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Social vulnerability, social-ecological resilience and coastal governance

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Research Article

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Non-technical summary. Our analysis shows that the framing of social vulnerability is shaped by a narrow definition of resilience, focusing on post-disaster return and recovery responses. This perspective does not account for the dynamism and non-stationarity of social-ecological systems (SES) which is becoming increasingly important in the face of accelerating environmental change. Incorporating social-ecological resilience into social vulnerability analysis can improve coastal governance by accounting for adaptation and transformation, as well as scale and cross-scale interactions.

Technical summary. Social vulnerability analysis has been unable to deliver outcomes that reflect the reality of vulnerability and its consequences in an era characterised by accelerating environmental change. In this work, we used critical discourse analysis and key informant interviews to understand different framings of social vulnerability in coastal governance and management, globally and in New Zealand. We found that the framing of system vulnerability could vary depending on the definition of resilience adopted, which has critical ramifications for coastal governance of linked systems of humans and nature. We found that the framing of social vulnerability in coastal governance is mainly influenced by engineering, community and disaster resilience, focusing on return and recovery governance responses to environmental change (e.g. hurricanes, wildfires). Instead, we suggest a novel perspective based on social-ecological resilience, which more accurately reflects the dynamics of linked systems of humans and nature (SES). This revised perspective, *general vulnerability*, accounts for the dynamics of Earth's systems across various spatial and temporal scales in the face of accelerating environmental change. Accounting for social-ecological resilience and its core aspects (i.e. panarchy, adaptation *and* transformation) is essential for informing coastal governance of SES (Do we adapt? or Do we transform the SES?).

Social media summary. Social-ecological resilience is essential for social vulnerability analysis in the face of accelerating environmental change.

1. Introduction

Social vulnerability assessment (SVA) is important for addressing rising concerns about the impacts of natural hazards and climate change (Adger, 1999; Cutter, 1996; Kelly & Adger, 2000). Social vulnerability refers to the degree of susceptibility of human systems (including individuals, communities and institutions) to adversity (Adger, 1999; Bevacqua et al., 2018; Cutter et al., 2003). Since its emergence, the concept has evolved, gained prominence in a multi-disciplinary context, and multiple methodologies have been developed to assess social vulnerability. These methodologies largely focus on (i) deductive approaches to identify *easy to measure* indicators (i.e. variables that reflect past or present conditions within a limited temporal range, and at a single spatial scale) and (ii) developing quantitative methods for aggregation and evaluation of these indicators (Aroca-Jimenez et al., 2017; Bjarnadottir et al., 2011; Fernandez et al., 2017; Mason et al., 2019; Spielman et al., 2020; Yoon, 2012).

Conventional quantitative SVA methodologies based on place-based indices (Cutter et al., 2003; Flanagan et al., 2011, 2018) can provide an overview of the social vulnerability landscape. However, when facing a constantly changing environment, or multiple plausible futures, these methodologies are insufficient to capture or reflect the complexities of near- and long-term social vulnerability. These limitations reduce the usefulness of quantitative SVA for decision-making, as a critical shortcoming in SVA is the limited ability to address the complex dynamics of linked systems of humans and nature (Adger et al., 2018; Chuang et al., 2018). In particular, traditional methods fail to adequately account for the qualitative and *hard to measure* aspects of social systems (Fawcett et al., 2017), the uncertainty of future scenarios of change (Adger et al., 2018), and system connectivity and interactions across multiple temporal and spatial scales (Chuang et al., 2018; Fawcett et al., 2017). For example, Chuang et al. (2018) are critical

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of static social vulnerability analyses based on snapshots in time and space. Static analyses do not consider that linked systems of humans and nature are dynamic social-ecological systems (SES), which have multiple scales, can exist in different configurations (e.g. coral dominated or algae-dominated coral reefs), and interact at various levels and may respond to an impact or a change on a different scale (Gunderson & Holling, 2002). Further, many SESs are non-stationary, as baseline conditions measured previously have changed, negatively affecting responses unless this non-stationarity is considered (e.g. Nalau et al. 2021). Some scholars have highlighted the limitations of these SVA methodologies and discussed problems such as the need for robust conceptual underpinnings in defining the 'socioeconomic' vulnerability profile that does not lead to subjective vulnerability assessment (Hufschmidt, 2011), monitoring and evaluating the effectiveness of adaptation responses (Fawcett et al., 2017; Hinkel, 2011), incorporating the complex dynamics of SESs in future scenarios of change (Adger, 2000; Fawcett et al., 2017), and inclusion of cascading and cumulative impacts of drivers at different locations and spatial scales (Adger et al., 2018; Lawrence et al., 2020a; Thomas et al., 2019).

Most coastal governance and management adopts an engineering, community or disaster resilience mindset to better predict hazards, apply engineering strategies to minimise or mitigate impacts, increase system robustness to maintain system state, and allow for rapid recovery to restore the previous configuration ('return to normal') (Adams-Hutcheson et al., 2019; Garmestani et al., 2019a; Pelling, 2010). Coastal governance based upon engineering, community or disaster resilience has been imported to the governance of coastal SES without adequately acknowledging the fundamental differences between different conceptions of resilience (e.g. engineering resilience, community resilience, disaster resilience ***VS.*** social-ecological resilience (*sensu* Holling, 1973)).

These problems are fundamental limitations to SVA, as well as engineering, community or disaster resilience discourses for the governance of SES. Here, we seek to improve SVA for coastal governance by incorporating a SES perspective. A SES is a self-organising, dynamic and complex system of humans and nature, characterised by resilience, adaptability, transformability, and multiple scales (panarchy) (Gunderson & Holling, 2002). Accounting for SES dynamics at multiple spatial and temporal scales is necessary to increase the accuracy and application of SVA to social vulnerability in real-life (Garmestani et al., 2020). Importantly, the definition of resilience adopted for coastal governance has critical ramifications for the types of policies and management applied to coastal zones globally (Allen et al., 2019).

We adopted the definitions of resilience offered by Allen et al. (2019) to bring clarity for coastal governance. Allen et al. (2019) discussed three main definitions of resilience for SESs: (i) resilience as a rate; (ii) resilience as a process; and (iii) resilience as an emergent property. *Resilience as a rate* is shaped by an engineering mindset (engineering resilience or resiliency) (Allen et al., 2019; Holling et al., 2002). In this definition, resiliency is a term frequently used to address a system's robustness, its ability to resist change, and the capacity to prevent a regime shift (Holling, 1996; Holling et al., 2002). *Resilience as a process*, which is mainly applied in community resilience and disaster resilience, emphasises building, maintaining, or enhancing system resilience (Allen et al., 2019).

