Neus (Snowy) Evans

Social-ecological resilience through education for sustainability

A case study of community scale resilience

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Theoretical Development of Resilience

Through

Education for Sustainability

Chapter 1. Contextualising the research

Introduction

This research was undertaken within the Cairns region of Tropical North Queensland in Australia. The Cairns region encompasses the coastal area from Tully, 150 kilometres south of Cairns, to Cape Tribulation, 140 kilometres to the north and to Ravenshoe, Herberton and Mareeba, 100 kilometres inland (*Figure 1.1*). Far North Queensland expands from Cardwell, 200 kilometres south of the City of Cairns, to the Torres Strait on the northernmost point of the country (*Figure 1.2*). Over the last twenty years Cairns has experienced unprecedented environmental changes, mostly due to increased urban development. A soaring human population has resulted in the transformation of landscapes from chiefly untouched verdant hillsides, country roads and cane paddocks to ad hoc, developer-driven commercial and domestic development which has not considered many of the region's ecological values and ecosystem functions (Cairns and Far North Environment Centre Inc [Cafnec], 2007). Ecologically unsustainable growth is contributing to declining environmental conditions which may compromise local options for future generations. One area of significant concern is changes in the water quality of waterways leading to the Great Barrier Reef. Over the past 150–200 years, runoff from land-based agricultural activities and urban development has caused a fourfold increase in the levels of anthropogenic pollutants entering Great Barrier Reef waters via catchments (Haynes, 2001). It is projected that by 2020 the Great Barrier Reef will suffer further significant biodiversity loss, partly due to coastal development and population growth as well as threats due to climate change (Intergovernmental Panel on Climate Change [IPCC], 2007).

Environmental changes are not unique to north Queensland. Stories of major sustainability threats brought about by urbanisation, over-consumption of natural resources, and adverse agricultural practices abound worldwide (see Cutter & Smith, 2001). One renowned example is the collapse of the Canadian cod fisheries in the early nineties due to over-fishing. Despite warnings, humans continue to deplete non-renewable resources, damage ecological systems – at times beyond repair, reduce social stability, and increase the gap between rich and poor (Queensland Government Department of Education, Training and the Arts [DETA]2006b). Each time the Intergovernmental Panel on Climate Change (IPCC) produces an updated report they advise that previous reports underestimated the magnitude of change. Humanity's global footprint now exceeds Earth's capacity to regenerate by about 30 per cent (World Wildlife Fund [WWF], 2008). This is causing system instability of social and ecological systems.

