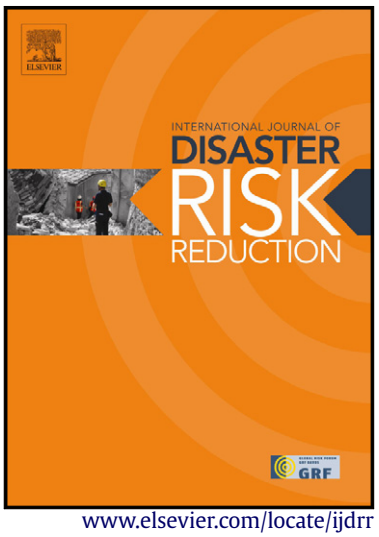

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Translation and Evaluation of the Baseline Resilience Indicators for Communities on the Sunshine Coast, Queensland Australia

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Abstract

There is a pressing need for longitudinal assessments of a community's level of disaster resilience in order to identify appropriate strategies for building and enhancing resilience. Despite significant challenges, there are several assessment tools available that organise and emphasise specific resilience themes in multiple ways, at multiple scales. In this study we adapt the Baseline Resilience Indicators for Communities (BRIC) to apply to our case study region and call upon local and district disaster management experts to evaluate the appropriateness of the assessment tool for this case study location. Our findings identify that the absence of an ecological resilience theme has limited the usefulness of the BRIC for the case study region, as has the inability of the BRIC to transition between local to regional scale indicators of resilience.

1.0 INTRODUCTION

Enhancing disaster resilience in communities is intrinsically linked to the ability to be able to accurately assess levels of disaster resilience (Graugaard, 2012). Accurate assessments of resilience can potentially lead to the identification of relative areas of concern within communities where resilience is declining or the community is unable to respond or adapt. It can also provide an opportunity to enact alternative plans and strategies or locate alternative resources if a community's capacities, assets and resources are assessed as being insufficient (O'Jenkins, 2011). Longitudinal assessment studies can assist a community to trace its progression towards their ideal of a resilient community thereby assisting with the development of enhancement strategies. Similarly, comparative assessments between communities of similar vulnerabilities, resourcing and capabilities could assist in identifying the efficacy of isolated programs and policies.

Despite this critical need there is much work to do. The identification of metrics for assessing disaster resilience has been described as one of the "grand challenges" of disaster risk reduction (Subcommittee on Disaster Reduction, 2005). Unfortunately, it is questionable how well we are progressing toward achieving this grand challenge. As there is no universally accepted definition of resilience (Lei et al., 2014) or community resilience (Arbon et al., 2012), nor is there a uniform approach for assessing a community's disaster resilience. It is also not clear whether assessment

methods available satisfy even the most basic of methodological requirements such as validity, reliability, and usability.

This article responds to the call for empirical, academic evidence to identify just how resilience thinking is applied and practiced by local practitioners, managers and community members in a disaster risk management context (Walker and Salt, 2006; Matyas and Pelling, 2012). To this end, we present a conceptual translation, application and evaluation of the BRIC (Cutter et al., 2010) for the Sunshine Coast local government area in Queensland, Australia.

The Australian Context

As Australia continues to be impacted by more frequent and intense natural disasters; Federal, State and Territory governments have committed to adopt a `whole-of- nation resilience based approach to emergency management' (COAG, 2009). The Council of Australian Governments (COAG) vision of co-ordination and co-operation to `enhance Australia's capacity to withstand and recover from emergencies and disasters' was translated into the *National Strategy for Disaster Resilience* (NSDR) by the National Emergency Management Committee in 2011. The NSDR clearly identifies the shared responsibility for individuals, households, communities, governments and businesses to build disaster resilient communities. To this end, the NSDR is proposed to be the `first step in a long-term, evolving process to deliver sustained behavioural change and enduring partnerships' (NSDR, p2).

Disaster Resilience Assessment

Building resilient communities can be a complex endeavour. A community-of-place (see Skerratt, 2013) consists of multiple stakeholders and individuals each of which are nested within complex networks of power, with as Allen (2003, px) identifies, `highly divergent aims related to resilience'. Community resilience can therefore be viewed as the combination of multiple resiliencies within a community, some of which are enhancing resilience; whilst others may be undermining resilience (Wilson, 2013).

Further complexity can be attributed to scaling issues, as perturbation or interruptions at a regional , state, national or even global scale manifest as impacts at the local scale, and vice versa (Olwig, 2012; Wilson, 2013). The local level or local scale is emphasised in policy positions and in academic research, as Adger et al. (2005) suggests the local scale is the scale at which resilient pathways are put into effect and impacts are experienced. Berkes and Ross (2013) argue that it is at the local level, at the community scale that the concept of resilience is least understood. Despite this obvious focus at the local scale, decision-makers on the other hand are required to view risk management from a multiple stakeholder's risk perspectives, with consideration of their interrelations across and between geographic and institutional scales (Komendantova, 2014).