Resilience as an emergent property of SESs (***social-ecological resilience***) explicitly accounts for the possibility that SESs can exist in different configurations or regimes (Gunderson & Holling, 2002; Wilson et al., 2013). Social-ecological resilience is an overarching approach to explain the dynamics of SESs, as it encompasses adaptation but also transformation, as well as panarchy (scale and cross-scale interactions) (Folke et al., 2010; Gunderson & Holling, 2002; Holling et al., 2002). Panarchy, or 'nature's rules', incorporates hierarchy and dynamism and accounts for the interconnectedness of social-ecological resilience and vulnerability on multiple spatial and temporal scales (Allen et al., 2014; Garmestani et al., 2020).

Each definition of resilience could be useful and fit the purpose for a specific context. However, the differences between their core assumptions create framing that hinders interchangeable and generic applications for SES. For example, *resilience as a process* is useful to address management strategies for enhancing community resilience to some natural hazard events (i.e. 1% Annual Exceedance Probability coastal inundation). But for a coastal community that is frequently exposed to inundation (due to climate change impacts), coastal governance should adopt the social-ecological resilience framing in order to allow for adaptation (e.g. protecting coastal wetlands) or transformation (e.g. managed retreat of a community away from its current coastal location).

Adaptation is the process of adjusting to changing conditions but remaining in the same configuration with a similar set of processes and structures defining that regime. *Transformation* is the process of shifting a SES with the human agency to a more desirable configuration with a different set of processes and structures than the previous configuration. Transformation is a response to the heightened vulnerability that rarely gets invoked, because community and disaster resilience have focused on the *rate or process* definitions of resilience (i.e. engineering resilience, community resilience or disaster resilience). The *resilience as a rate or process* definitions fail to account for non-stationarity in systems, and the presence of critical thresholds or tipping points, that when exceeded, will result in the system of interest shifting to a new regime with different processes and structures. Given that coastal SESs, like other SESs, are non-stationary and do have thresholds, consideration of potential alternatives for coastal governance when such a threshold is reached is critical (Lawrence et al., 2020a). Acknowledging these thresholds, and the potential for SES to fundamentally re-organise, provides an opportunity to change systems with high vulnerability through transformation (Lawrence et al., 2020a).

Here, we use social-ecological resilience to present a novel framing of social vulnerability and argue that social-ecological resilience is an essential consideration for SESs by addressing the neglected aspects of social vulnerability such as cross-scale interactions (temporal and spatial scales) and transformation (Gunderson & Holling, 2002). We focus on the links between social-ecological resilience and vulnerability (Allen & Holling, 2010; Gallopín, 2006) to discuss: (i) how these concepts have been framed and applied in practice. Framing, as we address in this research, refers to the relationship between understanding (ontological and epistemological aspects) of polysemic concepts or boundary objects such as resilience and vulnerability (Baggio et al., 2015; Strunz, 2012), its perception between users (mindset), and defining its contributing variables (Fairhurst & Sarr, 1996; Tannen, 1993); (ii) how the definition of resilience affects the framing of vulnerability; (iii) how the framing of social vulnerability could influence its assessment outcomes; and (iv) how the application of these different concepts could impact the

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implementation of adaptive and transformative coastal governance in New Zealand (and globally), with a qualitative two-stage analytical approach consisting of Critical Discourse Analysis (CDA) and key informant interviews.

2. Methods

A qualitative two-stage analytical approach including a CDA and key informant interviews was adopted (Hajer, 2005; van den Brink & Metze, 2006; Weiss & Wodak, 2007). While key literature, including the existing literature reviews (Davidson et al., 2016; De Sherbinin et al., 2019; Ferro-Azcona et al., 2019; Moser et al., 2019; Siders, 2019) was considered in the CDA process, conducting a separate 'systematic literature review' was outside the scope of this research.

CDA is often used in social science research to examine the relationships and connections between the meaning of a concept, its perception among users, and its application in social and political contexts (Catalano & Waugh, 2020; Rogers, 2004). Our CDA was not meant to provide a detailed typological review based on individual articles. Instead, CDA was used to deconstruct discourses: principally natural hazards, disaster management and climate change discourses, and analyse trends in social vulnerability framings. Tannen (1993) found that while different discourses could create multiple framings of a concept (i.e. social vulnerability), framing, in turn, delivered a valuable basis for shaping discourses and their practical application.

As our primary database for CDA, the Web of Science was searched for articles published on the topic of coastal social vulnerability to climate change. Keywords including 'social vulnerability', 'coast*', and 'climate change' were used in multiple combinations to filter and screen the peer-reviewed publications between 2000 and 2020. Our search identified ninety-three papers (Supplementary Table 1). Also, the Google Scholar database was searched to include significant research that was possibly missed during the Web of Science search (20 more papers were reviewed).

We also conducted a series of semi-structured interviews to acquire in-depth, first-hand and practical information about the framing of vulnerability, and its influence on developing and applying SVA frameworks in New Zealand's coastal governance and management (as the case study for research leading to this article). Interviewees were selected:

(1) from decision-makers, managers, and practitioners involved in the development or application of SVA. Ten interviews were selected: eight from regional and local councils (the government organisation responsible for applying SVA in practice); one from the Ministry for the Environment (the Central Government agency responsible for developing SVA guidance); and one leading researcher engaged with developing SVA in New Zealand (Supplementary Table 2).
(2) representing a variety of councils with a diversity of social and ecological features (i.e. economically privileged and non-privileged municipalities).

Interviewees were asked five to six open-ended questions regarding their perceptions of social vulnerability (and transformation), its application in the current coastal governance and management practice, and the features of a forward-looking SVA framework to improve decision-making and policy development in practice (Supplementary Table 3). To preserve the participants' anonymity during the analysis, each participant was allocated a unique code. Interview transcription files were analysed with NVIVO 12 software.

3. Results

3.1. Framing of resilience in the coastal literature

Social vulnerability was commonly defined as a measure of a social system's susceptibility to adversity due to the lack of coping capacity, adaptability or recoverability (Adger, 2000; Cinner et al., 2012; IPCC, 2014; Shaw et al., 2014). In these contexts, quantitative assessments of social vulnerability indicators were the primary method of SVA (González-Baheza & Arizpe, 2018; Hagenlocher et al., 2018). Some coastal SVA research either did not address the term resilience or applied it in a generic fashion without any particular definition or framing (Cinner et al., 2012; Hardy & Hauer, 2018; Kelly & Adger, 2000). Risk, hazard, disaster, recovery, adaptation, coping capacity and resilience were among the most frequent terms.

