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Rescuing biodiversity in paradise:

A qualitative investigation of students' perceptions of risk

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Education, the University of Auckland, 2018.

Abstract

New Zealand's biodiversity includes large numbers of endemic species whose existence have become threatened since the introduction of predators, such as possums. The Government has signalled a goal of Pest Free New Zealand by 2050 which involves the use of the poison 1080 to control these pest species. But this poison's use is contentious because of the risks involved.

However, risk is often ignored when teaching socio-scientific issues in a classroom programme. Consequently, students are unaware of the sociocultural complexity impacting on their perceptions of risk. This study investigated ways that 40 secondary school students (16-17 years) communicated their risk ideas about the use of the poison 1080 to rescue New Zealand's unique but threatened biodiversity, an important socio-scientific issue within this country.

This research involved two data generating phases. Initially participants were asked to answer open-ended questions related to the use of 1080. In phase two, semi-structured interviews were conducted with a selection of the students. Data were then analysed using a framework based on the ideas of Douglas (1999). She developed the Grid-Group Cultural Theory and asserted that this theory was useful to explain irreconcilable differences within society. Douglas' ideas were combined with those of Schwarz and Thompson (1990) and Steg and Sievers (2000) to develop a new analysis framework to qualitatively analyse these secondary students' views of risk.

Four cultural types are accommodated within the new Risk Analysis Framework – Nature Tolerant; Nature Benign; Nature Ephemeral; and Nature Capricious. Findings showed that the framework was able to identify all of these cultural types. Furthermore, the analysis uncovered that indicative words revealed a common language used by students in those four cultural types. Moreover, analysis showed that common mechanisms were used by these students to communicate risk views regardless of their cultural type. The use of the analysis framework can assist students to be more aware of the differing risk perceptions they hold as well as developing an awareness of the perceptions held by others, so enabling an appreciation of the complexity of science-based issues such as the use of 1080.

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I would like to acknowledge the assistance given to me during this learning journey by my two supervisors – Associate Professor Bev France and Dr Sally Birdsall. Without your support, both professionally and personally, this project would not have been possible. You are both special people. I would also like to acknowledge the support given to me by my family during this journey.

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Chapter One
INTRODUCTION

Ko te koiora kanorau, he tauoranga, ko te koiora kanorau to tātou tauoranga
Biodiversity is life, biodiversity is our life
(New Zealand Department of Conservation [DOC], 2017)

1.1 Introduction

The Māori (indigenous population of New Zealand) whakatauki or proverb above proclaims the importance of conserving the diversity of life for all our futures. This whakatauki underpins the work carried out by DOC and is fundamental to this research, because the biodiversity in New Zealand is unique and worthy of conserving. For the purposes of this research, biodiversity "describes the variety of all biological life - plants, animals, fungi, and microorganisms - the genes they contain and the ecosystems on land or in water where they live" (Ministry for the Environment [MfE], 2000, p. 6).

Many New Zealanders view their country as close to paradise. They believe their country is a land of great beauty and uniqueness that contributes to all New Zealanders' prosperity and well-being and so has extraordinary value. This uniqueness is a result of an 85 million-year geographical isolation from the rest of the world (Brockie, 2013). But whilst New Zealand is one of the most unique areas of life on Earth it is also one of the most threatened. New Zealand's ecosystems contain numerous introduced pest species, such as rats, stoats, rabbits and possums (McGlone et al., 2014) which threaten both New Zealand's environment and economy. McGlone et al. argue that despite New Zealand providing world leadership in pest management, there is an urgent need to do more, such as the increased need for pest monitoring. Furthermore, while more than 90% of New Zealanders accept that introduced pest species require management, there is considerable controversy about the types of management that should be used (Russell, 2014). In particular, there is controversy about the accompanying risks of using these management strategies. This diversity of views of the risk of pest management within New Zealand's society is what I wanted to investigate. This chapter will explain this interest and details of each section are now provided.

Following the introduction, Section 1.2 explains how my research interest developed and describes the factors that influenced its early direction. Then Section 1.3 provides a discussion of New Zealand's unique biological place in the world. Section 1.4 describes the multiple threats

to New Zealand's biodiversity. This is followed in Section 1.5, by a discussion of a biodiversity rescue strategy. Section 1.6 follows with a description of the risks involved in using this rescue strategy. Section 1.7 provides a conclusion to this chapter and includes an outline of my personal views and the over-arching aim of this research. Section 1.8 describes the arrangement of this thesis.

1.2 My research interest and early factors influencing this research

There are four major influences that guided the early direction of this research. The first major influence was my New Zealand up-bringing. In the late 1950s, my father demonstrated the need to conserve resources and to care for the environment. He was an environmentalist long before the term became well known, in fact, pre-dating the establishment of both Greenpeace and Friends of the Earth in the 70s, which are two well-known environmental advocacy groups (Reynolds, n.d.).

Having left school at 11 years old, my Dad's environmental ideas were largely self-taught. He believed in re-cycling, up-cycling, composting and made his own liquid fertiliser. It was a black, viscous mix of lawn-clippings, seaweed and water and had a glorious smell of the ocean. Dad always had a large vegetable garden, growing most of what our family needed from seed. He encouraged us to participate in the vegetable-growing happenings. Sometimes he would take my brothers and me on bush walks and identify different forest features for us. He especially enjoyed discussing the diversity of vegetation and how plants were used in the past by Māori, which he considered *tangata whenua* (that is, original inhabitants of New Zealand). Incidentally, and much to our delight, Dad had a large repertoire of whistles and could respond to the calls of native birds, often encouraging a selection of them to fly close by.

Dad lamented the damage caused to the bush by the introduced deer, pigs, goats and possums, all of which he considered pest species. On occasion, our visits to the bush included weekend stays in DOC-owned huts. Sometimes Dad would leave the hut early to tramp into the bush and go deer stalking, inevitably returning with a deer carcass draped over his shoulders, that we would inspect and be taught about. Dad was a butcher and so he soon had the carcass gutted and chopped up into manageable sections which were then packed into boxes into the back of the car and taken home for us to eat. Nothing was wasted. He salted the skins to cure them for sale and he kept the guts as a source of fertiliser. On our return home, the guts were deeply dug into a section of his beloved garden. My environmental opinions have been strongly influenced

by these early-life experiences and I hold deep-seated views about the need to rescue New Zealand's biodiversity from these pest species.

During my teenage years my father decided on a change of occupation from butchering and worked for a time as a shepherd in the north of the North Island of New Zealand. This change in direction entailed us all moving to a small rural area to live. This was where I met my future husband and so began the second major influence on the direction of this research.