Enhancing a community's resilience by progressively addressing weaknesses and strengths is in keeping with Norris et al. (2008, p130) theorizing of resilience as ` a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance'. Manyena (2014, p434) views disaster resilience as the `intrinsic capacity of a system, community or society predisposed to a shock or stress to adapt and survive by changing its non-essential attributes and rebuilding itself'.

Other complexities that add to the grand challenge of assessing a community's resilience relates to the conceptualisation of resilience being gender or culturally based (Norris et al., 2008), or the

trajectory of resilience building within a socio-ecological system being largely non-linear (Welsh, 2013). As a result, in order to accommodate these place-specific characteristics and uncertainties, several assessment methods have focussed on assessing the inherent characteristics of a community in regard to their ability to cope, their capacity to innovate and adapt, and the resources, networks and infrastructure that will support mitigation, response and recovery efforts (Cutter et al., 2008).

In practice there are two main forms of community disaster resilience assessment tool: community based participatory assessment tools and top-down assessment tools. Top down assessment tools are typically applied by one institution or stakeholder (Cutter et al., 2010; Shaw et al., 2012; Frazier et al., 2014) whereas, community driven participatory tools are applied by the community in question (Arbon et al., 2012; CARRI, 2013). Hybrid tools have also been developed which have been designed to be applied by one institution / stakeholder, but rely upon extensive community consultation via interviews or surveys (Cohen et al., 2010).

The top-down tools are often simpler to apply, quicker and cheaper which may result in an ongoing monitoring program becoming more achievable to implement. As an alternative to the top-down method of assessment, tools like the Community Disaster Resilience Scorecard Toolkit (Arbon et al., 2012), and the CARRI-CRS (CARRI,2013) employ participatory methods that engage and involve community members in undertaking the assessment. In addition to enabling the community to assess its own level of disaster resilience, participatory methods have other significant co-benefits. They provide an opportunity for building connectivity / social cohesion and for collectively sharing responsibility for disaster responses, co-learning and capacity building opportunities (Olwig, 2012; Allen, 2006; Paton and Johnston, 2001). As there is no evidence to suggest that a community that scores well on an assessment of community resilience through either method will cope and recover quicker and easier than a community that scored less; these co-benefits are particularly attractive and support the `shared responsibility' mandate promoted at all levels of government.

The scale at which the assessment is undertaken is an important factor, as results of a study may vary in accordance with scale of the aggregate data, often referred to as the modifiable areal unit problem. Similarly, assessment methods utilizing indicators imply homogeneity across the study area (Frazier et al., 2014). Therefore small scaled, community or local data is preferred by many researchers as it allows for localized characteristics and nuisances to be considered which are important to a community's resilience (Wood, Burton and Cutter, 2010; Frazier et al., 2014).

Our research project evaluated two disaster resilience assessment methods for the Sunshine Coast local government area. A participatory assessment method developed by the Torren's Research Institute (Arbon et al., 2012) was evaluated by community members (see Singh-Peterson et al., in review). The BRIC represents a second method which was selected as a top-down assessment method. The evaluation results are presented in this paper. Unlike participatory methods of assessment, the BRIC does not claim to enhance or build capacities that increase a community's resilience through the application of the assessment tool. It was chosen because the DROP conceptual model from which it was developed was relevant and appropriate for the Sunshine Coast. It's application as a top-down method was also appealing to research partners in regard to ease and expense of application.

In the following paper, we conceptually apply the top-down method of the Baseline Resilience Indicators for Community (BRIC) to the Sunshine Coast local government area in Queensland, Australia. Despite the differences in process, policies, common hazards and cultural practices we

question whether the conceptual framework from which the BRIC was developed can be translated across to the Australian context. An evaluation of the effectiveness and usability of the BRIC was determined via surveys and forums with district level and local level disaster resilience experts. It is not the intention of this study to critique the foundational work developed by Cutter et al. (2010) but to test the potential of translation of the BRIC for an Australian case study.

The Baseline Resilience Indicators for Communities (BRIC)

The BRIC is a foundational tool designed to assess a community's disaster resilience. The indicators were developed from the Disaster Resilience of Place (DROP) theoretical framework (Cutter et al., 2008). The DROP model focuses on antecedent conditions, specifically related to inherent resilience, that is; the existing networks, infrastructure, planning/policies and capacity within the community to respond and recover from disaster.

The identification of categories or components of community disaster resilience represented in the BRIC are based on the premise that `resilience is a multifaceted concept, which includes social, economic, institutional, infrastructural, ecological and community elements' (Cutter et al., 2010, p6). The BRIC therefore consists of indicators that represent the categories of economic, infrastructure, social, community and institutional resilience following support in the literature to suggest that a capitals framework, originating in the community development sector, is well placed to frame community resilience (Buikstra et al., 2010).