In other research, *resilience as a process* (Mussi et al., 2018; Orencio & Fujii, 2013; Shao et al., 2020) and *resilience as a rate* (Lam et al., 2016; Silver et al., 2019; Wu et al., 2016) were the most frequent definitions of resilience. These discourses discussed the resilience and vulnerability of a social system through three perspectives:

(1) ***Enhancing resiliency* or *resistance*:** commonly mentioned in the research influenced by the *rate* definition. Resilience was associated with an intrinsic or pre-existing capacity to reduce system vulnerability. Avoiding or mitigating hazard exposures and risks were the main strategies for enhancing system resiliency and reducing vulnerability (Colburn et al., 2016; Ge et al., 2017; Martins & Gasalla, 2020).
(2) ***Coping capacity* (adaptation) and *adaptability* (adaptive capacity)**: more frequent in research that defined resilience as a process. These terms implied enhancing (or building up) resilience as the pre-disturbance capacity to improve a social system's adaptability, maintaining its existing state, and avoiding regime shifts (Gerrity & Phillips, 2020; Smith et al., 2018).
(3) ***Return* and *recovery*:** common in both rate and process discourses, addresses post-disturbance capacity in human systems to bounce back when a system is out of equilibrium (Adger, 2000; Kelly &Adger, 2000). Returning to a system's optimal or equilibrium state was more noticeable in the rate discourse (Shaw et al., 2014). In the process definition, recovery mainly indicated the capacity to return to a general pre-disturbed state, or 'return to normal' regardless of optimality or desirability of that state (Bennett et al., 2016; Chang et al., 2018; Martins & Gasalla, 2020).

Despite the growing application of social-ecological resilience in environmental governance and management research in the last couple of decades (Angeler et al., 2018; Garmestani & Benson, 2013; Jozaei et al., 2020), this discourse has not been well considered in SVA research. Adger et al. (2005) were among the few scholars who adopted social-ecological resilience and argued the role of multi-level governance, with cross-scale connections, to create both adaptive and transformative capacities in coastal SESs. Noting the clear limitations of adaptive governance with respect to scale, cross-scale interactions and inadequate consideration of law, Garmestani and Benson (2013) combined

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adaptive governance, panarchy and law to create *resilience-based governance* of SES with applications for any SES, but with clear ramifications for coastal governance (e.g. Florida, USA).

Although several SVA scholars mentioned social-ecological resilience in their research, there was no evidence that the concept was adopted to create a social-ecological resilience framing. For example, Hagenlocher et al. (2018, p. 76) addressed the vulnerability of coupled 'social-ecological systems', but the term was applied as a more suitable 'unit of analysis' in hazard and risk assessment (Hagenlocher et al., 2018). The authors instead adopted a *resilience as a process* discourse ('build resilience' or 'enhance resilience') with no clear link to social-ecological resilience (*resilience as an emergent property*) of SESs (Hagenlocher et al., 2018).

Dominated by *resilience as a process* and *resilience as a rate* definitions, adaptive capacity was identified as the primary capacity required to reduce social vulnerability. From these perspectives, adaptive capacity refers to the ability of a social system (i.e. a community) to cope with hazards and risk drivers, recover after being disturbed, return to a normal state, and avoid transformation (Delfino et al., 2019; Freduah et al., 2018; Joakim et al., 2015).

This characterisation of adaptive capacity is very different from research on social-ecological resilience, where adaptive capacity is the *potential* of a SES to alter resilience in response to change and maintain the current regime, while transformative capacity is the *potential* of a SES to fundamentally change its processes and structures with human agency and reorganise into a new regime (Garmestani et al., 2019b). Since social-ecological resilience received little consideration in SVA research, transformative capacity and its role in addressing social system vulnerability was disregarded or ambiguously addressed in coastal SVA research.

Finally, the results showed inadequate consideration of scale and cross-scale spatio-temporal connectedness in addressing social vulnerability. Of the literature reviewed, only a few researchers addressed cross-scale interactions as an aspect of resilience or as a way to reduce vulnerability (Cutter et al., 2003; Thomas et al., 2019).

3.2. Framing of social vulnerability in New Zealand coastal governance practice

The analysis of interviews demonstrates the predominance of engineering, community, and disaster resilience discourses amongst New Zealand's coastal governance and management practitioners. The key terms frequently observed in responses included: hazard, risk, disaster, coping, and recovery. *Resilience as a process* was the primary definition used by coastal zone practitioners. As one participant discussed, New Zealand's SVA and risk assessment system has a focus on natural hazard and disaster vulnerability: 'I think we are reasonably well serviced for the sort of traditional disaster type of event, the major event that causes damage.'

Resilience as a rate was evident in the interviews through addressing resistance or avoiding change, timely recovery and 'back to stability'. Most importantly, there was only one reference to social-ecological resilience. In general, most participants referred to the IPCC definition of vulnerability as a useful and practical framing. This definition discusses vulnerability as a concept that incorporates a variety of variables such as 'sensitivity or susceptibility to harm' and a lack of 'coping' and adaptive capacity (IPCC, 2014).

In this context, adaptive capacity was frequently mentioned as a key means for dealing with change and uncertainty. Amongst the interviewees, adaptive capacity was frequently defined as a social system's (or a community's) ability to adapt, retain or maintain its existing state, bounce back, build back (or build back better), return to normal, or recover after turbulence. Again, this definition differs significantly from the definition of adaptive capacity from social-ecological resilience, where adaptive capacity is the *potential of a SES to alter resilience in response to change and maintain the current regime* (Garmestani et al., 2019b). Before the questions related to transformative capacity were discussed with participants, only one interviewee directly discussed transformation as an aspect of social-ecological resilience, but argued transformation as an attribute of adaptive capacity:

> "…There are probably different ways you could look at it [adaptive capacity]. So, you could say, well, there's the adaptive capacity that allows us to return to the existing status quo, stable state. Ok. [or] you could also think of adaptive capacity in the … and now we're getting back into that resilience as transformation … What resilience is actually is the community thriving in some ways, and it doesn't have to replicate itself as … all of those foundations are evolving over time anyway. So, we might see over time there's been a move from, sheep farming in New Zealand to dairy… because they invented nylon and didn't need to farm sheep for wool anymore. There was a bottom dropped out of the market. So, they transformed the economy."

Moreover, a few participants indicated the multifaceted and complex nature of concepts such as vulnerability, adaptive capacity, and resilience and argued that various attributes are involved in their framing. One interviewee argued:

> "… I think actually, adaptive capacity, we just don't understand what that is. I really don't think anyone understands, and it's just a convenient term. There have probably been some theoretical descriptions of it. However, I don't think in practice it has so many meanings to so many people."

Another participant added that resilience and adaptive capacity are more challenging to understand and apply in the context of incremental and cumulative drivers such as sea level rise:

> "… With ongoing sea level rise, it's kind of a difficult concept, I think, because with the ongoing sea level to rise for several centuries. It's never going to be completely resilient unless we make some major transformational changes, move away or do something radical or move ahead of the curve, so to speak, of sea level."

In the last part of the interview, transformation and transformative capacity were discussed with the participants. We shared our interpretation of transformation as a system fundamentally changing its key processes and structures with human agency and shifting to a new configuration (see Section 1.). The analogy used to better communicate transformative capacity was a coastal community which is capable of: (i) changing its main functional attributes to, local coastal tourism for example, if farming, as a traditional way of living, is not an option anymore; or (ii) undergoing managed retreat and relocating to another place if adaptation strategies are not feasible.