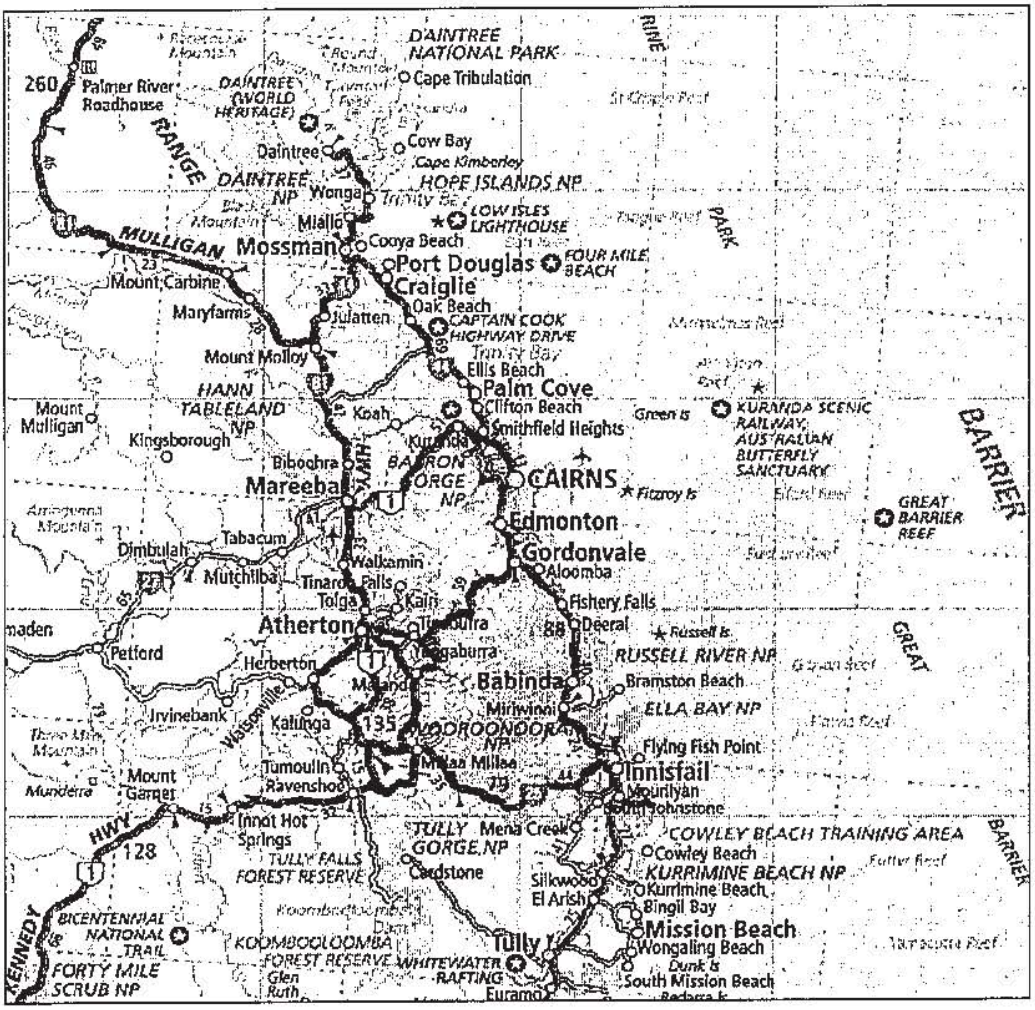

Figure 1.1. Map of Cairns region
(Explore Australia, 2008)

Education is heralded as a key strategy for mitigating unsustainable trends and working towards the creation of a sustainable future (Fien & Tilbury, 2002; DETA2006b; United Nations Economic and Social Council, 2008). According to the United Nations Commission on Environment and Development (1987), a sustainable world is one where ecological, social and economic needs are balanced to meet the needs of present generations without compromising the ability of future generations to meet their own needs. The United Nations declared the years 2005 to 2014 the Decade of Education for Sustainable Development with aims to integrate the principles, values, and practices of sustainable development into all aspects of education and learning (United Nations Educational Scientific and Cultural Organization [UNESCO], 2002b). Education for sustainability is conceived of as developing the skills, knowledge and values that promote sustainability through the application of transformational pedagogical approaches, and enabling students "to become active participants and decision-makers in the change process" (Tilbury & Wortman, 2004, p. 9). The approaches include envisioning, systemic thinking, critical (reflective) thinking, participation in decision making, and partnerships for change (Australian Research Institute in Education for Sustainability [ARIES], 2005b).

The theories and practices of education for sustainability are commendable, but other work is useful to further understanding, and merits consideration. Education for sustainability has been developed from an understanding of Earth systems as being in a state of equilibrium. Even though Earth has experienced many past periods of change, the planet's environment has been relatively stable for the last 10,000 years (Rockström et al.2009). The ideal of a sustainable society, with balanced ecological, social and economic systems, is built on a foundation of regular temperatures, readily available fresh water and biogeochemical flows (Rockström, et al., 2009). Researchers suggest increases in global disturbances such as climate change and abrupt ecological occurrences like earthquakes, cyclones and tsunamis indicate this period of stability is now under threat (Rockström, et al., 2009; Steffen et al., 2004). Earth systems are nearing a tipping point beyond which the planet will likely undergo very rapid, unpredictable and irreversible environmental changes (see Flannery, 2008; Resilience Alliance, 2009) which may even be cataclysmic. These uncertainties present opportunities to reconsider the knowledges and skills needed to enable a truly sustainable society. According to James Lovelock (2009) the state of the planet is too far gone to consider mitigation. What we really need are adaptation strategies. Social-ecological resilience (SER) theory recognises the importance of adaptation (Folke, 2006; Folke et al.2002; Folke, Hahn, Olsson, & Norberg, 2005) and SER is central to this book.