In the early 1970s my husband and I purchased a mixed stock farm of sheep and cattle. It was 1,000 acres of Northland clay - hard land to work. The property was surrounded by native bush and had few facilities. As an example, there was only one fence which provided the farm border and it wasn't entirely stock-proof. Moreover, our first home was an old Kauri villa with a roof that leaked in 14 places whenever it rained. We became experts at placing buckets and pots strategically in each room to collect the rain water, but we didn't care because we had big dreams. One of these dreams was to breed a top-quality herd of Angus cattle and my husband worked long hours to realise this dream. He built water reservoirs for the stock, designed and built cattle yards and endeavoured to control the large amounts of gorse (an introduced pest plant) by constructing internal fences within the farm border. He reasoned that having smaller paddocks would enable him to better control the farm animals and would encourage them to graze on this introduced pest.

At this time the Animal Health Board (a New Zealand Government agency), had embarked on regularly testing all cattle herds for bovine tuberculosis (bTB). This wasting disease probably had arrived in New Zealand during the middle of the nineteenth century at the same time as cattle and deer were introduced by European settlers (Operational Solutions for Primary Industries [OSPRI], n.d.). Bovine tuberculosis was spread by direct cattle-to-cattle contact. However, the spread of the disease was much more rapid in New Zealand than could be explained by this method alone and the numbers of infected cattle kept increasing. Consequently, any cattle found to test positive for this disease were slaughtered and disposed of at the farmer's expense. This was followed by a partial quarantine of the infected herd (OSPRI, n.d.). The mystery of why the disease was spreading and cattle continued to be infected was solved in the 1960s with the discovery that the introduced Australian brush-tailed possum (*Trichosurus vulpecula*) was a significant bTB reservoir of infection (Landcare Research, 2000). This cat-sized marsupial had been introduced into New Zealand forests in 1837 to establish a fur trade and had spread since that time (Hutching, 2015). In the 1960s it was shown that dying bTB infected possums often wandered onto farmland. Cattle, which can be inquisitive animals, were sniffing and licking

these possums. This inquisitive behaviour resulted in the cattle contracting and spreading this disease to other herd members (Hutching).

My husband and I knew that there were a number of possums living on the farm because we could hear them walking over the roof of our house in the night. Our semi-wild cat would catch and kill them and occasionally my husband would shoot them when they were close to the fruit trees in our orchard. They were (and still are) instantly identifiable because the vocalisations they make are a hideous rasping and hissing sound.

When it came time to test our cattle, my husband and I were devastated to find that a large proportion of our precious Angus herd tested positive for bTB and needed to be slaughtered. It was possible that in his efforts to control the grazing of the stock by erecting internal fences, the contact between our cows and the possums had been increased. We will never know. The discovery of these 'reactors' as they were called by the Animal Health Board in our herd was a major blow to our dreams, but we persevered. We were not the only farmers to be affected, in fact at that time, we heard of several people within the farming community who had committed suicide because of the emotional and financial stress.

Shortly afterwards my husband suffered a serious spinal injury while working on the property. Despite two back operations, we had to sell the farm. My view of possums, that were deeply influenced by both my father's attitudes and our farming experiences, have remained as visceral as they were then and have contributed to my deep-seated environmental views.

My husband died several years ago. I continue to live on the lifestyle block that we purchased in North Waikato as bare land shortly after selling our farm. This purchase has also influenced my research journey. On my lifestyle block, I have progressively planted a wide variety of native plants to encourage native birds to feed and nest, which I take delight in watching. Additionally, I have a small flock of sheep that breed each year and I regularly eat the fattened, well cared for lamb-meat. Furthermore, I have a large garden and orchard and enjoy growing and harvesting most of my own vegetables and fruit. I have three large bins, producing dark and friable compost which I dig back into the garden plots, that is reminiscent of my father's ideas. Moreover, I have possum traps which are set regularly around the property to control the numbers of these pests. When I do catch a possum, the carcass is buried deep into a fallow section of the garden to rot and recycle. My aversion to these hissing pests has not diminished.

The fourth factor influencing this research was my career. I have been a secondary science teacher for 29 years. Because of my father's interest in the environment, the science degree that

accompanied my teacher training had an ecological focus. During my teaching career, I have established 'ecology clubs' and taken groups of students on outdoor educational visits to areas within New Zealand of ecological importance in order to share the special qualities of our country. Examples of these visits include day trips to carry out tree-planting on offshore predator-free island sanctuaries, overnight camps in forested areas to carry out dawn-chorus bird counts as well as snorkelling with fish in marine reserves. I hoped that each of these visits enabled the participating students to gain some experience of New Zealand's unique environment.

These four factors (my childhood, farming, lifestyle-living and teaching) influenced the direction of this research. I passionately believe that New Zealand has a unique place in the world with a diversity of life or biodiversity, worthy of preserving - and rescuing from introduced pest species.

However, as a result of my years of teaching and listening to students' views as well as living in the country all my life, I am aware that my views about these pest species are not unanimously held by all New Zealanders. In fact, there exists a multiplicity of views about the risks involved in eradicating pests to accomplish a New Zealand biodiversity rescue – or a means of rescuing the country's unique native plants and animals from pest species. Russell (2014) opined that because New Zealand is a relatively young nation, the awareness and need for management of pest species is part of the "national identity" (p. 137). He further asserted that "most conservation conflict in wildlife management is essentially a human-human issue" (p. 137). This multiplicity of views about the risks involved in rescuing New Zealand's biodiversity is what I am interested in investigating.

However, what most New Zealanders do agree on are the qualities that make New Zealand so unique, which will now be discussed.

1.3 Unique New Zealand and the precarious state of its biodiversity

The geographic isolation and island biogeography mean that New Zealand's biodiversity is important because of its uniqueness (Brockie, 2013). The variety of ecosystems that make New Zealand unique have evolved without many of the animals and plants found elsewhere in the world. Approximately 80% of the flora is native to New Zealand (DOC, 2013a) and of the 245 species of birds living in New Zealand before the arrival of humans, 71% were endemic (Brockie, 2013). The remaining species originated in Australia or are migratory species (Royal Forest and Bird Protection Society of New Zealand, 2009).

Indeed, New Zealand's unique biodiversity has been recognised by The Organisation for Economic Cooperation and Development (OECD). In 2007 the OECD carried out a performance review of member countries. Stated in the review was, that in a global context, New Zealand has a "special responsibility for biodiversity conservation, since a high percentage of its 90,000-native species are endemic and unique" (OECD, 2007, p.5). These ideas are supported by many New Zealand citizens who believe that conserving New Zealand's unique biodiversity is important as well as expressing a desire to "ensure the experience of New Zealand's natural environment remains a part of the Kiwi way of life" (DOC, 2006, p.3).