Although one interviewee argued that transformation is complex or is a 'leap too far', others found transformative strategies to be a proactive response to the uncertain impacts of climate change: '[transformative strategies] would be more like a proactive *vs* reactive kind of response.' Most participants asserted that a coastal society with transformative capacity is less vulnerable than a society without it. In their accounts, transformation is a

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useful means by which social systems could address the complexity and uncertainty of future scenarios of climate change and reduce vulnerability through adaptive learning and novel experimentation. Therefore, interviewees mentioned that although the current SVA methodologies in New Zealand do not account for transformation, it should be incorporated in a future-oriented SVA methodology:

> "… They [community] need to evolve; they need not go back to the baseline but somehow grow and strengthen from that position. So yeah, it [transformative capacity] is fundamental. Transformation is fundamental to improving resilience or reducing vulnerability."

Other issues raised in the conversations were scale mismatches and inadequate consideration of synergistic relations between different temporal and spatial scales. The changing nature of social vulnerability, through time and across levels (e.g. community, regional or national levels) was argued as a significant component of an effective SVA. Participants discussed that an SVA framework should be forward-looking and deliver a long-term and systems-level (multi-scale) understanding of social vulnerability. For example, some interviewees argued that while some adaptation strategies might decrease community vulnerability in the short term or at a particular location, those strategies could undermine resilience and increase vulnerability in the long term at other locations. In addition, participants discussed that while a community group might have adequate adaptive capacity to cope with climate change impacts, the entire system (including other communities and their governance systems) might still be vulnerable.

Overall, the results of the interview analysis suggested the initial prevalence of *resilience as a process*, and adaptive capacity as a means of recovery and generally maintaining a system's state amongst New Zealand coastal managers and practitioners. However, when the idea of transformation was discussed, most participants confirmed that transformative capacity plays an important role in reducing social vulnerability. Therefore, a clear understanding of the *type of adaptive capacity* and identifying *components of transformative capacity* should be included in developing vulnerability assessment methodologies. Conceptualising system vulnerability, lack of consideration of spatial and temporal scales (cross-scale interactions), absence of forward-looking, non-prescriptive and holistic approaches, and disregarding uncertainty of future scenarios of change in assessing vulnerability were other significant problems of conventional SVA raised in the interviews.

4. Discussion

The results of the CDA demonstrate that coastal social vulnerability research is still dominated by the engineering, community and disaster resilience discourses, which mainly define *resilience as a rate or resilience as a process* (Gerrity & Phillips, 2020; Smith et al., 2018). The case study interview analysis revealed that this prevalence extends to a smaller scale, namely New Zealand's coastal governance and management. Although *resilience as a rate* is commonly applied in coastal physical and infrastructure vulnerability assessments, our findings indicate that this definition has been applied in some SVA contexts, both in the literature (Colburn et al., 2016; Ge et al., 2017; Martins & Gasalla, 2020) and amongst practitioners. *Social-ecological resilience* (resilience as an emergent property of SESs) and its core ideas (e.g. multiple regimes or configurations, adaptation and transformation, panarchy) were seldom addressed in coastal research and amongst the interviewees. For example, Adams-Hutcheson et al. (2019) examined the dominance of the disaster resilience discourse in New Zealand (due to the long history of exposure to natural hazards such as tsunamis and earthquakes) and discussed the requirement of 'fit-for-purpose resilience' to respond to the dynamics and uncertainty of climate change impacts.

Influenced by the *resilience as a process or rate* definitions, a framing of vulnerability as an antonym of resilience (i.e. system vulnerability is the flip side of its resilience) is prevalent in coastal research globally (Chen et al., 2020; Yang et al., 2019) and found through interviews with New Zealand coastal governance experts. Both the *rate and process* definitions created a normative perspective of resilience and vulnerability (high resilience and low vulnerability are desirable), assuming higher system resilience leads to higher stability and lower vulnerability (Harvey & Woodroffe, 2008; Hufschmidt, 2011), despite the fact that highly resilient systems may be in a very undesirable state (Zellmer & Gunderson, 2008).

However, some international researchers and interview participants disputed the prevailing disaster resilience discourse, focusing on vulnerability to rapid, episodic and catastrophic drivers. This discourse underpins adaptive capacity for resisting change, system robustness (maintaining system state) and recovery from adversity (O'Connell et al., 2015; Reghezza-Zitt et al., 2012; Siders, 2019). Further, the results of the CDA and interview analysis suggest that the outcomes of conventional SVA based on engineering, community and disaster resilience discourses do not adequately address cumulative and cascading impacts of ongoing climate change, potentially generating inaccurate or skewed results, which could lead to undesirable consequences for coastal SESs (Adams-Hutcheson et al., 2019; Fawcett et al., 2017; Hinkel, 2011).

It is clear that given the reality of accelerating environmental change, social-ecological resilience is an essential consideration for vulnerability research, particularly for coastal areas facing ongoing sea-level rise. Social-ecological resilience can address the shortcomings of conventional SVAs based on *resilience as a process and resilience as a rate* by accounting for scale, cross-scale interactions and the possibility that SESs can exist in different configurations (Folke et al., 2010; Garmestani et al., 2020; Holling et al., 2002). We call this framing ***general vulnerability***, which, like social-ecological resilience, is a descriptive term and could be either negative or positive.

4.1. Specific vulnerability vs general vulnerability

As our findings indicate, social vulnerability primarily indicates the *specific* vulnerability of a social system, or a particular sector within it (e.g. significant cultural sites, infrastructure, households, farming or housing sector) to a specific (or set of) drivers (e.g. floods, erosion, tsunami, other storm events) (Koks et al., 2015; Mason et al., 2019). As discussed previously (Janssen et al., 2007), SVA outcomes based on specific vulnerability mainly inform strategies to reduce the susceptibility of social systems to a specific hazard, without adequately accounting for: (i) broader scale vulnerability or differential vulnerability (Thomas et al., 2019) and the vulnerability of multiple sectors within the social system (or the SES across different spatial scales); (ii) unknown, unknowable, cumulative and cascading drivers (Adger et al., 2018; Lawrence et al., 2020a); and (iii) the dynamics of

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vulnerability and its changing nature across multiple spatio-temporal scales (Chuang et al., 2018).

With respect to the dynamics of vulnerability over time, some interviewees argued that although hard infrastructure and engineering adaptation measures to sea-level rise (e.g. stop banks, levees, dykes, sea walls) might reduce the vulnerability of local properties to coastal flooding, these strategies can increase social vulnerability at the broader regional scale, and at medium and long-term time horizons. Further, participants maintained that under ongoing sea level rise, focusing on vulnerability strategies (e.g. return to normal, build back, or build back better in the same location) might reduce susceptibility in the short-term, but will likely inhibit preparations for transformation such as managed retreat and increased social vulnerability over the long-term (Lawrence et al., 2020b).