Of consequence is the fact that the ecological domain is not represented in the BRIC. Cutter et al., (2010) explains that this is due to ecological data being inconsistent and concerns about the `relevancy when developing proxies for ecological systems for large and diverse areas' (p5). Despite this omission, the BRIC does include proxies for other diverse conditions such as social resilience and community capital. The intention behind each of the categories of resilience is summarized in Table 1. The indicator suite is reflective of key themes present in the community resilience literature. It is not clear though whether a comprehensive conceptualisation of each category has been adequately characterised by the indicator suite.

<<insert Table 1: Summary of each category of indicators that comprise the Baseline Resilience Indicators (Cutter et al., 2010, p8)>>

The BRICs are intended to provide a comparative view of resilience for two or more communities of interest. Similarly, for a single community, longitudinal assessment will determine the magnitude of the change, and direction of change in a community's resilience between assessments can therefore, facilitate a re-evaluation of emergency preparedness policies and programs, and support the adaptive cycle of community resilience building (Cutter et al., 2010; Cohen et al., 2013). In this way, the indicators are not absolute indicators, it is the geographical or temporal application of the BRIC which provides greater value.

The BRIC were piloted as part of a large comparative assessment of 736 counties within the United States Federal Emergency Management Agency's (FEMA) Region 4, which consists of the south eastern States of Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee. The results of the pilot study demonstrated that the BRIC was able to identify the relative levels of resilience between counties in regard to each category of resilience (i.e. economic,

infrastructure, social, community and institutional resiliencies). In principle, the BRIC are proposed to be multi-scalar – applicable at any scale (Cutter et al., 2010; p.5) and for use by single institutions or stakeholders to assess community resilience. This is yet to be tested in the Australian context.

3.0 METHODOLOGY

3.2 Case Study: Sunshine Coast Local Government Area

The study was undertaken in the Sunshine Coast region of Queensland, Australia. At the time of the research project, the Sunshine Coast Local Government Area occupied the region between Gympie, Somerset and Moreton Bay Regional Councils in South Eastern Queensland (see Figure 1).

<<insert Figure 1: The location of the Sunshine Coast local government area positioned within the state of Queensland, and Australia (inset). >>

The Sunshine Coast is a popular tourist destination located approximately 100 kilometres north of the Queensland capital city of Brisbane. The sub-tropical climate and sandy beaches support a thriving tourism industry. The region is roughly 3000 km² dominated by coastal plains and basalt ridgelines to the west of the region. In 2011, the region was home to over 306,903 people and receives over 2.5 million domestic visitors annually and approximately 270,000 international visitors annually (Sunshine Coast Council, 2013). Consistent with a sea-change community, the demographic profile of Sunshine Coast residents is slightly older than the Queensland average with a median age of 42, rather than 36. This trend reflects the migration of retirees to the region and the movement of younger populations moving out of the region for employment or education (ABS, 2011). Accordingly the percentage of households with children is lower than experienced in Greater Brisbane and the percentage of child free households and lone households is greater. Similarly, the percentage of households that earn a high income (more than $2500/ week) was significantly less than Greater Brisbane and the percentage of households that earn a low income (less than $600/week) was higher than the average household in Greater Brisbane (ABS, 2011)

In 2011, the Sunshine Coast Regional Council compiled a regional disaster risk assessment task assessing 24 potential natural and human-made hazards (Sunshine Coast Council, 2013). The assessment considered seasonal variations of each risk to ensure a more dynamic and accurate assessment of potential risk exposure. As a result, the risk assessment identified that Storms attributed to East Coast Low Pressure Systems and Tropical Cyclones exhibit the greatest risk to the residents of the Sunshine Coast. Other high priority risks include flooding, fire and drought (Sunshine Coast Council, 2013).

Following the State government model, multiple government management arrangements exist within the Sunshine Coast under the Local Disaster Management Group (LDMG) and the District Disaster Management Group (DDMG).

In alignment with the State model, the LDMG has multiple functions which include: developing, reviewing and assessing effective disaster management plans at the local scale to build public awareness of disasters and disaster prevention. Additionally, the LDMG co-ordinate and direct resources as needed and enact and align local policies and plans with State government initiatives. The DDMG exists at the State level and similarly serves multi purposes and functions at a larger geographical scale. Its main responsibilities are to develop effective district level disaster

management strategies which align with the State Disaster Management Group's strategic policy framework, and to ensure that the community is aware of mitigation, preparation and recovery practises when exposed to emergencies and disasters.