Chris Carter, the New Zealand Minister of Conservation between 2002 and 2007, has also discussed the importance of conserving biodiversity. In his opinion, New Zealand's biodiversity is worthy of preservation for the ecosystem services or natural capital it provides at a national level. In the foreword of a document produced by DOC, he described an international growing realisation that ecosystem services underpin sustainable development and economic growth. Carter commented that "one of the best ways to preserve ecosystem services is to protect important landscapes and environments that provide those services" (DOC, 2006, p.3).

In 2017, Dr Jan Wright reported on the desperate situation of New Zealand's native and endemic bird populations which are a vital part of this unique biodiversity. She was the third Parliamentary Commissioner for the Environment and served for two consecutive terms, between 2007 and 2017. In New Zealand, the role of Parliamentary Commissioner for the Environment was set up under the Environment Act 1986. Rather than reporting to a Government Minister, the Commissioner is an independent parliamentary officer, whose role is to provide members of the New Zealand Parliament with advice about environmental issues (New Zealand Office of the Parliamentary Commissioner for the Environment [PCE], 2011). This special position in New Zealand means that these commissioners have broad powers to investigate environmental concerns and are independent of the government of the day.

In her 2017 report Dr Wright stated that of the 168 native bird species, 80% are at risk or worse, and 93 of these species are endemic (PCE, 2017). She described how introduced pest species hunt and eat native birds as well as feeding on native lizards and insects and so "degrade the mauri of the forest" (PCE, 2017, p.14). *Mauri* is a Māori term and translates as 'life force.' Dr Wright believed that the 2016 announcement by the Government of New Zealand to be predator free by 2050 was a commendable goal. She ended her report to the Government by arguing it was time to "rethink conservation" (PCE, 2017, p. 98).

While her report focussed particularly on the state of the native bird populations, Dr Wright argued that the ecosystems containing these birds would benefit as well from the eradication of pest species, meaning New Zealand's biodiversity would be rescued. Furthermore, her ideas are upheld by the current (at the time of writing) Parliamentary Commissioner, Rt Hon Simon Upton, who stated in his Strategic Intentions report that "there are very few 'easy' environmental challenges" (Upton, 2017).

The threats to New Zealand's unique environment will now be discussed.

1.4 Threats to New Zealand's unique environment

New Zealand has a history littered with poor decisions relating to the natural environment. An example of poor decision-making was the introduction of alien predator species. These predators prey on New Zealand's flora and fauna and cause significant detrimental impacts on the indigenous biodiversity. In fact, Molloy, et al. (2002) created a ranking system for classifying threatened species and described New Zealand as having one of the highest rates of threatened native species in the world. For example, 37% of New Zealand's endemic birds were listed as threatened. Moreover, 34% of New Zealand's plants are threatened (Hutching & Walrond, 2017).

To address this imperilled biodiversity in New Zealand, and as a result of the international Convention on Biological Diversity (1993), the New Zealand Ministry for the Environment released the first State of the Environment Report (MfE,1997). This report provided some baseline data for measuring trends. Subsequently, in 2000, a twenty-year New Zealand Biodiversity Strategy was developed. This strategy established national goals for managing and conserving New Zealand's biodiversity. Furthermore, they included strategies about introduced species which were considered important for economic, biological and/or cultural reasons. The goals involved the need for both community and individual action "to halt the decline of New Zealand's indigenous biodiversity" (MfE, 2000, p. 2).

However, despite the establishment of these national goals, the OECD's environmental performance review in 2007 was critical of New Zealand's biodiversity rescue attempts, stating:

> Biodiversity conservation still faces major challenges in New Zealand. Despite sizable decreases in the numbers of certain pests (e.g. rats, possums, rabbits) in some areas, invasive species continue to pose serious risks to indigenous ecosystems and species.
>
> (OECD, 2007, p. 5)

The main threats and drivers of change to the indigenous biodiversity as identified within *The New Zealand Biodiversity Strategy* (MfE, 2000) are competition by invasive alien pest species, habitat modification and destruction and human activities including over-exploitation.

The foremost threat to New Zealand's natural biodiversity has been the introduction of alien pest species. One example is the Australian brush-tailed possum (*T. vulpecula*). Without natural predators, the numbers of these pests have continued to increase. Possums threaten New Zealand's unique biodiversity by feeding on native foliage and seeds. Nugent, Sweetapple, Coleman and Suisted (2000) describe possums as "reluctant folivores" (2000, p.10) as they prefer to eat fruit, flowers and leaf buds rather than mature leaves. This specialised browsing habit poses a significant risk to the functioning of a forest because it disrupts the formation of seeds and reduces the food available for native species. Worse still, possums eat indigenous birds' eggs and chicks, bats and even our native snails (Green, 2004). Additionally, they compete with all our native species for habitats.

Possums also cause significant browsing damage to young seedlings in plantations of *Pinus radiata*, an exotic species planted in the central North Island of New Zealand. This species is of economic importance because it is a significant source of building and fencing material within the country as well as providing export revenue. Moreover, possums cause browsing damage to plants grown on steep farmland hillsides planted for erosion control. In places where this browsing is significant, and the plants die, there can be a risk of the collapse of the hillside. Additionally, possums can also cause browsing damage in commercial fruit orchards (Green, 2004). A further example of the economic peril this pest species poses, as discussed earlier, is they transmit bTB to cattle and deer. The economic worth of these animals both domestically and internationally is then compromised (New Zealand Office of the Parliamentary Commissioner for the Environment, 2017).

Habitat modification is also a significant threat to New Zealand's indigenous, terrestrial biodiversity. Before the arrival of humans, a unique and dense forest covered much of the land (DOC, 2013b). New Zealand's forest is unique because it has more similarities to the ancient Gondwanaland forests than anywhere else in the world. For example, the ancestors of native trees like the Kahikatea and Rimu evolved 250 million years ago (DOC, 2013b). The early Māori burnt some of these forests for cultivation. This practice was continued with the arrival of the European settlers, so today native forest covers only 23% of New Zealand (DOC, 2013b). Furthermore, many of these forest ecosystems are now isolated fragments surrounded by farmland, so the animals and plants living within these fragments are often small populations

under stress. Habitat modification continues with grazing of bush and drainage of wetlands (Smith & Wratten, 2003).