Moreover, we found that traditional SVA methods based on specific vulnerability, do not take adequate account of the dynamics of SESs in a changing environment. Disregarding the interconnectedness between human and natural systems could create skewed assessment outcomes. For instance, rural systems have different dependencies to particular ecosystem services or functions, which influence their respective vulnerability. A rural community based on tourism (as the main function of that society) might have a different vulnerability to a specific climate hazard (i.e. drought), compared with an adjacent farming community. However, the traditional SVA indicators (i.e. based on age, income, gender ethnicity brackets) do not capture these functional attributes.

Transformative capacity (Garmestani et al., 2019b), as a central notion in social-ecological resilience, is a useful concept to address the general vulnerability of a SES. For example, instead of adaptation, if the SES is in an undesirable state coastal governance could intervene and facilitate the transformation of the SES to a more desirable state (Figure 1). Coastal governance could target capacity building and providing incentives to vulnerable coastal communities to shift their main economic focus and transform their SES if the traditional way of living becomes less viable (for instance, from agriculture to locally-based coastal tourism).

For *general vulnerability*, rather than prescriptive and deductive approaches to reduce vulnerability to a particular driver, SVA incorporating social-ecological resilience would encourage capacity building in SESs in response to unforeseeable and unknown drivers of change (Carpenter et al., 2012, 2019).

Most of the interviewees agreed that a coastal community with more intention to build transformative capacity would be less vulnerable than a locality without it. In their account, transformative capacity is a useful means by which social systems could respond to the complexity and uncertainty of future scenarios of climate change and should be considered in the SVA process:

> "… And, what we need to start looking at is a transformation of how we understand … transformability is a really important concept here. And maybe that's more of a better way of looking at it [adaptive capacity] actually is rather than, what are we being resilient to here?"

The connectedness of resilience and vulnerability across multiple spatio-temporal scales was also addressed as another essential consideration for reform of the SVA process. Panarchy is a nested set of adaptive cycles and has important ramifications for vulnerability (Gunderson & Holling, 2002). Panarchy is increasingly being recognised as a strong foundation for delivering more holistic and flexible governance and management interventions under change and uncertainty (Garmestani & Benson, 2013; Gunderson et al., 2022). Panarchy concerns the cumulative and cascading effects of resilience and vulnerability across spatial and temporal scales (Allen et al., 2014; Gunderson & Holling, 2002; Gunderson et al., 2022). For example, Garmestani et al. (2020) argue the utility of panarchy to address 'emerging vulnerability' of small and large scale ecosystems under human-induced change, and discuss panarchy as a useful means for better visualisation and communication of scientific data to non-scientific audiences (i.e. practitioners and communities).

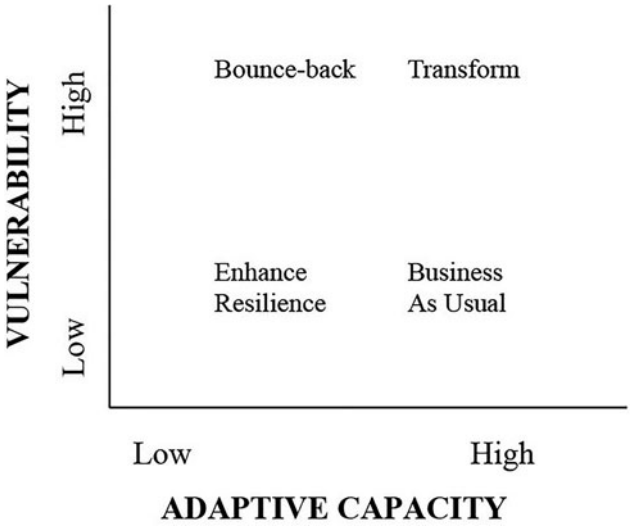

Figure 1. The relationship between vulnerability and adaptive capacity for SES. When a SES has low vulnerability and low adaptive capacity, build or foster the resilience of the existing regime (enhance resilience). When vulnerability is low and adaptive capacity is high, governance continues 'as is' (business as usual). When vulnerability is high and adaptive capacity is low, governance should encourage a 'return to normal' (bounce-back). When vulnerability is high and adaptive capacity is high, governance should look to transform the SES to a new regime. While adaptive capacity is similar to transformative capacity there are differences in these two capacities of SES. In particular, adaptive capacity underpins the resilience of an individual regime, while transformative capacity is the underlying potential of a regime to transform (via human agency) to a new, more desirable regime (see Garmestani et al., 2019b).

Panarchy describes multi-scale SESs and can address case study participants' concerns about a more holistic and visionary approach in vulnerability assessment. As some participants mentioned, although some strategies might decrease sub-system (i.e. a community) vulnerability on one scale, they may increase the vulnerability of the entire system (i.e. a region or a state). Also, some interviewees discussed that some adaptation options increase long-term vulnerability, for example, through intensification of development and increasing human population, and restricts the application of transformative strategies (such as managed retreat to a new location) when they are required (Lawrence et al., 2020b)

Incorporating social-ecological resilience could deliver an updated, non-normative framing of vulnerability (***general vulnerability***) which can help reform governance responses for coastal SES. Coastal governance that integrates social-ecological resilience into the decision-making approach can foment a regime of 'good governance' (Graham et al., 2003) that allows for adaptation to ongoing changing conditions in the current regime (Folke et al., 2005; Holling, 2001; Walker et al., 2004), or transformation when a system's resilience has been eroded (Chaffin et al., 2016).

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5. Conclusion

We highlight the most significant problem with the traditional framing of vulnerability for coastal governance and management: the use of engineering, community and disaster resilience definitions (*resilience as a rate or resilience as a process*), which do not account for scale and cross-scale interactions and the potential for transformation of SES. This framing results in a focus on recovery and 'return to normal' for coastal governance, which will become more difficult or impossible in the future in the face of rapidly accelerating environmental change (Park et al., 2012). These issues were highlighted by our CDA of the relevant literature and our case study of coastal governance experts in New Zealand, but the findings in this work apply to coastal governance of SES around the globe.

In particular, the spectre of climate change, including sea-level rise and larger and more frequent hurricanes (cyclones), highlights the need for a paradigm shift in SVA. These reforms include meaningful dialogue and collaborative engagement with actors and sectors across scales to prepare governance for adaptation *and* transformation (when necessary), rather than the prevalent disaster risk reduction framing of vulnerability (i.e, 'return to normal').

Finally, we recommend that future research is needed for advancing our knowledge and understanding of the characteristics of SES (e.g. adaptive and transformative capacities), their thresholds and tipping points, the process of evaluating general vulnerability, and the types of governance responses necessary for adaptation or transformation.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/sus.2022.10.

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Research transparency and reproducibility. We have provided relevant materials in the supplementary files with this manuscript.