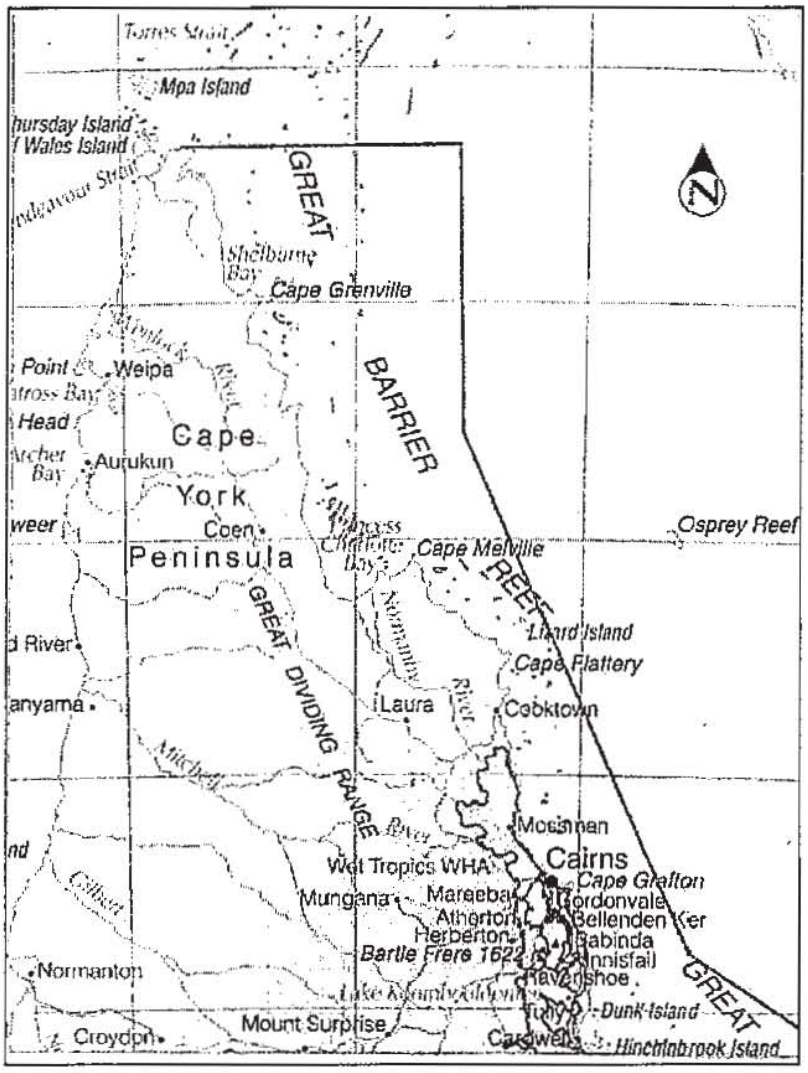

Figure 1.2. Map of Far North Queensland, Australia (Jacaranda Primary Atlas, 2001)

Resilience is a cross-disciplinary concept which can be defined in many ways (Adger, 2000). This book draws from the ecological sciences to broadly explain resilience as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker, Holling, Carpenter, & Kinzig, 2004, Resilience section, para. 1). Specifically, I explore social resilience to environmental changes at the school community scale through a social-ecological framework. Adger (20002007) defines social resilience as the ability of communities to adapt to external social, political or environmental changes. Hopkins (2008) argues community-level resilience is evident when societies are able to respond adaptively (as opposed to collapsing) to adversity. The Centre for Community Enterprise (2000) maintains that a resilient

community will take intentional action to enhance its adaptive capacity to respond proactively to change. This is because adaptive capacity enables social-ecological systems "to cope with novel situations without losing options for the future, and resilience is key to enhancing adaptive capacity" (Folke, et al., 2002, p. 7). I define a school community as the principal, teachers, students and any other people who participate in a school's daily business and operations. The social-ecological lens, which I explain further on in this chapter, provides a way to understand relationships between social and ecological systems.

I argue that if education for sustainability in schools is to be successful it must provide the skills, knowledge and understandings of students, staff and others in the school community to build capacity to manage change in ways that open rather than limit future options. To date, no published research has explored education for sustainability through a resilience understanding. This book investigates whether, and to what extent, education for sustainability in primary schools enhances resilience by fostering capacity for school community members to adapt to changing environmental conditions. I do this by investigating how principals, teachers and students in four Far North Queensland schools, known to prioritise education for sustainability, construct education for sustainability within their school settings. By construct I mean the ways these communities perceive, organise and enact the principles and practices of education for sustainability in their schools. The aim of the research is twofold. In the first stage I set out to understand and interpret the principals', teachers' and students' perceptions, explanations, beliefs, worldviews and actions with regard to education for sustainability (Patton, 2002). In the second stage I examine the consequences of their constructions of education for sustainability from a social-ecological resilience perspective. In doing this I identify strategies to effect resilience at the school community level.

Resilience is an abstract and difficult-to-measure concept. I investigate how and to what extent the principles and practices of schooling in the four schools foster resilience by applying the Australian Government's *Framework for Environmental Education for Sustainability* outlined in *A National Environmental Education Statement for Australian Schools* (Australian Government Department of the Environment and Heritage [DEH], 2005). The framework is a nationally agreed description for best practice which is based on the belief that effective education for sustainability requires the involvement of the whole school. The framework deals with governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos. I describe the framework in detail in Chapter Three.

One outcome of the research is a proposed set of qualitative indicators which infer a whole-school approach to education for sustainability informed by social-ecological resilience. Indicators are information systems (Redefining Progress, 2006) and often take the form of a sign, symptom, omen, signal, tip, clue, grade, rank, data, pointer, dial, warning light, instrument, or measurement (Meadows, 1998). Qualitative indicators are sets of statements which provide descriptive information and are particularly useful for learning about a phenomenon about which little is known (Tilbury, Janousek, Elias, & Bacha, 2007). The qualitative indicators in this book are sets of statements which provide a rich description of the broad characteristics of resilience in school communities. They combine understandings from the education for sustainability and social-ecological resilience fields and attempt to describe education for sustainability practices which build resilience. I explain what qualitative indicators are and their application in this study in detail in Chapter Three. Directly below I introduce the concept of resilience from a social-ecological perspective before discussing the rationale behind exploring resilience through education for sustainability. A more complete understanding of resilience and its application at school community level evolves throughout this book. The last section of the chapter describes the research questions and approaches, the significance of the study, and then outlines the layout for the remainder of the book.

