influence/ manage resilience.

Seven conclusions emerged: i) In assessing general resilience it is not a handbook that is needed but a way of thinking, and the process has to be adaptive. ii) Assessing and managing resilience cannot be tightly codified but requires conceptual rigour nonetheless. iii) Natural resource management plans need to expect the unexpected and be open to change. iv) The social components of resilience are least well understood or recognized in planning. v) Attributes that confer general resilience also tend to confer transformative capacity. vi) To be done effectively a general resilience assessment of an SES focussed on NRM needs to be integrated into whole-system regional planning.

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One way to start the process of assessment is by putting a resilience lens over any existing plan(s).

Introduction

Regional organisations established to coordinate management of landscapes and natural resources in Australia are required to prepare natural resource management (NRM) plans. In New South Wales and two Victorian regions these Catchment Management Authorities (CMAs) have recently incorporated a resilience approach (The Resilience Alliance www.resalliance.org/index.php/resilience_assessment/; Walker and Salt 2006, 2012) into their NRM planning processes.

The interpretation of resilience the CMAs have adopted is the capacity of a system to absorb a disturbance and to keep functioning in the same kind of way. Applying resilience, in this sense, involves two related aspects; *specified resilience* (the resilience 'of what, to what', which calls for identifying particular threshold limits in the system, beyond which it begins to function in a different kind of way, impacting on the quality of ecosystem services), and *general resilience* (the resilience of the system as a whole to any and all kinds of disturbances).

The initial emphasis placed by the five CMAs involved in this assessment was on specified resilience, identifying critical thresholds for control variables within the catchments. So long as control variables remain within these thresholds the social-ecological system keeps functioning in the same way, maintaining the same flows of goods and services. General resilience has received less attention to date, largely because attempting to understand and assess it proved in the timeframes and resources available. As a result the five CMAs (Murray, Namoi, Northern Rivers, Central West, Goulburn-Broken) came together for a workshop to share ideas on how to develop a framework for assessing general resilience. From the start, the catchments were considered as "social-ecological systems" (SES), not just biophysical systems, to emphasize the strong linkages and feedbacks between the biophysical and socio-economic systems that together determine the trajectory of the catchments. This emphasis framed the workshop discussion of general resilience.

Workshop Framework

General resilience is captured in the key phrases "the ability to cope with shocks and to keep functioning" and "the capacity to absorb disturbance and re-organize" (Walker and Salt 2012). The workshop attempted to answer the overall question, "what constitutes that 'ability' and that 'capacity'?" The guiding questions were, therefore:

1. What are the components of general resilience?
2. How can you assess it?
3. How, where, and when can you (or should you) influence it?

Of the components of resilience identified under Q1 a few can be measured directly, while others are more general and their levels and changes in them will be best assessed by relative differences. Most are difficult to measure, and many are hypotheses that are yet to be tested - and may be untestable. Some particular options for a few of the components were noted, and so we have addressed questions 1 and 2 together, giving the suggestions that were made where appropriate, but noting that this is very much a work in progress and needs considerable more attention.

We acknowledge the suggestion of an anonymous referee to present both questions 1 and 2 under each identified component.

Q 1 and Q2. What are the components of general resilience, and how can you assess them?

The assessment of what determines resilience was made on the basis of experiences in the CMAs, not on measurements or by a detailed survey of published studies. The aim was to present the findings of a group of practitioners charged with undertaking resilience assessments of the regions in which they live and work. A number of the participants are familiar with the resilience literature and this influenced identification of resilience components, but since the aim was not a scientific paper original literature citations are mostly not included.

The components of resilience identified varied in terms of how confident the participants were in including them, and therefore how confident one can be in including them in other resilience assessments. The conjectural nature of some may hopefully stimulate other researchers and practitioners to evaluate them more rigorously. Broad confidence levels were assigned along the lines of IPCC 2007 “to characterise uncertainty that is based on expert judgment as to the correctness of a model, an analysis or a statement”, and the components are presented in order of those judged to be in a higher confidence category (level 1 – L1) to those in a lower confidence level (level 2 - L2). The process was subjective, based on the strength of support for a component amongst the participants.

Some of the components apply to both the ecological and the socio-economic aspects of the SES while others are more restricted and the letters E (ecological) and S (socio-economic) are used to indicate this. Whilst the attributes are presented separately, they are closely interlinked and interdependent.