References

Adams-Hutcheson, G., White, I., Glavovic, B., & Lawrence, J. (2019). *Fit-for-purpose resilience in aotearoa New Zealand: Challenges and recommendations (Report for the National Science Challenge: Resilience to Nature's Challenges)*. University of Waikato. https://resiliencechallenge.nz/wp-content/uploads/2019/12/Adams-Hutcheson-White-Glavovic-Lawrence-2019.pdf.

Adger, W. N. (1999). Social vulnerability to climate change and extremes in coastal Vietnam. *World Development*, *27*(2), 249–269.

Adger, W. N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography*, *24*(3), 347–364. https://doi.org/10.1191/030913200701540465.

Adger, W. N., Brown, I., & Surminski, S. (2018). Advances in risk assessment for climate change adaptation policy. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *376*(2121), 20180106.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(5737), 1036–1039.

Allen, C. R., Angeler, D. G., Chaffin, B. C., Twidwell, D., & Garmestani, A. (2019). Resilience reconciled. *Nature Sustainability*, *2*(10), 898–900.

Allen, C. R., Angeler, D. G., Garmestani, A. S., Gunderson, L. H., & Holling, C. S. (2014). Panarchy: Theory and application. *Ecosystems*, *17*(4), 578–589.

Allen, C. R., & Holling, C. (2010). Novelty, adaptive capacity, and resilience. *Ecology and Society*, *15*, 3.

Angeler, D. G., Allen, C. R., Garmestani, A., Pope, K. L., Twidwell, D., & Bundschuh, M. (2018). Resilience in environmental risk and impact assessment: Concepts and measurement. *Bulletin of Environmental Contamination and Toxicology*, *101*(5), 543–548.

Aroca-Jimenez, E., Bodoque, J. M., Garcia, J. A., & Diez-Herrero, A. (2017). Construction of an integrated social vulnerability index in urban areas prone to flash flooding. *Natural Hazards and Earth System Sciences*, *17*(9), 1541–1557.

Baggio, J. A., Brown, K., & Hellebrandt, D. (2015). Boundary object or bridging concept? A citation network analysis of resilience. *Ecology and Society*, *20*(2), 2. http://dx.doi.org/10.5751/ES-07484-200202.

Bennett, N. J., Kadfak, A., & Dearden, P. (2016). Community-based scenario planning: A process for vulnerability analysis and adaptation planning to social–ecological change in coastal communities. *Environment, Development and Sustainability*, *18*(6), 1771–1799.

Bevacqua, A., Yu, D., & Zhang, Y. (2018). Coastal vulnerability: Evolving concepts in understanding vulnerable people and places. *Environmental Science & Policy*, *82*, 19–29.

Bjarnadottir, S., Li, Y., & Stewart, M. G. (2011). Social vulnerability index for coastal communities at risk to hurricane hazard and a changing climate. *Natural Hazards*, *59*(2), 1055–1075.

Carpenter, S. R., Arrow, K. J., Barrett, S., Biggs, R., Brock, W. A., Crépin, A.-S., Engström, G., Folke, C., Hughes, T. P., Kautsky, N., *et al.* (2012). General resilience to cope with extreme events. *Sustainability*, *4*(12), 3248–3259.

Carpenter, S. R., Folke, C., Scheffer, M., & Westley, F. R. (2019). Dancing on the volcano: Social exploration in times of discontent. *Ecology and Society*, *24*, 1.

Catalano, T., & Waugh, L. R. (2020). *Critical discourse analysis, critical discourse studies and beyond*. Springer.

Chaffin, B. C., Garmestani, A. S., Gunderson, L. H., Benson, M. H., Angeler, D. G., Arnold, C. A. (Tony), Cosens, B., Craig, R. K., Ruhl, J. B., & Allen, C. R. (2016). Transformative environmental governance. *Annual Review of Environment and Resources*, *41*(1), 399–423. https://doi.org/10.1146/annurev-environ-110615-085817.

Chang, S. E., Yip, J. Z., Conger, T., Oulahen, G., & Marteleira, M. (2018). Community vulnerability to coastal hazards: Developing a typology for disaster risk reduction. *Applied Geography*, *91*, 81–88.

Chen, Y., Liu, T., Chen, R., & Zhao, M. (2020). Influence of the built environment on community flood resilience: Evidence from Nanjing City, China. *Sustainability*, *12*(6), 2401.

Chuang, W. C., Garmestani, A., Eason, T. N., Spanbauer, T. L., Fried-Petersen, H. B., Roberts, C. P., Sundstrom, S. M., Burnett, J. L., Angeler, D. G., Chaffin, B. C., Gunderson, L., Twidwell, D., & Allen, C. R. (2018). Enhancing quantitative approaches for assessing community resilience. *Journal of Environmental Management*, *213*, 353–362.

Cinner, J. E., McClanahan, T. R., Graham, N. A., Daw, T. M., Maina, J., Stead, S. M., Wamukota, A., Brown, K., & Bodin, Ö (2012). Vulnerability of coastal