1.1 Preface to a social-ecological resilience perspective

In modern western thinking and practice there is a habitual separation of environment and society which has led to a misguided belief that ecosystem response to human use is linear, predictable and controllable (Folke, et al., 2002). Recent climate change events, however, indicate that management approaches that treat ecological and social systems as separate entities are failing to provide public security, and essential goods and services (such as water, fresh air and oil) and that these approaches reduce the ability of social and ecological systems to respond to change (Folke, et al., 2002; Krasny & Tidball, 2009). A case in point is the flooding of New Orleans which occurred when human engineered river embankments burst following Hurricane Katrina in 2005.

An alternative approach is a social-ecological systems perspective, which considers people and ecosystems are complex, dynamic, fluid, context specific, and unpredictable (Adger, 2000; Marshall & Marshall, 2007). Based on complex systems theory, social-ecological systems theory emphasises an integrated view of social and ecological systems. Humans depend on the capacity of ecosystems to

provide essential goods and services such as water and oxygen, while ecosystems' ability to provide these depends largely on people acting sustainably. Therefore, in considering community level resilience to environmental changes, "delineation between social and natural systems is artificial and arbitrary" (Berkes, Colding, & Folke, 2003b, p. 3). A social-ecological framework provides me with a way of understanding social and ecological systems as synergistic and interdependent because what happens in one inevitably affects the other.

One point to consider is the applicability of the ecological concept of resilience to the social sciences. That the concept of resilience from the ecological sciences is readily transferred to the social sciences can be contested. One of the first papers exploring links between social and ecological systems was published by Folke, Pritchard, Berkes, Colding and Svedin (1998). The paper raised many issues that have since been explored. A revised 2007 copy of the paper (Folke, Pritchard, Berkes, Colding, & Svedin, 2007), found that nearly ten years later most of the research on societal development, sustainable development and social futures still treats ecological and social systems as separate. Adger (2000) explores potential links between social and ecological resilience in resource dependent communities. He concludes that the attributes germane to ecological resilience (the capacity to cope with surprises and change) are precisely the same ones which enable innovation, coping with change and social learning in social institutions. Folke et al. (2007) argue that confronting the challenges brought about by global change requires an integrated view of social-ecological systems. This is important when considering a school's capacity to provide the skills, knowledge and understanding of students, staff and other in the school community to build capacity to manage change.

Social-ecological systems have three defining characteristics: resilience, adaptability, and transformability. Resilience is a system's ability to keep functioning while experiencing change or disturbance. A resilient system is able to absorb (expected and unexpected) disturbances without significantly changing its structure, function and identity (Walker, Anderies, Kinzig, & Ryan, 2006). Loss of resilience can lead to irreversible changes, vulnerabilities and reduced functional capacity (Adger, 2007). Adaptability is the ability to adapt to changing circumstances. A resilient system is adaptable, and is therefore able to respond to feedbacks from other systems in ways that help the system adjust to changing circumstances. In social-ecological systems, adaptability refers to the capacity of humans to manage resilience (Walker, Anderies, et al., 2006). Transformability is the ability to change to something completely different when the current system is untenable (Walker, et al., 2004; Walker & Salt, 2006).

The characteristics of social-ecological systems (resilience, adaptability and transformability) are underpinned by scale which refers to other systems operating at different temporal and spatial levels. Walker et al. (2004) point out the social component of a social-ecological system consists of groups of people organised at multiple levels with differing views about what is and is not desirable and/or acceptable. In a school, what a single student does may be affected by other students; the teacher; the whole year level including teachers and students; the whole school community including parents; and the whole social-ecological system in which the school is embedded, which includes the social, economic, political and ecological context in which the school is nested. On a larger scale what the school does is affected by the local community; the education department; state governance; federal governance and the larger social-ecological system in which all the systems are embedded. People at the school community level are affected by internal forces within their own level as well as external forces at levels above and below. While staff and students in a school may be willing to move forward with local climate change initiatives or actions to improve local ecological conditions, the effectiveness and durability of their actions may be tenuous without support from levels above such as Education Queensland or below such as local community members.