Another threat and driver of change to the indigenous biodiversity identified within *The New Zealand Biodiversity Strategy* (MfE, 2000) has been human activities, mostly the growth of the farming industry. Since the arrival of European settlers, New Zealand's most important economic products have been those grown on pastures (Peden, 2012). This conversion of land into pasture has resulted in almost half (14.7 million hectares) of New Zealand's total landmass of 26.5 million hectares becoming farmland (Federated Farmers of New Zealand, 2013). Meaning the total area of land on which indigenous species are found has been greatly reduced. Other examples of human impact on the indigenous biodiversity of New Zealand were the previous over-exploitation of several endemic species. For example, all 11 species of moa and the Huia were hunted to extinction by Māori hunters and European collectors respectively. Additionally, seals were hunted to near extinction in the late 1700s to early 1800s (Smith & Wratten, 2003).

I strongly believe the control and even eradication of these introduced pests from New Zealand is needed to rescue the depleting natural biodiversity. One such method of controlling these introduced pest species is the use of sodium fluoroacetate as a biodiversity rescue strategy. However, sodium fluoroacetate is a poison and using it comes with risks. The use of sodium fluoroacetate and the risks involved with its use will now be discussed.

1.5 Using sodium fluoroacetate as a biodiversity rescue strategy

Sodium fluoroacetate is a stable, white and water-soluble compound. The bio-degradation of this compound is temperature and moisture dependent (Green, 2004). Sodium fluoroacetate is commonly known as 1080. This refers to the registration number given by the British scientists at the Patuxent Wildlife Research Center in Maryland, USA (Proudfoot, Bradberry & Vale, 2006). The active ingredient in the compound is fluoroacetate which occurs naturally in many poisonous plants found in Australia, Africa, South America and India. It is believed that these plants may have developed this poison as an adaptation to discourage animal browsing (Eason, Miller, Ogilvie & Fairweather, 2010). Significantly, it does not occur in many of New Zealand's plants - a land which lacks native land mammals (Royal Forest and Bird Protection Society of New Zealand, 2017).

Sodium fluoroacetate (1080) is a metabolic poison that works by disrupting the cellular respiration pathway, especially in mammals. The ingestion of a lethal dose results in heart or

respiratory failure. Death often occurs within 6–48 hours after eating the poison (Eason et al., 2010). If mammalian carnivores ingest 1080, the central nervous system malfunctions and this can result in convulsions. Apart from the potentially prolonged time to die, and a painful death, the other significant risk associated with the use of sodium fluoroacetate is that currently there is no known antidote (Green, 2004).

The toxic nature of sodium fluoroacetate was first noted in the 1930s and it was introduced as a general rodenticide in the USA in 1946 (Eason, et al., 2010). However, its use was restricted by 1990 in that country because of its toxicity to all mammals. Currently the poison is licensed in USA for use against coyotes only, which prey on sheep and goats (Proudfoot et al., 2006). In Australia 1080 is used to control rabbits, and New Zealand it is used to kill unwanted introduced mammalian species - in particular, possums (Green, 2004).

Sodium fluoroacetate has been used in New Zealand since the mid-1950s and is the only poison registered for aerial application (Green, 2004). The poison is applied using helicopters fitted with global positioning systems to track dispersal. Additionally, 1080 is dyed blue/green with cinnamon flavouring added to deter birds and other wildlife (except possums, who are attracted to the cinnamon flavouring). Green argues that 1080 is not deposited within 20 metres of major waterways and the public are notified before any aerial distribution operations. Water quality is regularly tested by the Environmental Protection Authority in New Zealand and in their tenth annual report on the aerial use of 1080 in New Zealand stated that there was “no evidence of adverse effects on the public’s and operators’ health, waterways or land” (Environmental Protection Authority, 2016, p.3).

Significantly, New Zealand is the largest user of 1080 in the world (Eason et al., 2010). Many believe that the country has a unique position in the world to use 1080 and that there are little substantial adverse effects on native species in New Zealand (Green, 2004). This belief is held because there are only two native mammals, and they are both nocturnal, omnivorous bats (Meduna, 2007). Within New Zealand, the two main users of 1080 are TBfree New Zealand and DOC (Green, 2004). TBfree is the New Zealand agency responsible for managing the eradication of bTB by controlling the wildlife reservoirs of the disease, namely possums (OSPRI, n.d.). DOC is responsible in New Zealand for managing conservation land, which includes managing pest species, to improve the health of natural ecosystems (Green, 2004).

The amount of active ingredient of 1080 used per year is less than 0.1% of the total active pesticide ingredients used (Eason et al., 2010). Also, the dispersal rate of 1080 is limited to 1-2

kg per hectare (van Klink, Kemp & O'Donnell, 2013). Green (2004) argues that poisoning is essential in remote and inaccessible areas of New Zealand. He asserts that although methods such as trapping, shooting and the use of repellents to deter possum browsing are used, the ability to control pests over large areas is limited. In his report, Green acknowledges that some bird species in areas throughout New Zealand where 1080 has been used have died by accidentally ingesting the poison. Regular reviewing of bird populations using radio-tagging, has been implemented and Green asserts that accurate reporting of deaths is improving, and numbers are declining. However, he accepts that there are risks to some bird life, especially predatory birds such as the native Ruru or Morepork (*Ninox novaeseelandiae*). In his 2004 review, Green also states that there are promising biological control methods being researched, however he believes that the need for poison technology, especially 1080, remains.

Of especial importance for this research, regardless of over 60 years of research and practical experience the use of 1080 is still embroiled in controversy (Green & Rohan, 2012). This controversy is deeply embedded within New Zealand's culture because of the perceived risks involved with its use and these will now be discussed.

1.6 The perceived risks of using 1080

New Zealanders hold a multiplicity of views and concerns about the risks involved in the use of 1080. The public submissions that were received by *The Environmental Risk Management Authority* (ERMA) about 1080 being re-registered for aerial distribution in New Zealand were investigated by Green and Rohan (2012). Until 2011, this was a New Zealand Government agency responsible for implementing the *Hazardous Substances and New Organisms Act*, 1996. ERMA was then incorporated into the Environment Protection Authority in New Zealand. Green and Rohan found that 62% of the submissions were from New Zealanders concerned about the risks of using 1080 and a further 15% believed that the substance should be banned outright. Furthermore, 77% of the submissions were concerned about the risks of secondary poisoning of native animals and other wild animals and 17% were concerned about the risks to hunters in the forests of New Zealand.