communities to key impacts of climate change on coral reef fisheries. *Global Environmental Change*, *22*(1), 12–20.
Colburn, L. L., Jepson, M., Weng, C., Seara, T., Weiss, J., & Hare, J. A. (2016). Indicators of climate change and social vulnerability in fishing dependent communities along the Eastern and Gulf Coasts of the United States. *Marine Policy*, *74*, 323–333.
Cutter, S. L. (1996). Vulnerability to environmental hazards. *Progress in Human Geography*, *20*(4), 529–539. https://doi.org/10.1177/030913259602000407.
Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly*, *84*(2), 242–261.
Davidson, J. L., Jacobson, C., Lyth, A., Dedekorkut-Howes, A., Baldwin, C. L., Ellison, J. C., Holbrook, N. J., Howes, M. J., Serrao-Neumann, S., Singh-Peterson, L., *et al.* (2016). Interrogating resilience: Toward a typology to improve its operationalization. *Ecology and Society*, *21*(2), 27. http://dx.doi.org/10.5751/ES-08450-210227.
Delfino, A., Dizon, J., Quimbo, M. A., Depositario, D. P., *et al.* (2019). Social vulnerability and adaptive capacity to climate change impacts of women-headed households in the Philippines: A comparative analysis. *Journal of Environmental Science and Management*, *22*(2), 36–54.
De Sherbinin, A., Bukvic, A., Rohat, G., Gall, M., McCusker, B., Preston, B., Apotsos, A., Fish, C., Kienberger, S., Muhonda, P., *et al.* (2019). Climate vulnerability mapping: A systematic review and future prospects. *Wiley Interdisciplinary Reviews: Climate Change*, *10*(5), e600.
Fairhurst, G., & Sarr, R. (1996). *The art of framing*. Jossey-Bass.
Fawcett, D., Pearce, T., Ford, J. D., & Archer, L. (2017). Operationalizing longitudinal approaches to climate change vulnerability assessment. *Global Environmental Change*, *45*, 79–88.
Fernandez, M. A., Bucaram, S., & Renteria, W. (2017). (Non-) robustness of vulnerability assessments to climate change: An application to New Zealand. *Journal of Environmental Management*, *203*, 400–412.
Ferro-Azcona, H., Espinoza-Tenorio, A., Calderón-Contreras, R., Ramenzoni, V. C., País, M. d. l. M. G., & Mesa-Jurado, M. A. (2019). Adaptive capacity and social-ecological resilience of coastal areas: A systematic review. *Ocean & Coastal Management*, *173*, 36–51.
Flanagan, B. E., Gregory, E. W., Hallisey, E. J., Heitgerd, J. L., & Lewis, B. (2011). A social vulnerability index for disaster management. *Journal of Homeland Security and Emergency Management*, *8*(1), 3. http://dx.doi.org/10.2202/1547-7355.1792.
Flanagan, B. E., Hallisey, E. J., Adams, E., & Lavery, A. (2018). Measuring community vulnerability to natural and anthropogenic hazards: The centers for disease control and prevention's social vulnerability Index. *Journal of Environmental Health*, *80*(10), 34.
Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, *15*(4), 20. http://www.ecologyandsociety.org/vol15/iss4/art20.
Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*(1), 441–473. https://doi.org/10.1146/annurev.energy.30.050504.144511.
Freduah, G., Fidelman, P., & Smith, T. F. (2018). Mobilising adaptive capacity to multiple stressors: Insights from small-scale coastal fisheries in the Western Region of Ghana. *Geoforum; Journal of Physical, Human, and Regional Geosciences*, *91*, 61–72.
Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*, *16*(3), 293–303.
Garmestani, A., & Benson, M. H. (2013). A framework for resilience-based governance of social-ecological systems. *Ecology and Society*, *18*(1), 9. http://dx.doi.org/10.5751/ES-05180-180109.
Garmestani, A., Craig, R. K., Gilissen, H. K., McDonald, J., Soininen, N., van Doorn-Hoekveld, W. J., & van Rijswick, H. F. M. W. (2019a). The role of social-ecological resilience in coastal zone management: A comparative law approach to three coastal nations. *Frontiers in Ecology and Evolution*, *7*, 410. https://doi.org/10.3389/fevo.2019.00410.
Garmestani, A., Ruhl, J. B., Chaffin, B. C., Craig, R. K., van Rijswick, H. F. M. W., Angeler, D. G., Folke, C., Gunderson, L., Twidwell, D., & Allen, C. R. (2019b). Untapped capacity for resilience in environmental law. *Proceedings of the National Academy of Sciences*, *116*(40), 19899–19904. https://doi.org/10.1073/pnas.1906247116.
Garmestani, A., Twidwell, D., Angeler, D. G., Sundstrom, S., Barichievy, C., Chaffin, B. C., Eason, T., Graham, N., Granholm, D., Gunderson, L., Knutson, M., Nash, K. L., Nelson, R. J., Nystrom, M., Spanbauer, T. L., Stow, C. A., & Allen, C. R. (2020). Panarchy: Opportunities and challenges for ecosystem management. *Frontiers in Ecology & the Environment*, *18*(10), 576–583. https://doi.org/10.1002/fee.2264.
Ge, Y., Dou, W., & Zhang, H. (2017). A new framework for understanding urban social vulnerability from a network perspective. *Sustainability*, *9*(10). https://doi.org/10.3390/su9101723.
Gerrity, B. F., & Phillips, M. R. (2020). Vulnerability and resilience in San Mateo County: Identifying social, economic and physical discrepancies in stakeholder perception of risk. *Journal of Coastal Research*, *95*(sp1), 803–807.
González-Baheza, A., & Arizpe, O. (2018). Vulnerability assessment for supporting sustainable coastal city development: A case study of La Paz, Mexico. *Climate and Development*, *10*(6), 552–565.
Graham, J., Amos, B., & Plumptre, T. W. (2003). *Governance principles for protected areas in the 21st century*. Institute on Governance, Governance Principles for Protected Areas Ottawa.
Gunderson, L., Allen, C., & Garmestani, A. (2022). *Applied panarchy: Applications and diffusion across disciplines*. Island Press.
Gunderson, L., & Holling, C. S. (2002). *Panarchy: Understanding transformations in human and natural systems*. Island Press.
Hagenlocher, M., Renaud, F. G., Haas, S., & Sebesvari, Z. (2018). Vulnerability and risk of deltaic social-ecological systems exposed to multiple hazards. *Science of the Total Environment*, *631*, 71–80.
Hajer, M. A. (2005). Coalitions, practices, and meaning in environmental politics: From acid rain to BSE. In D. Howarth & J. Torfing (Eds.), *Discourse theory in European politics* (pp. 297–315). Palgrave Macmillan.
Hardy, R. D., & Hauer, M. E. (2018). Social vulnerability projections improve sea-level rise risk assessments. *Applied Geography*, *91*, 10–20.
Harvey, N., & Woodroffe, C. D. (2008). Australian approaches to coastal vulnerability assessment. *Sustainability Science*, *3*(1), 67–87.
Hinkel, J. (2011). Indicators of vulnerability and adaptive capacity: Towards a clarification of the science-policy interface. *Global Environmental Change*, *21*(1), 198–208.
Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, *4*(1), 1–23.
Holling, C. S. (1996) Engineering resilience versus ecological resilience. In P. E. Schulze (Ed.), *Engineering within ecological constraints* (pp. 31–43). National Academy Press.
Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, *4*(5), 390–405.
Holling, C. S., Gunderson, L. H., & Peterson, G. (2002). Sustainability and panarchies. In L. H. Gunderson & C. S. Holling (Eds.), *Panarchy: Understanding transformations in human and natural systems* (pp. 63–102). Island Press.
Hufschmidt, G. (2011). A comparative analysis of several vulnerability concepts. *Natural Hazards*, *58*(2), 621–643.
IPCC (2014). *Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change*. Cambridge University Press.
Janssen, M. A., Anderies, J. M., & Ostrom, E. (2007). Robustness of social-ecological systems to spatial and temporal variability. *Society and Natural Resources*, *20*(4), 307–322.
Joakim, E. P., Mortsch, L., & Oulahen, G. (2015). Using vulnerability and resilience concepts to advance climate change adaptation. *Environmental Hazards*, *14*(2), 137–155.
Jozaei, J., Mitchell, M., & Clement, S. (2020). Using a resilience thinking approach to improve coastal governance responses to complexity and uncertainty: A Tasmanian case study, Australia. *Journal of Environmental Management*, *253*, 109662.
Kelly, P. M., & Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change*, *47*(4), 325–352.
Koks, E. E., Jongman, B., Husby, T. G., & Botzen, W. J. W. (2015). Combining hazard, exposure and social vulnerability to provide lessons for flood risk management. *Environmental Science & Policy*, *47*, 42–52.

https://doi.org/10.1017/sus.2022.10 Published online by Cambridge University Press

Lam, N. S., Reams, M., Li, K., Li, C., & Mata, L. P. (2016). Measuring community resilience to coastal hazards along the Northern Gulf of Mexico. *Natural Hazards Review*, *17*(1), 04015013.