Resilience theory is attentive to the multifaceted nature of social-ecological systems because as well as enabling a system to overcome change or disturbance, resilience fosters capacity to mitigate perturbations, self-organise, learn and adapt in ways that are constructive (Folke, et al., 2002). When further change takes place, "resilient systems contain the experience and the diversity of options needed for renewal and redevelopment" (Walker et al.2002, p. 23). A system that lacks resilience is less able to respond, and is more vulnerable to undesirable changes.

1.2 Why investigate resilience through education for sustainability?

Resilience has been studied in many contexts such as leadership (Folke, et al., 2005), sustainable development (Folke, et al., 2002; Perrings, 2006), management (Berkes, et al., 2003b), ecological systems (Gunderson & Holling, 2002), social-ecological systems (Berkes, et al., 2003b; Folke, 2006) and social systems (Adger, 2000; Adger, Kelly, Winkels, Quang Huy, & Locke, 2002; Marshall, 2006), but apart from Fazey et al. (2007), Krasny and Tidball (2009), Tidball and Krasny (2007), and Krasny, Tidball and Sriskandarajah (2009), resilience within an education context has received little attention. The concept of resilience adds a new dimension to education for sustainability and has the potential to

enhance adaptive capacity. Resilience incorporates the concept of change and response to change into the definition of sustainability which existing literature seems to omit (Krasny & Tidball, 2009). Change, whether rapid or gradual, is a normal function in social-ecological systems and, therefore, critical to sustainability (Walker & Salt, 2006). In this thesis I explore how combining the understandings from resilience theory with education for sustainability knowledges and practices can enhance overall learning outcomes. To date we do not know whether and to what extent the theoretical and practical ideas of the resilience concept are included in current whole-school approaches to education for sustainability. This research is a first attempt to investigate this.

This research takes place during a period of global instability and transformation. Volatility of world economies and powers, threats of terrorism, war and ecological disasters dominate the news, and the uncertainties of peak oil and climate change loom. Since I started this research three years ago, the focus within the education for sustainability field has shifted from biodiversity to climate change. A resilient system has the capacity to adapt to new circumstances, learn and develop. I argue that school education plays an important role in equipping students with the capacity to manage change in ways that will open, rather than limit, future sustainability options. Administering schools in ways that enhance resilience can help school communities build capacity to manage unanticipated future events. Knowledge and understanding of resilience can empower us to make informed choices and actions. I suggest resilience based school management enables administrators to make choices that will foster teaching and learning for adaptive capacity. The relationship between resilience and education for sustainability is explored in more detail in Chapter Two.

1.3 Research questions

This study is guided by the following overarching research question:

- What is the role of education for sustainability in fostering social-ecological resilience within school communities?

I investigate how education for sustainability is constructed in each of the four schools from a social-ecological resilience perspective and I identify strategies to effect resilience at school community level. A social-ecological resilience lens enables me to consider whether the way school members think about, organise and enact education for sustainability enhances resilience. I intentionally kept the research question broad for two reasons. First, education for sustainability and social-ecological resilience are both extensive subjects that expand across various scales (local, regional, national and

global). I wanted to keep a wide perspective which would enable me to make wide-ranging cross-scale connections. Second, I make sense of the world through a systemic perspective. Systems thinking takes a big picture view by identifying connections and relationships between parts rather than solving problems through a linear cause and effect paradigm (ARIES2005a; Sterling, 2004). Flood (2001) explains "valid knowledge and meaningful understanding comes from building up whole pictures of phenomenon, not by breaking them into parts" (p. 133). A systems view helped me develop deep understanding of my research area and how to generate change that can work with, rather than against the current education system.

The research question gave rise to a number of sub-questions which helped orientate the research method. These are:

- What are the characteristics of schools that prioritise education for sustainability and how are they similar or different to the characteristics of approaches described in the social-ecological resilience literature?
- In what ways are each school's construction of governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos, similar or different to those described in the literature on social-ecological resilience? What are the implications for the schools' ability to build resilience?
- If a school models actions and undertakes explicit teaching and learning for sustainability, does that promote the ability of the school community to think and act in ways that foster resilience?
- If a school has a well developed whole-school approach to education for sustainability, does that mean school members are better able to manage and respond (adapt) to environmental threats such as climate change?

1.4 Research background, methodology and complexities

This research forms part of a larger research project sponsored by the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF) – *Project 4.9.7: Understanding social resilience and identification of social resilience indicators for management* (Marine and Tropical Sciences Research Facility [MTSRF], 2006). The project takes an integrated cross-disciplinary approach and involves researchers from the social and biophysical sciences across two universities and the CSIRO, the national government body for scientific research in Australia. The research team was contracted to

develop a set of indicators of social resilience that are generally applicable to linked social and ecological systems in north Queensland. The indicators are meant to be useful for monitoring and reporting the general social resilience of north Queensland communities. As a doctoral candidate I had the freedom to direct my own research as long as the study was directly relevant to the aims of the team's project. As my professional background is in education and my previous research experience is in school-based education for sustainability, I decided to investigate resilience within an education for sustainability context at the school community level.