3.3 Application and Translation of the BRIC to Assess the Sunshine Coast's Disaster Resilience

It was anticipated that the application of the BRIC to the Australian context may not appropriate in many instances, due to differences in policies (e.g. health insurance policies) or in the types / formats of available data. What was important to the broader research objectives however was to determine whether the philosophy of the BRIC, or conceptual framework could be translated across to an Australian setting. The process adopted was to initially consider each of the individual indicators presented in Cutter et al. (2010) and identify available data sources and suitability to the case study area. Following this, substitute indicators were identified in keeping with the Cutter et al. (2010) criteria for indicator selection (see Appendix 1), and the criteria that the enumeration unit was at the local government area scale only . The substitute indicator was ideally a replacement of the original indicator whose relevance to the conceptual framework was justified through a review of academic literature and an initial assessment of data availability and accessibility. To this end, the selection of indicators was undertaken in consultation with representatives from the Sunshine Coast Regional Council and Emergency Management Queensland. Following on, contact with data holders was established and data sets requested. In all cases, the unit of enumeration was at the local government area scale reported through Census surveys by the Australian Bureau of Statistics or via collection and provision of data by the Sunshine Coast Regional Council, Emergency Management Queensland or other specialist data providers.

After making three requests for the data (either through email or telephone) or the research team was advised that the data set was not available, an alternative indicator was identified satisfying the same criteria.

The selection of each variable by Cutter et al. (2010) followed an extensive data analysis process. Initially each variable was standardised into comparable scales and enumerated units. The variables were then analysed against one another, to determine if there were any statistically significant correlations – if the correlation was strong (Pearson's R> 0.7) then it was considered that there was too much similarity between the variables, and one was omitted. Finally, the internal consistency or reliability was assessed using the Chronbach's Alpha Reliability / Item analysis. Variables that obtained an internal consistency (Chronbach's alpha = 0.7) were retained, and became part of the indicator suite.

Following the identification of Sunshine Coast indicators available at the local government area scale; the statistical analysis employed by Cutter et al. (2010) was not repeated for these datasets. The assumption employed here was that there were no statistically significant correlations between the indicators, and that all indicators were internally reliable. This was considered to be an appropriate process for an evaluation study testing the conceptual framework and applicability of the BRIC for adoption in Australia. Should the evaluation of the BRIC be positive and the assessment of resilience yield results that were considered accurate; these steps would be appropriately applied to an endorsed suite of indicators to check for significance and reliability. At this stage, this process is beyond the scope of this evaluation study.

Once indicators for the Sunshine Coast were identified, and data obtained, the process was to normalise the data for each variable using a Min – Max scaling scheme. This involves each variable being decomposed into a range between 0 (worst score / low resilience) and 1 (best score / highest level of resilience). As an additive model, scores were then aggregated for each indicator into composite indicator scores (assuming equal weighting) for each resilience theme.

3.4 Evaluation of the BRIC by the LDMG and DDMG

An assessment of the Sunshine Coast's disaster resilience was produced as a preliminary report which was distributed to all members of the LDMG and DDMG (see section 4.1). A discussion forum was then facilitated at the end of the quarterly LDMG and DDMG meetings so the group could discuss pertinent elements of the evaluation. Additionally, an online and hard copy evaluation survey was completed by LDMG and DDMG members. In total, 17 of the members of the LDMG and DDMG completed the survey presented in Table 2, and participated in the discussion forums. Their comments were recorded and transcribed by the lead researcher during the facilitated discussion forum. Responses to the survey questions also informed the evaluation of the BRIC.

In total there are approximately 40 members of the Sunshine Coast's LDMG and DDMG who represent key service providers such as telecommunications (Optus and Testra) energy (Energex), water (Unity Water) and health services (Sunshine Coast Medicare Local). Other members consist of emergency service operators such as Queensland Fire and Rescue Services, Queensland Ambulance, Rural Fire Brigade and Queensland Police; in addition to State and Local government representatives. The 17 people who contributed to the survey were from the organisations named above. The discussion forums comprised of the same 17 people plus an additional 10 members who did not complete the survey.

The LDMG and DDMG were chosen to evaluate the BRIC as the membership consisted of organisations most likely to employ as assessment method, and secondly these groups were multi-sectoral groups of stakeholders who held expertise in coordinating and planning for the Sunshine Coast within this context. No biases based upon job description, expertise, gender or sector of operation were encountered.

<<insert Table 2: Evaluation Survey – BRIC >>

4.0 RESULTS

4.1 Adaptation of the BRIC – Preliminary Report Content

The suite of indicators chosen for the Sunshine Coast and the rationale behind these choices are summarized in Appendix 1. As the central tenet of this study was primarily concerned with the evaluation of the applicability of the BRIC's conceptual framework and the availability of data; the results of the assessment are presented in Table 3 and summarized as follows.