1. Diversity (L1 - E,S).
Ecologically it involves having a diversity of both structure (e.g. grassland and woodland), and function (e.g. controlling soil erosion and providing fodder), and includes diversity of responses to shocks (e.g. two species of grass control erosion, one declines under grazing but not drought, the other does the reverse).

Biophysical diversity determines the diversity of resource use options, and these can become locked in by damming rivers, vegetation clearing, land-forming (changing the land surface through grading), etc., all actions aimed at delivering a particular set of products considered important at the time of development. It can be costly or impossible to regain the potential for alternative resource uses. Landscapes that retain the diversity and functional capacity to generate other values and other products can be the foundation for post-shock recovery, or transformation to a new system. Maintaining such options can mean foregoing known short term benefits.

In social systems, diversity includes: diversity of ideas and practices (management techniques/methods) promoted for example by in/out migration of population, balanced with continuity of people (holders of history and culture and therefore learning); having a diverse, balanced population structure (i.e., we need the knowledge and wisdom of the older people, but not a population that is all old people - a trend occurring in Australian farming areas); locational diversity of organisations (proximity to community, not all centred in one place). It is also about acknowledging that the social system functions across a diversity of scales with tensions between scales. These can be negative (e.g. exploitative) or positive (e.g. complementary functions), depending on their nature.

Social system diversity also includes diversity of economic sectors. A mix of primary production, processing, manufacturing and service sectors, and reliance on different input or output markets make an economy less vulnerable to shocks that affect a particular sector.

Assessment: For most CMA assessments the various aspects of diversity will best be reflected by relative changes. Attempts to be more specific suggested a narrowing of the focus on diversity to response diversity - different ways of maintaining/ performing the same function. Key functions of the SES (e.g. agricultural production, energy supply, transport, etc.) are achieved in different ways, and changes (losses - relative or quantitative) in this diversity would be one important way of assessing it.

2. Connectivity (L1 - E,S).

Connectivity in ecological systems enables otherwise isolated populations to recolonise sites where local populations have been extinguished. Thus, ecological corridors may enable species to move along climatic gradients as climate change proceeds. Such corridors may also, however, inadvertently aid the spread of pests and weeds.

In social systems it involves the degree of bonding (within communities) and bridging (between communities), reflected in the degree and the strength of networks and the number of partnerships. Connections to international and national markets enable regional specialisation and consequent benefits from comparative advantage. Disadvantages include loss of regional self-sufficiency and exposure to global business cycles.

Assessment: Communication networks and social networks (related to Social Capital as well as modularity and agency). This involves both social and communication infrastructure (broadband, etc). An example is the Central West CMA 'schools' for increasing landowners' skills and knowledge transfer in using the internet, twitter, etc. What is the status of communication and networking in the region? Knowledge feedbacks; how quickly knowledge is transferred through formal/informal networks requires mechanisms and technology to transfer knowledge.

How effective is information flow? Is it a limiting factor (see attributes above), and can it be given a relative rating?

3. Modularity (related to diversity and connectivity) (L1 - E,S).

A modular system has loosely connected groups of more tightly interacting components such that the interdependence of all components is limited. Hence, a shock sustained by one part does not make the whole system dysfunctional.

In ecosystems it relates to the dynamics of meta-populations. In the social system, transport, medical, communications and energy generation systems are examples shown to be important in the CMA regions. Not being fully connected, and having variation between the parts of a system, can help prevent its collapse. For example, dairy farms in the Goulburn-Broken Catchment use genetically uniform cattle and are also highly connected by the movements of stock, vehicles and people, so making milk production from the dairy system as a whole vulnerable to disease (such as the Anthrax outbreaks that occurred in the late 1990's).

Decentralisation of governance would enhance modularity because leadership and government functions are replicated spatially, in a somewhat differentiated manner. With centralised governance loss of leadership or government functionality compromises the system as a whole.

Apart from noting particular changes, there were no suggestions for how to assess modularity, in general.