To conduct the research I took a constructivist approach from the qualitative standpoint. Qualitative research is the most suitable approach when researching an area where little or no research has been attempted. Qualitative methods allow a researcher to 'dig deep' by asking who, what, why, when and how questions to illuminate phenomena (Kayrooz & Trevitt, 2005). Qualitative research is inductive, emergent and shaped by the researcher's experiences (Creswell, 2007). Qualitative researchers assume that research is not a linear, orderly and pre-determined process. Unexpected events form part of the research process and should be welcomed as opportunities to learn (Clark, 2004). In this work, I employ a constructivist approach to research. I understand knowledge and meaning as emergent, fluid, multiple and subjective and I develop new knowledge and new understanding through interactions and occurrences (Creswell, 2007). I make sense of occurrences through textual descriptions. Although I developed a study purpose and design early on in my research, the approach was flexible enough to take advantage of emergent conditions.

Constructivists understand that knowledge is constructed and reconstructed through personal experience. People perceive the world in their own way and create their own meanings from events (Burr, 2003). In Schwandt's (1998, p. 237) words "constructivism means that human beings do not find or discover knowledge so much as construct or make it" and constructivist researchers "invent concepts, models, and schemes to make sense of experience". Researchers with a constructivist epistemology understand studied realities to be "social products of the actors, of interactions, and institutions" (Flick, 2006, p. 78). Patton (2002, p. 96) explains the foundational question a constructivist researcher asks is "how have the people in this setting constructed reality? What are their reported perceptions, 'truths,' explanations, beliefs, and world-view?" These are the questions upon which I constructed my research and the way I conceptualised the resultant indicators.

Qualitative researchers study how phenomena are constructed in people's everyday activities (Silverman, 2009). As per Astleithner et al. (2004) I understand indicators as social constructs embedded in place and time. By exploring how education for sustainability is constructed in the everyday life of each of my four case study schools, I investigate whether the constructions mirror or hold resilience characteristics. I study the consequences of the constructions from a social-ecological resilience perspective. The indicators I develop offer a starting point to consider whether and how education for sustainability may facilitate resilience. From a positivist perspective, indicators are transferable. I do not suggest my indicators are transferable to schools in other areas of Australia or the world because I understand context and identity is fluid. Each school has multiple and individual constructions of education for sustainability. For example, the principal, teachers, students, documents, all project individual understandings of education for sustainability. A positivist approach would attempt to eliminate multiple representations. I, on the other hand, examine what the constructions are and how they are constructed, and then consider the consequences for fostering resilience. In considering complexities of quantitative and qualitative research, my main concern in this book is that my qualitative approach is consistent.

1.5 Prelude to the case study approach and methods

This book is an exploratory multi-site case study based in four Far North Queensland schools located between Edmonton, south of Cairns, and Cape Tribulation to the north (Figure 1.3). I apply a combination of qualitative participatory and narrative methods within the case study approach to research practice at the intersection of education, sustainability and socio-ecological resilience thinking. I explain the methods in detail in Chapter Three. Yin (2003) argues that exploratory case studies are useful when there is little existing knowledge about the case, when the literature provides no conceptual framework or hypotheses and when context is important to understand the case. Stake (1995) believes exploratory case studies are useful to maximise learning when time is limited.