In a separate study, Russell (2014) asserted that while New Zealanders are generally accepting of the need to manage the pest situation, the acceptability of using poisons as a management strategy had declined because of their perceived risks. He carried out a national survey of attitudes towards introduced wildlife by comparing data collected in 1994 and again in 2012 from over 800 adult participants. He found that less than 1% of the participants felt that doing

nothing about pest management was an option. Therefore, for the vast majority of New Zealanders, the issue was not about whether we need to control the pest species and so rescue our unique environment, but the focus for the participants in his study was the risks associated with how it is carried out.

Moreover, Russell (2014) stated that while there has been considerable effort focussed on developing new technologies to control pest species, there has been little work carried out to examine the differing attitudes of New Zealanders about this issue. Russell's analysis revealed that regardless of living in urban or rural areas, participants' support for the use of 1080 as a control method had dropped by 9% between the two surveys. In his analysis Russell identified that in 2012, 18% were undecided about the use of 1080, 42% of the participants believed 1080 should be used, and 40% believed it should not be used at all. He argued that the debate largely focussed on the risks associated with the aerial application and the humaneness of the poison.

An example of a group who are opposed to the use of 1080, Save Animals From Exploitation (SAFE) is an organisation within New Zealand advocating for safety of all animals, including pest species. Established in 1932, the stated goal of this organisation is to disseminate their views by participating in public discussions to "foster a more informed understanding of the state of human-animal relations in contemporary Aotearoa New Zealand" (SAFE, n.d.). SAFE members hold strong opinions about the risks of 1080 and believe it is a dangerous chemical and should be banned from use. They strongly support the view that all animals that die from 1080 poisoning have an "extremely cruel and protracted" death (SAFE, n.d.).

Many Māori within New Zealand also express concern about the risks involved with the use of poisons, especially 1080, with respect to *kaitiakitanga* (guardianship of the environment). These concerns relate to the perceived poisoning of the *mauri* of the forests, the risks to the purity of water, and availability of traditional forest food sources, such as the edible native fern, Pikopiko (Royal, 2007). Described as bush asparagus, the tips of this native fern (*Asplenium bulbiferum)* can be steamed, stir-fried or added to bread dough (Royal & Kaka-Scott, 2013). When 1080 drops occur in forested areas, people are strongly urged not to enter the area and so the food would be unavailable. Additionally, some Māori, such as the Ngātiwai tribe, also believe that the Kiore should be protected. Kiore are a species of rat that were brought to New Zealand by early Māori as a food and clothing source. Like possums, they prey on native species and are susceptible to 1080 poisoning. Although the rat is no longer eaten, members of the Ngātiwai consider themselves guardians of the Kiore. Moreover, they believe these rats to be *taonga*, or a

significant treasure and that these are cultural and historical reasons why the rats should survive (Bradford, 2008).

In New Zealand the Treaty of Waitangi is a document that was signed between Māori and Britain in 1840. While not a law itself, many of New Zealand's laws refer to this document to ensure that Māori values and culture are protected and reflect our bicultural heritage (Hayward, 2012). Therefore, Māori concerns about the risks of using 1080 must be considered by the government and their agencies.

A further group with opinions about the risks involved with the use of 1080 are the numerous recreational hunters within New Zealand, many of whom belong to groups like the Deerstalkers' Association, established in 1937 (New Zealand Deerstalkers' Association, n.d.). For many New Zealanders, hunting is an important way of life as well as a method of food gathering. The animals hunted are typically wild deer and feral pigs and, because they are mammals, they are susceptible to the risk of accidental or secondary 1080 poisoning while grazing (Sperry, n.d.).

Fraser (2000) opines that there are approximately 50,000 active recreational hunters in the country. The Game Animal Council was established in New Zealand in 2013. This organisation is a statutory body which is governed by the Game Animal Council Act, 2013. It was established to ensure the rights of people, who are interested in the sustainable management of game animals for recreational hunting, are protected (Game Animal Council, 2014). This organisation was instrumental in the development of recreational hunting areas and is totally opposed to the use of 1080 or any other poison to control game animals such as deer and feral pigs. Their belief is that "toxin applications on public lands can have significant adverse effects" on these animals (Game Animal Council). As well as the risks to the animals of dying of the poison, the council is concerned with the risks associated with hunters potentially eating the meat of animals that may have been contaminated with a sub-lethal dose of 1080 before being hunted and killed by their members. Furthermore, they assert that hunting is a sport that significantly contributes to export earnings, in that overseas tourists may travel to the country to participate in guided hunting for these game animals. They believe that the continued use of 1080 could place this tourist business at risk if people chose not to come to New Zealand because of this perceived threat. Additionally, the Council argues that hunting plays a role in maintaining the mental and physical well-being of the participants (Game Animal Council).

For other New Zealanders, the application of 1080 using aerial methods is totally abhorrent. They believe that this method of application contaminates the environment and adversely affects

national waterways. This adverse effect can be worsened because there is always a risk that at times fences housing farm animals can be breached allowing these animals potential access to the poison. Additionally, pilots delivering the 1080 by helicopter can mis-calculate, and furthermore people sometimes ignore the warning information to stay away or to remove stock from affected areas. These are all potential risks that some people believe are too great to take (Green, 2004).

A further group within New Zealand that is opposed to the use of 1080 are many dog owners (Pollard, 2011). Dr Pollard believes that throughout New Zealand, dogs are at extreme risk from 1080 because of the increased use of this poison throughout the country and that the substance should be banned. She reported on a 2011 survey of 52 veterinarians working in New Zealand. The postal survey was conducted by members of the National Poisons Centre and the Otago University Pharmacy School. The veterinarians who were contacted during the survey described how they had dealt with the owners of 65 dogs that had died of 1080 poisoning throughout the year. Pollard contends that many more dogs than that had probably died from the poison within that period, however their deaths were not reported to any authorities. She argues that dogs are particularly sensitive to 1080 and states that 1.75mg of this poison is a lethal dose for a 25kg dog. Moreover, she contends that this amount is 125 times more than is needed to kill an adult possum, so the risks to dogs are extreme. Furthermore, Pollard believes that the protocol of removing warning signs in an area after six months from the application of 1080 further increases the risk to dogs. Pollard contends that the time for 1080 to biodegrade in the environment can vary and 1080 poison can remain in the bodies of dead pest species for long periods of time. She further argues, that poisoned carcasses of pest species can fall into waterways where passing dogs could drink the contaminated water and die. Additionally, she believes that the inquisitive nature of most dogs, meaning they will investigate, nuzzle and potentially chew things they find of interest, places them and also their owners at risk from being exposed to 1080.