4. Reserves (L1 - E,S).

Having reserves in both the ecological and socio-economic domains confers general resilience. This component is one way in which specified and general resilience are related, because systems in which the controlling (biophysical, social, economic) variables are all operating well within known thresholds have relatively higher general resilience to unexpected shocks. In the economic system it amounts to having convertible financial capital to draw on when needed. Also, beyond financial, if capital stocks of all kinds get drawn down it leads to a decrease in resilience.

Again, assessment suggestions were all of a particular nature.

5. Governance (L1 - S).

Clarity of institutional roles is one of the most important, but often poorly defined, parts of governance. Some overlap is good, but confusion and ambiguity about roles causes delays in response times and reduces response capacity. For example, planning laws that inadequately consider cumulative, secondary or feedback effects were considered to be a common problem leading to lowering of resilience. Too often regulations (like those associated with water reform in the Murray Darling Basin) are developed in silos and both planners and farmers have to deal with many pieces of regulation some of which are contradictory.

The discussion on governance identified a deeper problem of the clash between regional attempts at promoting resilience and the structure and functions of State and Federal bureaucracies. CMAs are trying to take a regionally-based systems approach, aware of interactions within and across scales, and of uncertainty around shocks, thresholds and system responses. Bureaucracies, however, are tied into a hierarchical structure with artificial sectoral boundaries, targets that are unforgiving of uncertainty, and an underlying (largely unrecognised) assumption that social-ecological systems are linear, equilibrial and predictable. The result is fundamental contradictions between policies and actual social-ecological system behaviour. Related problems are i) the inconstancy of policy, which shifts with electoral cycles and is aimed at those cycles, not at the region; and ii) the bureaucratic tendency to a "one size fits all" approach. A more comprehensive account of Australia's NRM governance is given by Ryan (2011).

Assessment: There is no one way to measure governance, but one can infer its influence by comparing and contrasting different governance regimes over time. Key aspects, however, are flexibility, a degree of overlap in responsibilities and functions, empowerment in local decision making, and the ability to change the rules that govern resource use. Are any of these changing? Is there evidence of distributed governance – for example having the authority and resources at a local scale to detect a problem and address it without recourse to State or Federal Government?

6. Having a shared mental model (L1 - S).

This is what distinguishes resilience in a SES from resilience in purely ecological systems. It is the process of developing a shared understanding of the SES as an interacting, dynamic system, and what maintains it. Is there a shared mental / conceptual model of the region as a SES ("system"), identifying what really matters? It is the 'engine' for generating commitment, getting ideas adopted and making catchment management decisions. Some participants questioned whether this deserves L1 status.

Assessment: Achieving full agreement amongst diverse stakeholders with contradictory interests is an ideal that is unlikely to be achieved, not least because any mental model

necessarily has some assumptions that can only be tested when a shock hits. A useful interim stage, though, can be reached when stakeholders work together so they come to understand each others' mental models even though they may disagree. In the debating process the overlaps between models can be explored, and here lie opportunities for cooperation. The process is as important as the product.

The conceptual model should be consistent with the best local and scientific knowledge available. Developing an indicator for this is a work in progress.

7. "Social Capital" (L1 – S).

While it was agreed that a complex attribute called social capital was an important component of resilience and probably warrants level 1 confidence, its complexity is such that it cannot be assessed as a single entity; and the degree of confidence that could be individually assigned to the various inter-related elements that make up social capital was not high. The three interrelated elements identified by the participants as the most important and general contributors to social capital are therefore included below as the next three separate components (points 8, 9 and 10) with level 2 confidence.

Assessment: For the following three attributes identified as contributing to social capital in (8, 9 and 10) statistics are available that can be used as indicators. Because many other resilience attributes are not easy to measure and don't have readily available data there is a danger that these measurable attributes could carry more weight than they deserve.

One way to assess community capacity is to consider organizations such as Landcare (in Australia) and Conservation Management Networks. They can be assessed in terms of the numbers of such organisations, the numbers of active members and (estimated) viability, and changes in these over time. These again only provide a partial indication and need to be considered carefully so that they don't outweigh other aspects for which data are less easily accessed.

8. Social cohesion (L2 - S).

This is reflected in the intention to support each other, such as in volunteerism, sporting groups and community networks. Equitable distribution of benefits, costs and opportunities is likely to foster cohesive responses to shocks, as is leadership that crosses individual and group interests.