As the first application of the adapted BRIC for the Sunshine Coast, an assessment of baseline weaknesses and strengths across the resilience categories is cautiously presented. Assuming that the adapted BRIC was successful in comprehensively capturing the dimensions of each resilience category, the Sunshine Coast has strengths in the areas of social and institutional resilience. As the community has been impacted by nine disasters in the last five years (Queensland Government,

2013) it is reasonable to assume that the social and institutional capacity to deal with disasters has been enhanced by these prior events.

Areas of weaknesses identified by the BRIC include the resilience levels of the economy and local infrastructure, in addition to the community capital. The indicators of large: small businesses and the proportion of residents who own their houses outright reduced the score of the economic resilience significantly. Both however, are popular indicators of community vulnerability, and as such, are appropriate indicators within this category.

The medical capacity indicator (number of vacant hospital beds) of the infrastructure resilience greatly reduces the category's overall score. The District Emergency Nursing Director of Queensland Health, who commented on this indicator, stated that although there are usually no vacant hospital beds on the Sunshine Coast, capacity can be created. During a disaster, hospitals close non-essential services and can respond to need. The medical capacity indicator is arguably, not a reflective indicator of the resilience of existing infrastructure, and it is likely that the Sunshine Coast has a higher level of disaster resilience than suggested from this score. Similarly, the indicator of access / evacuation potential `principle arterial miles per square miles' was difficult to contextualize, and apply a score to. The social capital category primarily incorporated indicators of place – attachment and social engagement. This was an area of data deficiency with the final result not likely to be representative of the average level of social capital across the local government area. For example, although it is well recognized that innovation and creativity are key attributes of a resilient community. Currently, the level of innovation is indicated by the percentage of residents employed in arts and recreational services, which might not provide an accurate depiction of innovation in human agency, or spare capacity.

In summary, the areas of strength identified by application of the adapted BRIC are the resilience categories of institutional and social resilience. Although infrastructure and community capital have received low scores of resilience, the research team consider that this may be in part, a reflection of misaligned indicators rather than the actual state of resilience. The economic resilience however, has also been identified as an area of weakness although the research team consider that the indicators chosen are appropriately applied in this setting. The data suite presented here is intended to be the `best fit' of local data to the conceptual framework of the DROP model (Cutter et al., 2008). The evaluation of the adapted BRIC, and subsequent discussions by the LDMG and DDMG has led to the identification of alternative content that is considered to better represent this particular case study location.

4.2 *Evaluation of the Adapted BRIC*

An additional aim of this study was to evaluate the adapted BRIC, as a top-down assessment tool to determine whether the DROP conceptual framework could be appropriately applied to the Sunshine Coast local government area. The findings from this evaluation are presented as three converging themes. As an empirical tool, the process of application is a highly relevant component of the evaluation in regard to usability, and efficacy. As important are considerations of context, that is, the framework or philosophy from which the tool has been developed, and content in reference to scalability and appropriateness to the Sunshine Coast community. Poor performance on these three

dimensions would limit uptake of the methodology and its application of community resilience assessments.

4.2.1 Context

The findings demonstrate that there is demand for an assessment tool that can measure a community's disaster resilience. Specifically, of the 17 LDMG and DDMG survey participants, over 80% considered that it is absolutely important that there is a tool available to measure community resilience to disaster. The other participants responded that it was somewhat important whilst another participant answered that they weren't sure.

All of the participants considered that there were many stakeholders who would benefit from applying the BRIC, such as emergency service professionals, non-government organisations and the community itself. The benefits proposed included the facilitation of a shared opinion of the risks and how to direct resources. Participants also felt that local government, disaster management organisations and response agencies could build their coordination and education strategies around the findings of BRIC assessments. Other participants considered that in theory 'at risk' communities could use the assessment to build their own self-reliance by making use of the information collected and building local capacity in partnership with social management agencies. There were concerns amongst the LDMG and DDMG that the indicators may have limited relevance to the small communities within the case study region.

Most of the participants (over 80%) responded that resilience indicators are only one way to measure resilience. During the discussion forum, the LDMG considered that they can be effective if they are transparent and meet with a robust criterion. Several other methods for assessing a community's resilience were proposed, such as measuring the actual responses and recovery dynamics following a real event cognisant that all disasters are different in nature and that the permeation in responses and impacts is difficult to plan for, and account for if employing metrics. Face - face interviews and personal contact were also important sources of obtaining information from the source of the impact and directly from those who are affected as anecdotal feedback was considered to be of great benefit.

There were different views amongst the LDMG and DDMG members regarding the accuracy of the assessment. When asked whether the application of the adapted BRIC provides a good picture of the strengths and weaknesses of the Sunshine Coast's disaster resilience; the participant's responses were divided. Most (76%) thought that the adapted BRIC provided `a good general assessment', whilst a further 17% people were unsure. The remaining respondents answered that the assessment produces an assessment that isn't reliable but holds some value.