These environmental, economic, social, recreational and cultural concerns about the use of 1080, expressed by many New Zealanders are complex. The issues are complex and controversial, not because there is widespread disagreement about saving the unique, natural biodiversity of New Zealand, but rather because they involve differing ideas about the risks involved in managing this rescue. Additionally, they include a complexity of interwoven issues.

1.7 Overall aim of this research

My conservation-focussed upbringing, rural experiences and living in New Zealand have led me to where I wanted to find out more about why people think the way they do about the risks involved around rescuing the biodiversity within our country. Dr Wright believes that native birds in New Zealand are a *taonga* and her aim was the "restoration of abundant, resilient, and diverse native birdlife" to New Zealand (PCE, 2017, p. 8.). Part of my identity as a New Zealander is the belief that New Zealand is a unique but imperilled place. I support the strategies proposed by the Parliamentary Commissioner. I believe that while the use of 1080 is risky, the alternative – like doing nothing - is riskier. Until a more effective strategy is found I accept the risks involved in the use of 1080.

Moreover, I also believe we must all become more aware of, and especially engage in, resolving the urgent environmental issue that we face of the destruction of New Zealand's indigenous biodiversity by introduced pest species.

Also, as a teacher in New Zealand, I have become very interested in students' differing views of risk. Of particular interest to me are students' views associated with the risks around the use of poisons, specifically 1080, to control and potentially eradicate possums from the New Zealand environment. Students' views about suitable methods to rescue New Zealand's biodiversity are of particular interest to me because in my experience as a teacher, the variety of opinions within society can be echoed in the classroom. Therefore, the broad aim of this research was:

> *To explore students' views about an environmental risk situation.*

1.8 Outline of this thesis

Within this project there are eight chapters. Chapter 1 introduced this research, my beliefs and interests, and provided an outline of the importance of biodiversity. The chapter identified New Zealand's unique biodiversity, the complexity of the issue of rescuing our biodiversity, and risks around conserving it using the poison 1080. This chapter also identified the broad aim of this research as well as the personal positioning of the researcher. Chapter 2 provides a discussion of the relevant literature about risk. It also includes a justification of the research questions which were developed for this study. This is followed in Chapter 3 with a description and justification of the research design underpinning this study. Additionally, a timeline of the research is discussed as are the methods used to generate and analyse data. Chapter 4 outlines the development of two tools used within this study to analyse data about students' views of risk.

Chapters 5, 6 and 7 discuss the analysis of the data collected and Chapter 8 summarises and provides conclusions and implications of this research.

Chapter Two
LITERATURE REVIEW

The totality of beliefs and sentiments common to the average members of a society forms a determinate system with a life of its own. It can be termed the collective or common consciousness.

Emile Durkheim (1984, p.38)

2.1 Introduction

Emile Durkheim is widely regarded as the one of the main founders of modern social science. He believed that studies in social science should be carried out holistically, rather than being limited to the specific actions of individuals. In the quote above, first published in his thesis in 1893 and then again in 1984 in *The Division of Labor in Society*, he expresses how he believes that shared beliefs and ideas operate as a unifying force within any society (Peyre, n.d.) and this idea underpins this thesis. As an example of a society having shared beliefs or a "common consciousness" (Durkheim, 1984, p.38), most citizens in New Zealand believe that the country has a unique and threatened biological heritage or biodiversity that is worth saving. However, deciding on suitable methods to protect this unique biodiversity is a contentious issue as each method comes with differing degrees of risk.

Durkheim's beliefs strongly influenced the ideas of Mary Douglas who was one of the seminal theorists of ideas about risk (Lupton, 2013). She developed a grid/group typology to identify the four cultural types that she opined existed within any society which helps to explain how different groups regard risk in different ways. Nevertheless, ideas about risk have changed over time and there are many risk commentators who have differing theoretical perspectives.

Section 2.2 of this chapter provides a discussion of the relationship between science and risk and includes Funtowicz and Ravetz's (1992,1993) ideas about the science problem-solving strategies they believe individuals articulate in order to deal with risk issues. Additionally, this section includes how ideas about risk have been developing since the seventeenth century and have become more complex. In Section 2.3 a way of mapping the different theoretical perspectives of risk to display their differences and similarities is provided. This section also includes a focus on the sociocultural perspective, as this perspective proved useful in this study. Included in this section are Mary Douglas's (1978) risk ideas. In Section 2.4 the Cultural Cognition of Risk is discussed. This concept includes ways people can communicate their risk ideas. The idea that scientific literacy is difficult to define is discussed in Section 2.5. This section also includes the

notion that there is broad consensus about the need to improve the scientific literacy within science education communities especially in a world increasingly dominated by the growing interdependence of science and technology. Sections within different curricula statements that identify the importance of students to be able to describe the risks associated with this growing interdependence are also discussed. In Section 2.6 the use of socio-scientific issues and socially acute questions are deliberated along with how they can assist with the implementation of post-normal science into classrooms to investigate risk situations. In Section 2.7 a justification is provided for the direction of this research.

2.2 The relationship between science and risk

We are increasingly confronted with complex risk issues, both individually and as a society, in today's "technologically-advanced society" (Zeidler & Lewis, 2003, p. 289). Furthermore, Berkowitz and Simmons (2003) opine that both new technologies and scientific knowledge are rapidly developing, and all members of society need to have an understanding of the implications of that knowledge upon the "global village" (p. 117) in which we now live. These beliefs support comments made by Funtowicz and Ravetz (1992, 1993) and Ravetz (1997) who state that novel situations and issues are facing industrialised nations and that everyone involved should be included in the decisions made about such issues. Silvio Funtowicz is a Professor at the University of Bergen (University of Bergen, n.d.) and Jerome Ravetz is an Associate Fellow at the James Martin Institute for Science and Civilization at the University of Oxford (Ravetz, n.d.). Together they developed a graphic display, shown in Figure 2.1, of three types of science problem-solving strategies they believe are needed to deal with the risks we face today. Funtowicz and Ravetz (1992) believe that the graphic display is a useful heuristic or learning tool because it explains the three types of problem-solving strategies needed to deal with risk issues within the two dimensions of the uncertainties within the systems of science and the factors or decisions that people within their field of science need to weigh up and make regarding risk.