Cohesion involves respect and a shared vision and values (which may enable transformation). It confers the ability to question or challenge, to ask 'what if?' without being excluded and to see an alternate future and determine alternate options collaboratively. It involves generating a sense of place and alignment to purpose. It relates to the importance of developing a shared mental model of the SES. Community NRM groups

can help develop leaders and are an important part of the social 'glue' in regional communities and increase coping capacity in times of natural disasters, such as floods and fires.

Assessment: (see 7 above)

9. Agency (L2 - S).

Agency is the capacity of individuals or groups, formal or informal, to influence, make or implement decisions. It is enhanced by access to knowledge and other resources, and social networks, policies or laws that support the agent's aims. It is the capacity to act, to make choices and to adapt. Defining terms of agency include responsiveness; representation; inclusiveness; acceptance/involvement. Without it adaptive capacity is minimal.

Assessment: (see 7 above)

10. Self awareness (L2 - E,S).

This involves monitoring social and biophysical systems with a willingness to acknowledge mistakes, to learn and to adapt. Resilience is increased if awareness and reflection are formalised by periodic evaluation of policies and procedures, and of organisations and individuals within them, and commitment to acting on lessons learned. Some participants believed the ability to monitor deserves L1 status.

Assessment: Establishment of a monitoring and evaluation program is a critical part of developing resilience and adaptive capacity. There is a danger that in some institutional arrangements it can become an exercise in reporting upwards to fulfil political ends (ticking boxes). Using MERI (Monitoring, Evaluation, Reporting and Improvement), adaptive management, and approaches such as triple loop learning to drive ongoing NRM (e.g. the Namoi CMA MERI Strategy) are critical. In particular, monitoring with resilience in mind involves trying to detect how near the system is to known thresholds, identifying important new ones, and proposing reallocation of investment away from thresholds that have been determined as not so critical.

11. Economic capacity / farm viability (L2 - S).

Low economic capacity (such as high debt:income and % operating costs, low equity) reduces response capacity, and therefore resilience. The focus of the group was on the agricultural systems, but they of course are coupled to the economic capacity and viability of the urban systems.

Assessment: use of changes in available statistics

12. Time since, and the nature of, shocks (L2 - E,S).

Resilience tends to be low immediately after a shock; for example, reserves (food, savings, and commitment of individuals to the social good) have been used up in the recovery so the system is vulnerable to an 'aftershock'. If, on the other hand, a long time passes between shocks complacency may grow and investment in resilience can decline. Resilience is likely to be higher at an intermediate time interval. It also depends on whether the shocks are of different types/periodicity. A system could become highly resilient in the face of the same shock occurring regularly. Memories of what worked in the past when recovering from a catastrophic change, or transforming to avoid one, can inform decisions. Memories are held within social networks, but are easily ignored and over time forgotten if effort is not invested in eliciting and maintaining them.

Assessment: no general methods were suggested.

To conclude this section, it is acknowledged that the categorization of the attributes into the two confidence levels can be challenged. It has been done, however, partly to raise the issue of assigning confidence for inclusion of attributes in assessing the general resilience of any SES and further discussion would be welcomed.

Q 3. How can / should you influence general resilience?

Managing resilience requires a systems approach to interventions (hence the need for the shared conceptual model). The key thing is not to intervene in a piecemeal fashion or in isolation of other stakeholders. It is important to do a full assessment, identify all the interventions proposed and then determine when and how each should be implemented, collaboratively, and in particular, how to sequence them because each is likely to have secondary effects that will influence the effectiveness and appropriateness of the other proposed interventions.

Following Questions 1 and 2, nine areas emerged as influencing interventions on which to focus attention:

1. Enhancement of information flow and education. In particular:

- Improve access, generally, to education facilities.

- For information flow, provide a detailed annual horizon scan that can inform a business planning cycle and strategic review (covering national and international political and policy trends, commodity prices, community attitudes, flood probabilities, etc). This will enhance response capacity to disturbances and shocks.

- Use emerging technology, such as the Goulburn-Broken CMA use of an interactive wiki approach for developing their Regional Catchment Strategy with their community (>1000 people accessed the website with a very low 'bounce' rate, though less than 10% actually made edits online - which may reflect the need for people to get used to this new technology and the opportunity it presents).