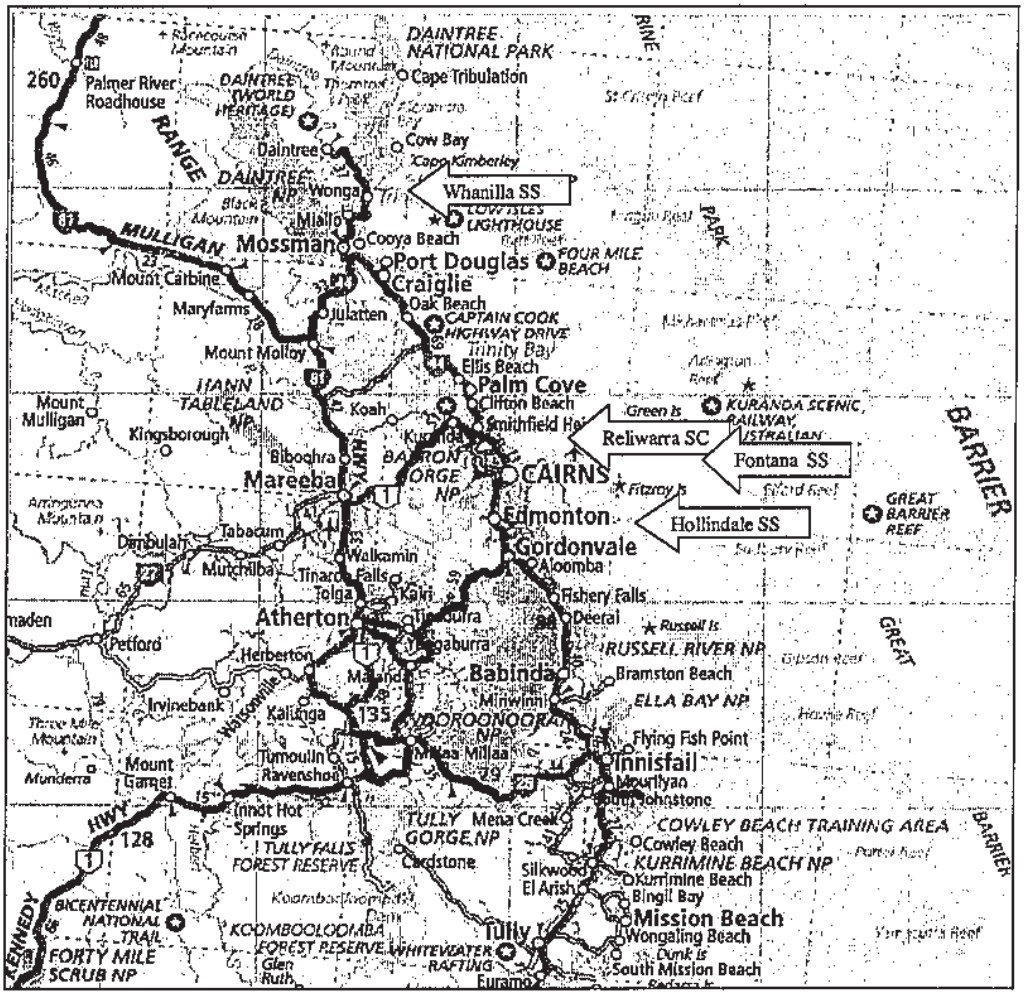

Figure 1.3. Location of case study schools
(Explore Australia, 2008)

For Denscombe (2007) a case study approach is most suitable when investigating complex situations where "to understand one thing it is necessary to understand many others and, crucially, how the various parts are linked" (p. 36). Schools are complex systems composed of many different people (who themselves are individual complex systems): teachers, students, parents, auxiliary staff, administrators, and people from many intersecting organisations, who are interconnected through similar yet individual interests in education (which is the whole). What a teacher understands education to be may be the same, similar or completely different to what parents, and/or students want or expect from education. Yet all participate in an interconnected manner within the education system. A case study approach offered me more opportunities than other more superficial approaches "of going into sufficient detail to unravel the complexities" of each school's situation (Denscombe, 2007, p. 36). This approach enabled me to investigate particular instances of education for sustainability through various

methods, to elucidate whether their characteristics enhance and/or promote thinking, learning and acting in ways that foster resilience. Although there are many separate studies of social-ecological resilience (for example, Berkes, et al., 2003b; Gunderson & Holling, 2002; Walker & Salt, 2006) and education for sustainability (Australian Government Department of the Environment, Water, Heritage and the Arts [DEWHA]2008; Henderson & Tilbury, 2004; Tilbury, Coleman, & Garlick, 2005), this is the first Australian study that combines the two fields. Sustainability and resilience are both context-dependent. Applying an exploratory case study within a qualitative approach enabled me to build context as well as a database of interviews, questionnaires, documents, archival records and direct observations from each school.

Data collection methods for this research involved naturally-occurring and manufactured data (Silverman, 2007). Naturally-occurring data is produced by itself and is found "in the field" (Silverman, 2007, p. 37). This includes, for example, documents, websites, and observations. Manufactured data is specifically designed by researchers in order to answer a research question. Examples of manufactured data in this research include interviews with school principals, volunteer teachers, groups of students, school sustainability reviews, and teacher questionnaires. Data analysis involved four stages and several sub-processes at each stage. In the first stage I apply five levels of qualitative analysis to the field texts from each of my case study schools in order to organise and synthesise the voluminous data I collected, as well as to identify themes, sub-themes and patterns. Each level involved different methods of data manipulation as suggested by Miles and Huberman (1994), Strauss (1987), Dey (1993), and Creswell (2007), and includes putting information into different arrays, making a matrix of categories and placing the evidence within such categories, and putting information in chronological order.

The second stage of analysis involves building the field texts into four full narratives. Each narrative represents how education for sustainability is constructed in one particular case study school. Richardson (1990) explains that narrative is a mode of reasoning and a mode of representation. Narrative provides a method for organising an event/action or series of events/actions into a chronologically, holistic and meaningful episode (Chase, 2005; Czarniawska, 2004a; Polkinghorne, 1995). Narrative method offered me a way to organise, make sense of and present a voluminous and disorderly collection of data. More detail about the narrative method and its application in this research is provided in Chapter Three.