4.2.2 Process

During the discussion forums the LDMG and DDMG members considered that the assessment was easy to replicate, once data pathways had been mapped out and data sharing relationships established. The high ease of use and low cost associated with applying the BRIC were seen as positive attributes. A notable detractor was the requirement to identify replacement indicators when using the tool in new contexts, and the difficulties encountered when attempting to do so. In this case, the research team had difficulty identifying suitable replacement indicators as the

conceptual framework was quite broad and the indicators represented some themes in the contemporary community resilience literature but not all. The selection criteria were similarly broad and required only that the indicator held relevance to the field of resilience, and could be credibly measured. However, the biggest challenge for applying the adapted suite of BRIC was in determining the variance or range of possible indicator scores (minimum and maximum) from which to allocate a score. For example; the indicator `principle arterial miles per square miles' was developed to represent the evacuation potential of the community. In order to position the case study region's evacuation potential in a range from best case to worst case or minimum and maximum arterial miles per square mile, further contextual information is required. As such a comprehensive data set of like communities is require to be compiled, or a replacement indicator which can link to datasets drawn from State government reporting requirements may be more efficient and credible.

4.2.3 Content

There was significant discussion about the comprehensiveness and the deficiencies of the BRIC for the Sunshine Coast local government. However, it was acknowledged that it would be extremely difficult to develop a generic assessment tool that `fitted' all geographical scales.

The primary concern raised at the LDMG and DDMG discussion forums was the omission of the ecological resilience category. The participants argued that the risk mitigation indicators were critical components of any assessment of community resilience. Cutter et al.'s (2010) reasons for not including this category related to difficulties in developing a generic proxy that represented place-specific environments. Arguably, ecological resilience is hugely variable across a region, which is also case for social resilience and community capital. Several participants suggested that the assessment needs to be capable of capturing the variation across the region and as such, these variations should determine the spatial scale of the assessment. One of the participants commented that the incorporation of environmental risk and exposure is important for communities who are dependent on agriculture as a primary industry and tourism dependent upon beaches and natural assets. These dimensions are captured in the local government's risk profiles and as such, discussion forum participants considered that the data concerns would be alleviated. LDMG and DDMG members also suggested that data could be collated at the community (sub-local scale) across the Sunshine Coast via a household survey to enhance the Australian Bureau of Statistic's community and local scale Census data provision.

Other indicators of community resilience that the LDMG and DDMG recommended include:

a. The potential for available support - where the community is located in relation to support - how far to capital cities and critical services and infrastructure.
b. Community's attitude to risk and resilience represented by the uptake of community training and the percentage involved in community preparedness exercises, and the estimated proportion of households that clean out gutters, drains and flood channels to protect against cyclones and/or storms
c. The level of need amongst the community would be useful thing for emergency services to know in addition to building a more comprehensive view of a community's resilience (e.g.: health and neediness.

d. Social resilience indicators which encompass psychological and emotional wellbeing and a way of measuring true social resilience.

5.0 DISCUSSION / CONCLUSION

The Baseline Resilience Indicators for Communities (BRIC) developed by Cutter et al. (2010) was one of the first translations of a conceptual model of community disaster resilience into an empirical assessment tool, enabling stakeholders to identify baseline levels of resilience within a community.

An amended version of BRIC was applied to the Sunshine Coast local government area. Some difficulties with the process of indicator selection and scoring were encountered which could potentially be alleviated with further mapping of existing data pathways. Despite these difficulties, the LDMG and DDMG identified that the BRIC is not suited to the Sunshine Coast local government area for two fundamental reasons. Firstly, our findings demonstrate that the omission of the environmental resilience theme – or connection with environmental risk and vulnerabilities restricted the usefulness of the tool for this case study setting. Environmental resilience has traditionally been concerned with `the ability of an ecological system to absorb change and disturbance and still maintain the same populations or state variables' (Holling, 973, p14). Within a socio-ecological context, the degree of disturbance and potential for an environment to lose its stability can have significant consequences for residents, particularly in regard to agriculture, fresh water supply, ecosystem services, beaches, wetlands and on native vegetation for flood mitigation/prevention of soil erosion. Although the BRIC is proposed to be an all hazards assessment tool, the LDMG and DDMG argue that consideration of ecological impacts warrant inclusion in an assessment tool.

Secondly, the LDMG and DDMG also identified some scaling issues with regard to the tool's ability to be applied across different communities. The LDMG and DDMG participants required more detail and wanted the assessment to account for the diversity across the region, particularly in regard to the institutional resilience, social resilience and community capital categories. Although it was acknowledged that some characteristics of a resilient community are more challenging to represent as discrete or composite indicators, as the indicators imply homogeneity across the study area. For example, social vulnerability or exposure to certain types of hazards will likely vary significantly across a study region. Other participants suggested that a participatory framework, rather than a top-down assessment was more in keeping with the `shared responsibility' policy position and that the assessment would benefit from local knowledge and the inclusion of community members.