2. Sponsor innovation programs and centres. This calls for developing a culture of innovation, which includes (but goes beyond) how to harness the innovation that is happening locally and around the world, including use of social media in relation to access to information, online learning opportunities, internet fora, etc.

3. Promote and review leadership. Leadership emerges as one of the most critical attributes of a resilient SES. Is it effective? What is "it"? (a person? a team? a process? all of these?) Why is it effective? Which leadership attributes are most effective? When does it need to change? How can change be effected?

4. Rationalise targets. The current NRM agenda is too often spread too thinly with too many required, or uncritically accepted, targets. Resilience helps to focus the agenda on the things that matter, i.e. the controlling variables underlying critical threshold effects. Re-assessing the need for existing nominated targets, using a resilience lens, is an appropriate place to start. Having the wrong catchment objectives due to failure to understand the dynamics of the SES is part of the problem - for example, promoting a certain landuse without appreciating impacts on other SESs. From a resilience perspective each nominated target needs to be questioned in terms of possible secondary effects. Reafforestation for carbon sequestration, or clearing land for development, for example, can have both positive and negative secondary effects in downstream catchments, and the consequences of these for resilience will depend on the particulars of the catchment concerned.

5. Shift funding policies from short term gains to long term resilience. The need is for continuity of funding with the proviso it is used to shift out of failing policies into better ones. It is important to have help *to* change, rather than help *not to* change. Influenced by threats to jobs and lobbying by industry, governments often do assist industries to resist change by subsidising them during times of low demand or rising competition. If transformation is necessary its feasibility will depend on having a financially feasible pathway, and taxpayer subsidisation may be a prerequisite for feasibility. Subsidy may also be necessary to assist some stakeholders to adjust by moving into another sector or retiring. Subsidised transformation may be less costly to society than a social-ecological collapse, but political palatability can be a challenge to this type of change.

6. Reduce mismatches between ecological and social scales. Do the crucial scales at which the catchment/region functions (and therefore needs to be managed) align with those at which it is currently managed? If not, can the latter be modified? The discussion in the workshop about scales indicated solutions are possible. The regional scale is not always appropriate for the issues being considered, but it's a starting point. There are no institutional barriers to stop CMAs working across scales (above or below) and three CMAs in the NSW Tablelands as well as three across northern Victoria have acknowledged inter-catchment linkages and now work together on some issues.

Subdividing regions into social-ecological sub-regions using a mix of social and environmental attributes has promise, without shifting the boundaries of regions. In the Goulburn Broken CMA, for example, decision making has been refined and improved from using two regions within the Catchment (irrigation and dryland) in the early 2000's to now recognising six sub-Catchment SESs. The previous coarse categorisation had ignored substantial spatial variation in biophysical and social dynamics. Acknowledgement of those differences is now reflected in strategies for managing each of the six SESs somewhat differently (Goulburn Broken CMA 2013). The NSW Catchment Action Plans have similarly reclassified their catchments into sub-regional SESs and their categorisation can be found at *http://www.nrc.nsw.gov.au*. The Goulburn Broken CMA's are at *http://www.gbcma.vic.gov.au*). This approach balances being small enough to understand important differences, while being large enough to allocate resources efficiently.

A resilience approach requires multiple scales which means that governance and other mechanisms need to be able to account for multiple scales, including cross region co-ordination mechanisms.

7. Enhance response diversity. This is as important socially as it is ecologically and physically and it warrants particular attention in terms of possible interventions. It involves having different people in a network providing the same function in different ways. It calls for recognising and celebrating response diversity, as opposed to eliminating it in an efficiency drive. It is related to organisational governance structures (redundancy); all organisations should have some functional redundancy.

8. Determine the appropriate sequence for implementing interventions. The evolving set of interventions needs to be considered in terms of the order in which they need to be made. For example, implementing water reforms that would impact on irrigators' livelihoods and the social and economic viability of some communities requires sound information, a genuine consultation process, carefully phased changes in rules and incentives, and support to enable some stakeholders to change to other economic activities. Assessing how and when to intervene requires an iterative approach, and is context dependent. What works in one SES often will not work in another.

9. Possible shocks, impacts and interventions. This involves undertaking an assessment of the possible/likely shocks that are of concern to a particular SES, listing their likely impacts and then examining appropriate interventions that could address these impacts. Going through this process will point to a range of actions needed that, collectively, will build general resilience. Studying responses by the system to shocks suffered in the past can provide insights into the most important attributes of resilience in that system.