In the third stage of data analysis I apply a four-step process to analyse the narratives for characteristics of education for sustainability. This required reading the narratives through and noting each instance which reflected each of the characteristics of the Australian Government's (2005) *Framework for Environmental Education for Sustainability* (DEH2005). These are governance, physical surrounds, resource management, teaching and learning, curriculum organisation, networks and partnerships, and school ethos. In the fourth and final stage of the analysis I derive and present a set of qualitative indicators which infer education for sustainability informed by social-ecological resilience theory. Stages One and Two analyse the field texts collected from each case separately, while stage three and four involve cross-case analysis to identify themes.

1.6 Significance of the study

So far in this chapter I have hinted at the significance of this study. If, as discussed above, we consider that (a) resilience provides adaptive capacity for change, (b) education for sustainability plays an important role in building capacity for sustainability, and (c) resilience is necessary for long-term sustainability, then a strong argument emerges for the importance of investigating whether, and to what extent, education for sustainability fosters resilience. To date no research in Australia, and only a few emergent studies elsewhere, have investigated resilience within the education context. Given resilience is considered essential for long-term sustainability (Adger, 2007; Folke, et al., 2002; Walker & Salt, 2006) and education is heralded as a major strategy for developing skills, knowledge and values to promote sustainability (Fien & Tilbury, 2002; DETA2006b; United Nations Economic and Social Council, 2008), it is important to investigate whether and to what extent education for sustainability fosters resilience.

This study has implications for individuals, groups, schools and programs concerned with education for sustainability. Environmental changes worldwide are causing instability of social-ecological systems and affecting their long-term sustainability. Education for sustainability is one way to engage and equip people for change towards sustainability (see ARIES2009). However, little is known about how people respond to change, or how society reorganises following change (Folke, et al., 2002). I argue that social-ecological resilience theory offers insights about change and response to change which can enhance current education for sustainability outcomes. The results of this study enhance current understandings of education for sustainability and contribute to the development of initiatives which teach people to take advantage of change in ways that enhance future options.

1.7 Organisation of the book

My research predominantly concerns two areas: education for sustainability, which combines understandings from the sustainability and education fields, and social-ecological resilience which has emerged from ecology. In Chapter Two I describe and develop understanding about the two sets of literature and pose possibilities for how the two combine to form new understandings. This sets the background for the findings that emerge from the research.

Chapter Three explains the methodology and methods. I explain why and how I apply a combination of participatory and narrative methods within a case study research approach to investigate ways that resilience can be enhanced or eroded in four Far North Queensland school communities that prioritise education for sustainability. I also describe the process for the development of the qualitative indicators which I present and discuss in Chapter Five.

Chapter Four presents the stories of the four schools in my study in a narrative style. The stories were constructed by me in consultation with the research participant teachers and principals. Each story narrates one school's learning journey and is compiled from my field texts.

Chapter Five builds on the stories presented in Chapter Four to develop a framework of qualitative indicators based on the four narratives and supported by other data I collected. In line with this study's intent to explore the interrelationship between education for sustainability and social-ecological systems resilience in schools, I develop a set of indicators of education for sustainability informed by social-ecological resilience theory. I also discuss the findings that emerged through development of the indicators.

Chapter Six concludes the book. I engage in a general discussion of the findings, discuss the limitations of the study, and provide conclusions and reflections as well as possible avenues to further advances in learning.

Conclusion

There is now a multitude of evidence that the way we currently live is not sustainable. Regardless of increasing warnings from the scientific community we continue to put unsustainable stress on critical ecosystem resources such as clean water and fresh air, seemingly without consideration to the ability of

ecosystems to continue to sustain future generations (Millenium Ecosystem Assessment, 2005). That the Earth is changing is also indisputable – icecaps are melting, temperatures are rising. However, scientists are not yet sure what the implications of the changes will be for future generations. What is known is that societies at all levels are going to have to respond to changes.

Education for sustainability has been put forth as one way to work towards establishing a sustainable future. The concept has developed considerably over the last thirty or forty years. The ecologically-based resilience concept offers a new dimension to sustainability which can build capacity to respond to change. I do not suggest that education for sustainability needs to be replaced; rather that the integration of resilience thinking concepts into education for sustainability has the capacity to strengthen long-term outcomes. However, we do not know if or to what extent education for sustainability already incorporates resilience concepts.

In this first chapter I have positioned my research at the intersection of education for sustainability and social-ecological resilience to investigate whether the way education for sustainability is constructed in four schools (known to prioritise education for sustainability) fosters social-ecological resilience. I argue resilience is an important aspect of sustainability; therefore, there is a need to ensure resilience concepts are included in education for sustainability initiatives.