Lawrence, J., Blackett, P., & Cradock-Henry, N. A. (2020a). Cascading climate change impacts and implications. *Climate Risk Management*, *29*, 100234.

Lawrence, J., Boston, J., Bell, R., Olufson, S., Kool, R., Hardcastle, M., & Stroombergen, A. (2020b). Implementing pre-emptive managed retreat: Constraints and novel insights. *Current Climate Change Reports*, *6*, 66–80.

Martins, I. M., & Gasalla, M. A. (2020). Adaptive capacity level shapes social vulnerability to climate change of fishing communities in the South Brazil Bight. *Frontiers in Marine Science*, *7*, 481. https://doi.org/10.3389/fmars.2020.00481.

Mason, K., Lindberg, K., Haenfling, C., Schori, A., Thomas, K., Popovich, B., Faulkner, R., Beban, J., Gunnel, C., Marsters, H., Read, D., & Borman, B. (2019). *Social vulnerability indicators for flooding in Aotearoa New Zealand: Research report*. Environmental Health Indicators Programme, Environmental Health Indicators Programme, Massey University.

Moser, S., Meerow, S., Arnott, J., & Jack-Scott, E. (2019). The turbulent world of resilience: Interpretations and themes for transdisciplinary dialogue. *Climatic Change*, *153*(1), 21–40.

Mussi, C. S., Bonetti, J., & Sperb, R. M. (2018). Coastal sensitivity and population exposure to sea level rise: A case study on Santa Catarina Island, Brazil. *Journal of Coastal Conservation*, *22*(6), 1117–1128.

Nalau, J., Torabi, E., Edwards, N., Howes, M., & Morgan, E. (2021). A critical exploration of adaptation heuristics. *Climate Risk Management*, *32*, 100292.

O'Connell, D., Walker, B., Abel, N., & Grigg, N. (2015). *The resilience, adaptation and transformation assessment framework: From theory to application*. CSIRO.

Orencio, P. M., & Fujii, M. (2013). An index to determine vulnerability of communities in a coastal zone: A case study of Baler, Aurora, Philippines. *Ambio*, *42*(1), 61–71.

Park, S. E., Marshall, N. A., Jakku, E., Dowd, A. M., Howden, S. M., Mendham, E., & Fleming, A. (2012). Informing adaptation responses to climate change through theories of transformation. *Global Environmental Change*, *22*(1), 115–126.

Pelling, M. (2010). *Adaptation to climate change: From resilience to transformation*. Routledge.

Reghezza-Zitt, M., Rufat, S., Djament-Tran, G., Le Blanc, A., & Lhomme, S. (2012). What resilience is not: Uses and abuses. *Cybergeo: European Journal of Geography*. https://journals.openedition.org/cybergeo/25554.

Rogers, R. (2004). *An Introduction to critical discourse analysis in education*. Lawrence Erlbaum Associates, Inc.

Shao, W., Jackson, N. P., Ha, H., & Winemiller, T. (2020). Assessing community vulnerability to floods and hurricanes along the Gulf Coast of the United States. *Disasters*, *44*(3), 518–547.

Shaw, D., Scully, J., & Hart, T. (2014). The paradox of social resilience: How cognitive strategies and coping mechanisms attenuate and accentuate resilience. *Global Environmental Change*, *25*, 194–203.

Siders, A. R. (2019). Adaptive capacity to climate change: A synthesis of concepts, methods, and findings in a fragmented field. *Wiley Interdisciplinary Reviews: Climate Change*, *10*(3), e573.

Silver, J. M., Arkema, K. K., Griffin, R. M., Lashley, B., Lemay, M., Maldonado, S., Moultrie, S. H., Ruckelshaus, M., Schill, S., Thomas, A., *et al.* (2019). Advancing coastal risk reduction science and implementation by accounting for climate, ecosystems, and people. *Frontiers in Marine Science*, *6*, 556.

Smith, E. F., Lieske, S. N., Keys, N., & Smith, T. F. (2018). The socio-economic vulnerability of the Australian east coast grazing sector to the impacts of climate change. *Regional Environmental Change*, *18*(4), 1185–1199.

Spielman, S. E., Tuccillo, J., Folch, D. C., Schweikert, A., Davies, R., Wood, N., & Tate, E. (2020). Evaluating social vulnerability indicators: Criteria and their application to the Social Vulnerability Index. *Natural Hazards*, *100*(1), 417–436. https://doi.org/10.1007/s11069-019-03820-z.

Strunz, S. (2012). Is conceptual vagueness an asset? Arguments from philosophy of science applied to the concept of resilience. *Ecological Economics*, *76*, 112–118.

Suckall, N., Tompkins, E. L., & Vincent, K. (2019). A framework to analyse the implications of coastal transformation on inclusive development. *Environmental Science & Policy*, *96*, 64–69.

Tannen, D. (1993). *Framing in discourse*. Oxford University Press.

Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2019). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, *10*(2), e565.

van den Brink, M., & Metze, T. (2006). Words matter in policy and planning. In M. A. van den Brink, & T. Metze (Eds.), *Words matter in policy and planning: Discourse theory and method in the social sciences* (pp. 13–20). Utrecht University Press.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, *9*(2).

Weiss, G., & Wodak, R. (2007). *Critical discourse analysis*. Springer.

Wilson, S., Pearson, L. J., Kashima, Y., Lusher, D., & Pearson, C. (2013). Separating adaptive maintenance (resilience) and transformative capacity of social-ecological systems. *Ecology and Society*, *18*(1), 22. http://dx.doi.org/10.5751/ES-05100-180122.

Wise, R. M., Fazey, I., Smith, M. S., Park, S. E., Eakin, H., Van Garderen, E. A., & Campbell, B. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, *28*, 325–336.

Wu, C.-C., Jhan, H.-T., Ting, K.-H., Tsai, H.-C., Lee, M.-T., Hsu, T.-W., & Liu, W.-H. (2016). Application of social vulnerability indicators to climate change for the southwest coastal areas of Taiwan. *Sustainability*, *8*(12), 1270.

Yang, X., Lin, L., Zhang, Y., Ye, T., Chen, Q., Jin, C., & Ye, G. (2019). Spatially explicit assessment of social vulnerability in coastal China. *Sustainability*, *11*(18), 5075.

Yoon, D. K. (2012). Assessment of social vulnerability to natural disasters: A comparative study. *Natural Hazards*, *63*(2), 823–843.

Zellmer, S., & Gunderson, L. (2008). Why resilience may not always be a good thing: Lessons in ecosystem restoration from Glen Canyon and the Everglades. *Nebraska Law Review*, *87*, 893.

https://doi.org/10.1017/sus.2022.10 Published online by Cambridge University Press