Conclusions

The distinction between specified and general resilience, discussed at the beginning of the paper, is important to guide the application of resilience in practice. Conceptually and practically it is more straightforward (particularly with regard to investment in annual on-ground programs) to engage with the notion of thresholds, and hence their prominence in the initial efforts by most CMAs to apply resilience concepts. In this working paper a framework has been provided for implementing the notion of general resilience, based on the three questions which must be addressed.

The points under each of the three questions came from sharing experiences and ideas from the five CMAs and proved helpful in addressing the first two questions. Section 3, however - what to do about resilience - is highly context dependent and is consequently less well developed.

The experiences to date in trying to implement a resilience approach led to six general conclusions:

1) It is not just a handbook that is needed. Embedding a resilience approach to planning requires the development of a culture, a mind-set. There is no one 'right' answer; in fact there may often be several 'right' answers, and the process (which is equally important) needs to be adaptive.

2) Assessing and managing general resilience cannot be codified too tightly. Though a structured approach and conceptual rigour is needed, planners must be open to new ideas.

3) Experience has shown that planning on the basis of forecasts and scenario development cannot account for all possible eventualities, and hence the importance of maintaining general resilience. This is highlighted by the experience in the Goulburn-Broken Catchment where the three most significant changes that required action in the past two decades came as complete surprises, despite the following rigorous forecasts and scenario development:

- There was significant land use change (including size of farms) in the early 1990's when the original Salinity Plan predicted it would be highly stable for at least the next two decades.

- It was predicted in the early 2000's that the region would never have an opening irrigation water allocation (made in October each year) of less than 30% of entitlement. Within two years it was 0% (i.e. no water to start the irrigation season).

- In 2010 it was predicted Lake Eildon (the Catchment's main storage) would take 6 years to fill after the millennium drought; it took just 6 months following the highest rainfall and flooding on record.

A strategic planning approach based on resilience would expect that unexpected things will happen and that it is necessary to have the flexibility and options for even radical changes in resource use patterns, to build general resilience, and to adopt an adaptive planning approach.

4) Social attributes of regional communities are currently poorly addressed in planning. In particular:

i) The lack of collective self-awareness and the different and sometimes incompatible 'mental models' held by the various stakeholder groups, the CMAs and the government departments. Hence the need for a shared mental model of the catchment as a social-ecological system (SES), including the various scales at which it functions.

ii) Inclusion of a wide range of interest groups and organisations that operate at a range of spatial and temporal scales. No one organisation or interest group can take the sole responsibility of developing the "right" plan.

5) Much of what confers general resilience also confers transformative capacity – the ability to envision a different future, and being willing and having the capacity to make fundamental changes to realise it. Having that capacity again puts a focus on governance and the extent to which making transformational changes are possible under current governance rules.

6) An important insight from the workshop is that even though the general resilience assessment of an SES initially focussed on NRM, it involves much more than that. To be done effectively it necessarily integrates NRM into whole-system regional planning.

The challenge of putting resilience concepts into practice can seem daunting in the face of lack of information and the necessary understanding. However, as emphasised repeatedly in the adaptive management literature, it has to be an iterative process. One way to start is by putting a resilience lens over any existing plan(s). Producing a first resilience-based NRM plan with the capacity to iterate as information needs identified in the plan become available is an important approach to incorporating general resilience concepts.

REFERENCES

Anderies, J.M., P. Ryan and B.H. Walker. 2006. Loss of Resilience, Crisis, and Institutional Change: Lessons from an Intensive Agricultural System in southeastern Australia. *Ecosystems* 9: 865-878.

IPCC 2007. Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties. Intergovernmental Panel on Climate Change, WMO UNEP.

Ryan,S. 2011. Australia's NRM governance. https://www.nrmlinks.org.au/threads/256-Australia-s-NRM-governance-system%20hairs

Walker, B.H. and D. Salt. 2006. Resilience thinking: sustaining ecosystems and people in a changing world. Island Press, Washington, DC.

Walker,B.H. and D. Salt. 2012. Resilience Practice: Building capacity to absorb disturbance and maintain function. Island Press, Washington, DC.