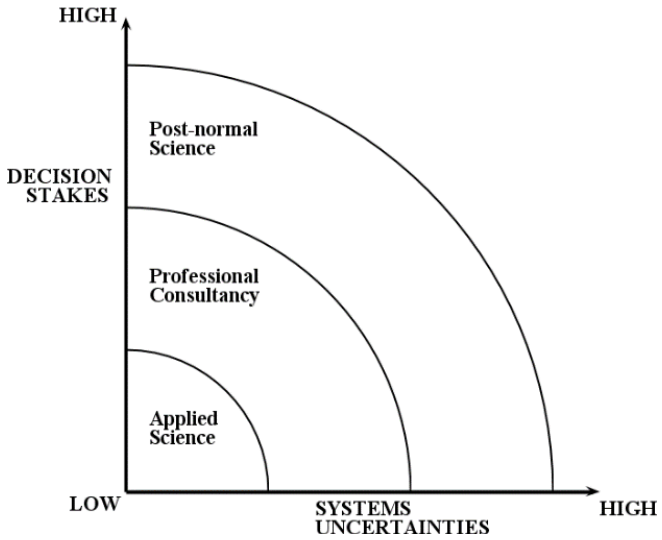

Figure 2.1. The three types of science problem-solving strategies (from Funtowicz and Ravetz, 1992, p. 254).

They named the first problem-solving strategy within their tool "applied science" (1992, p. 253) and opine this is the level where every science problem is well defined, has a straight forward solution and includes routine monitoring and regulation of systems, such as weather mapping within the environment. The second strategy displayed in Figure 2.1 is named "professional practice and consultancy" (p. 253). This level of problem-solving involves professionals like engineers and surgeons who are trained in science knowledge and skills relevant to their field, whose work is mostly routine, but are prepared to use their judgement to cope with uncertainties within their scientific field of expertise. The third strategy Funtowicz and Ravetz described is "post-normal science" (p. 253) which they believe is the "wild area" (p. 253) where both applied science and professional consultancy are inadequate domains to deal with the complex risk issues arising in today's world because they involve "ineradicable uncertainties" (p. 253). They assert that this is a new kind of science and is needed to understand complex risk issues where often "facts are uncertain, values in dispute, stakes high, and decisions urgent" (p. 253). Furthermore, they believe the creation of this new type of science practice involves the combining of knowledge of people with scientific expertise with those within the community involved in the issue and who are interested in tackling such risk issues to form an "*extended peer community*" (p. 254, italics in original), using "*extended facts*" (p. 254, italics in original) or personal and relevant knowledge about the issue. An example of such a complex risk issue in New Zealand where values are in dispute, is deciding which methods should be implemented to best protect our unique and distinctive biodiversity from the threat posed by introduced pest species.

Not only are today's risk issues complex, the notion of risk did not originate with "post-normal science" (Funtowicz & Ravetz, 1992, p. 253). To further complicate matters, people's

understanding of the notion of risk has changed over time. For example, Lupton (2013) asserts that originally the idea of risk was seen as a neutral concept when it emerged in the seventeenth century within the context of gambling and chance. During the eighteenth century, the concept became linked to mariners and the occurrence of events in nature that were beyond the control of humans. At this time in our history, risk related to the probability of a ship arriving home safely or being lost at sea. However, Lupton posits that with the rise of the industrialised world, developments in mathematical statistics influenced the concept of risk. These developments meant that natural phenomena could be quantified, calculated, predicted and either managed or avoided, so that the idea of risk was no longer just a function of nature. Lupton further argues that this quantitative concept then broadened to include whole populations rather than just providing meaning to individuals and included the idea that risk could have positive or negative effects. Consequently, in modern times, whole-population risk research is investigated.

To add further complexity to the concept of risk, Kasperson, a research Professor at Clark University in Massachusetts (Clark University, n.d.), asserts that during modern times a "mosaic of concepts and approaches" (1992, p. 155) has emerged when investigating risk. Because of this complex mosaic of risk concepts and approaches, theorists have attempted to map it and these differing theoretical concepts and approaches will now be discussed.

2.3 Mapping the range of theoretical risk concepts and approaches

Kasperson (1992) defines the concept of risk broadly as "the probability of experiencing harm" (p. 154) and believes that within the mosaic there are two all-encompassing ways of analysing risk which he identifies as "the technical and the social" (p.155) perspectives. He asserts that the *technical* perspective narrowly investigates risk. The focus in this perspective, he opines, is on the probability of a risk event occurring and the magnitude of the consequences caused by the event, where the two aspects are multiplied together to provide a quantitative analysis of risk. The *social* perspective, Kasperson asserts, is "rooted in social institutions and relationships" (p. 155) where human activities and values are analysed qualitatively. It is possible that this social perspective, with a focus on the "common consciousness" (Durkheim, 1984, p.38) of an issue in society, could identify a pathway for this research.

An investigation into these differing perspectives was also carried out by Peter Taylor-Gooby who is a research Professor of social policy at the University of Kent (University of Kent, n.d.) and Jens Zinn who is an associate Professor in Sociology at the University of Melbourne (The University of Melbourne, n.d.). They assert that risk research is complex. They argue that links

within the mosaic of approaches that are emerging are necessary as they may enable the development of "more holistic conceptualizations" (Taylor-Gooby and Zinn, 2006, p. 409) of risk research.

To illustrate these holistic conceptualisations Taylor-Gooby and Zinn (2006) identified a wide range of theoretical perspectives of risk. They developed a three-dimensional model to demonstrate their ideas and believe that their model, which they described as a "continuum" (2006, p. 407), can reveal the differing dimensions of risk perspectives and positioning of differing risk researchers. Their three-dimensional continuum is displayed in Figure 2.2 and text boxes have been added by the researcher to provide some explanation of the terms used within their model. The researcher believes that because risk perceptions are complex, an examination of this model provides some understanding of this complexity and moreover, could be fruitful to position the theoretical framework of this research.