In summary, the LDMG and DDMG's have determined that the BRIC in its present and adapted form is not suitably applied to the Sunshine Coast local government area. Despite the cost benefits associated with a top-down assessment methodology, the LDMG and DDMG were supportive of a participatory approach, acknowledging the benefit to the community in associated co-benefits. The LDMG and DDMG did identify some key indicators that may be fruitful in future assessments of disaster resilience. In addition to the ecological indicators; these included indicators of the potential for support in communities and the proximity of critical services and infrastructure, the community's attitude to risk and resilience, the community's level of need and the psychological and emotional wellbeing of the community. Further exploration and development of indicators drawing from the

lessons learnt from the application of the BRIC is recommended as a key line of future inquiry for the Sunshine Coast.

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Table 1: Summary of each category of indicators that comprise the Disaster Resilience Indicators (Cutter et al., 2010, p8):

Category	Underpinning philosophy / focus
Economic resilience	The economic vitality of the communities and the diversity of the local economy, both of which indicate the stability of livelihoods.
Institutional resilience	The characteristics that relate to prior disaster experience, mitigation and planning and resources.
Infrastructure resilience	The capacity for a community to respond and recover from disasters, as such, it includes an assessment of infrastructural vulnerability,
Community capital	The relationships between individuals, and their larger neighbourhoods and communities. It focuses on three central themes: sense of community, place attachment and citizen participation.
Social resilience	The differential social capacity within and between communities.

Table 2: Evaluation Survey – DRI

1. Do you think it is important that there is a tool available to measure community resilience to disaster? likert scale 1 – 5 (absolutely – not at all)
2. Who do you think would use this tool? Comment box
3. In your opinion, are indicators the best way to monitor and measure community disaster resilience? Or are there other methods as effective or more effective? Comment box
4. In your opinion, does the application of the adapted DRI provide a good picture of the strengths and weaknesses of the Sunshine Coast's disaster resilience? Liekart scale 1 – 5 (absolutely – not at all)
5. Currently, the DRI considers indicators of community capital, infrastructure resilience, economic resilience, institutional resilience and social resilience. In your opinion, are there other elements that are important to the Sunshine Coast that should be included? If so, please explain what these might be and why you believe them to be important. Comment box
6. Are there other indicators that you are aware of that would provide a better indication of community resilience. If so, please list these in the table below (columns for indicator, data set and whether the indicator is a substitute or additional indicator.
7. Lastly, are there any comments that you would like to make about the assessment of community resilience to disasters, or the suite of DRI indicators central to this study? Comment box.

Category	Indicator	Score (0 least resilie	Aggregated score per	Category	Indicator	Score (0 least resilient – 1	Aggregated score per
Economic Resilience	1. Home ownership	0.34	0.54	Institutional Resilience	1. Mitigation	1	0.80
	2. Employment	0.63			2. Flood Coverage	0.73	
	3. Income and	0.71			3. Mitigation	1	
	4. Single sector	0.6			4. Previous disaster	0.88	
	5. Business size	0.15			5. Mitigation and social	0.2	
	6. Health access	0.8			6. Mitigation	1	
Infrastructure Resilience	1. Housing	0.98	0.57	Social Resilience	1. Age	0.45	0.83
	2. Shelter capacity	0.61			2. Transportation	0.87	
	3. Medical capacity	0			3. Communication capacity	0.94	
	4. Care for housing / infrastructure	0.8			4. Language competency	0.99	
	5. Sheltering needs	0.44			5. Special needs	0.95	
Community Capital	1. Place attachment	0.6	0.51		6. Preparedness	0.79	
	2. Political	0.75					
	3. Social	0.65					
	4. Innovation	0.02					

Appendix 1: The suite of Indicators employed in the assessment of disaster resilience on the Sunshine Coast – adapted from the DRI

Theme	DRI	Cutter's DRI	Substitute or Additional Indicator / *Rationale (italicized)*
Economic Resilience	Housing Capital	Percentage Home Ownership	
	Employment	Percentage employed	Percentage of residents in the labour force
	Income and Equality	GINI coefficient	Socio – Economic Index of Disadvantage (SEIFA) *The GINI coefficient has not captured for the Sunshine Coast, nor is there anything similar.*
	Single Sector Employment Dependence	Percent population not employed in farming, fishing, forestry and extractive industries	
	Employment	Percent female labour force participation	
	Business Size	Ratio of large to small businesses	The ratio of large businesses (employing greater than 19 people) : number of small businesses (employing less than 4)
	Health Access	Number of physicians per 10,000 population	Number of full-time Doctors employed in general practice on the Sunshine Coast for every 10,000 people during 2011/12
Institutional Resilience	Mitigation	Percent population covered by a recent hazard mitigation plan	
	Flood Coverage	Percent housing units covered by NFIP policies	Percent of households with household insurance coverage (top two types)
	State Services	Originally `Municipal Services'. Percent municipal expenditures for fire, police and EMS.	Percentage of the Queensland's 2012/13 budget for Sunshine Coast's fire, police and EM. COULD NOT OBTAIN DATA
	Mitigation	Percent population participating in Community Rating System for flood (CRS)	Percentage of population covered by awareness raising and preparedness programs facilitated by first responder organisations.
	Political Fragmentation	Number of governments and special districts	REMOVED FROM DATA SUITE *Always 3 layers of government.*
	Previous Disaster Expenditure	Number of paid disaster declarations	Number of NDRRA activations in the last four years (from 2009/10)
	Mitigation and social connectivity	Percent population covered by Citizen Corps programs	Percentage of the population (older than 15yrs) engaged in unpaid work for an organization or a group. *Australia (Sunshine Coast) equivalent*
	Mitigation	Percent in Storm Ready communities	Percentage of the population covered by first responder programs (QAS, SES, RFS, Red Cross). *Australia (Sunshine Coast) equivalent*
Infrastructure Resilience	Housing type	Percent housing units that are not mobile homes	Percentage of dwellings not caravans, cabin, houseboats, improvised home, tent and sleepers out
	Shelter capacity	Percent vacant rental units	Bed occupancy rate of hotels, motels and serviced apartments (June Qtr 2013)
	Medical capacity	Number of hospital beds	Percentage of vacant hospital beds

		per 10,000 population	
	Access / Evacuation potential	Principle arterial miles per square miles	COULD NOT OBTAIN DATA *Recognised as an important indicator, however as a coastal area, land-sea evacuations also important to estimate. Data capture required*
	Housing age	Percent housing units not built before 1970 and after 1994	Number of dwellings built prior to the change in building code (1991?) to include the cyclone ratings? COULD NOT OBTAIN DATA - *Data capture required*
	Care for housing / infrastructure		Estimated proportion of households that clean out gutters, drains and flood channels to protect against cyclones and/or storms. *Data available through the 2012 Queensland Regional Household Survey Report, Office of Economic and Statistical Research OESR*
	Sheltering Needs	Number of hotels/ motels per square miles	
	Sheltering Need		Estimate proportion of multi-person households who have made arrangement for members of the household to stay with a family member or friend if evacuation is required. *Data available through the 2012 Queensland Regional Household Survey Report, Office of Economic and Statistical Research OESR*
	Recovery	Number of public schools per square kilometre	*DID NOT USE – Difficult to assign a score to as there is not a standard or ideal number of schools etc. that supports sheltering needs. Also does not consider the identified evacuation centres – Data capture required*
Community Capital	Place Attachment	Net international migration	*DID NOT USE – Questionable indicator suggesting that attachment of place represented by place of birth*.
	Place Attachment	Percentage of the born in a state that still resides in the same state	Percentage of the Sunshine Coast population who lived at the same address 5 year ago. *Original data set not available*
	Political Engagement	Percent voter participation in the 2004 election	Percentage of Sunshine Coast residents who voted in the recent local government election. *Australia (Sunshine Coast) equivalent*
	Social capital - religion	Number of religious adherents per 10,000 population	Percentage of residents with a religious affiliation
	Social Capital – civic involvement	Number of civic organisations per 10,000 population	Number of community, sporting, cultural and interest groups registered on the Council website. *DID NOT USE - Difficult to assign a score as the range of values for different geographies is not clear.*
	Social Capital - advocacy	Number of social advocacy groups per 10,000 people	Number of social advocacy groups per 10,000 people. *COULD NOT OBTAIN DATA - Data capture required*
	Innovation	Percentage population employed in creative class occupations	
Social Resilienc e	Educational equity	Percent of pet. population with college education to the pet. population with no high	Percentage of population with no high school diploma. *DID NOT USE - Difficult to assign range and score for the original indicator.*

		school diploma.	
	Age	Percentage of non-elderly population	
	Transportation access	Percentage of households with a vehicle	
	Communication Capacity	Percentage of households with a telephone	Percentage of households with internet access. *Data capture required to gain telephone data set. Internet access data was available.*
	Language Competency	Percent population not speaking English as a second language	Percentage of population who speak English as a first language or speak English well as a second language. *Considered a better indicator based on existing data sets.*
	Special Needs	Percent population without a sensory, physical or mental disability	Percentage of population who have identified that they require assistance to complete core activities. *Considered a better indicator based on existing data sets.*
	Health coverage	Percent of the population with health insurance coverage.	*DID NOT COLLECT - Australia has a public health system, this indicator seems less relevant*
	Preparedness		The percentage of residents surveyed who believe that they are prepared or very prepared for a natural disaster. Data set available. *Additional indicator which captures disaster readiness or preparedness directly.*