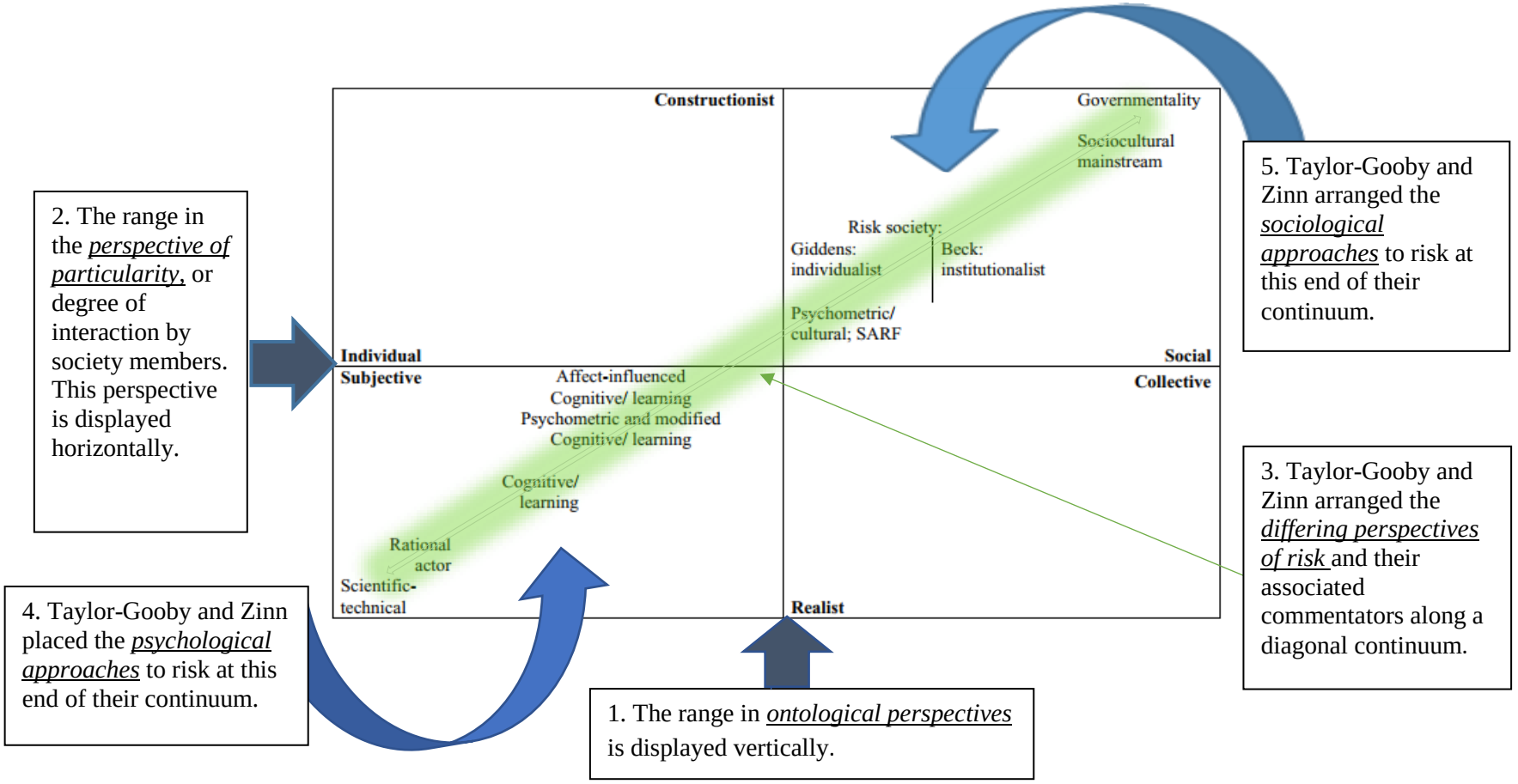

Figure 2.2. A three-dimensional model of risk research that maps the mosaic of the two perspectives of risk analysis and the two approaches to its study used by risk commentators, developed by Taylor-Gooby and Zinn (2006, p. 407). The text-box explanations and their sequencing were added by the researcher to provide some explanation of the terms Taylor-Gooby and Zinn used.

Firstly, within their model they established vertical and horizontal dimensions. The differing *ontological* perspectives, or the nature of reality that they assert researchers possess when investigating risk, provide the vertical dimension. Taylor-Gooby and Zinn (2006) ranged this dimension from a *realist* to a *constructionist* perspective. They assert that risk commentators with a *realis*t perspective believe risks have an independent existence, external to individuals or social groups. Additionally, these commentators believe that individuals are the passive recipients of risk information, to which they then respond. At the other end of this dimension, Taylor-Gooby and Zinn described commentators with a *constructionist* perspective, who believe risks are influenced by people's jointly constructed understandings, interwoven with cultural factors in a society.

On the horizontal dimension of their model Taylor-Gooby and Zinn (2006) named the "*particularity*" (p. 407) perspective – that is the degree of interaction or distinctiveness within all societies' members. They argue this perspective ranges from *individual* to *social*. Within this dimension they assert that on the left-hand side are the commentators researching through a perspective that describes individual people as the conveyers of risk perception, whose understanding of risk is subjective and can be analysed at a personal level. On the right-hand side of this dimension, Taylor-Gooby and Zinn assert that risk commentators use a perspective where cultural assumptions are seen to be shared socially within group situations and are collectively developed.

Then, overlaying these *ontological* and *particularity* perspectives in Figure 2.2, Taylor-Gooby and Zinn (2006) placed their third dimension, that they assert are the two main approaches to risk research. They named these two main approaches the *psychological approach* and the *sociological approach* and they placed these approaches diagonally opposite on their model.

When developing an understanding of Taylor-Gooby and Zinn's (2006) concepts, there is a need to investigate their previously published working paper to gain a deeper understanding of their ideas. In this working paper, published in 2005, they were exploring the mosaic of risk perceptions and positioning of risk researchers. This paper provides a further perspective of their ideas about the landscape of risk commentators because they explained how they believed that their three-dimensional model allowed similar research fields to be placed closer together on their continuum. Together with their 2006 paper, their views enable a deep understanding of the positioning of the various risk commentators. They argued the placement of each research field could also be moved diagonally as well as vertically or horizontally to more accurately reflect each perspective's positioning with respect to the others.

The researcher believes that this model could enable scholars to develop a deep understanding of the different perspectives on risk. Additionally, the model could provide a mechanism to position where the researcher could investigate ideas about the "common consciousness" (Durkheim, 1984, p.38) of risk. Furthermore, a simpler continuum may have appeared somewhat reductive, but their three-dimensional model allows the mapping of the individual risk perspectives within the *psychological* and *sociological approaches* and their relative placement to all other perspectives. Additionally, the model displays the links between each researcher's ontological positioning as well as their perspective of "particularity" (Taylor-Gooby and Zinn, 2006, p. 407) or degree of interaction.

To clarify the differing perspectives of risk research, Taylor-Gooby and Zinn (2006) further divided each of the two approaches they identified in their model. They placed the *psychological approach* toward the realist end of the ontological perspective and the individual end of the perspective of particularity. This approach is further sub-divided into *Scientific-technical* and *Cognitive/learning* perspectives. They describe the followers of the *Scientific-technical* perspective as carrying out investigations where experts' accounts of risk are privileged over lay-persons', and risk is viewed objectively. Lupton (1999, 2013) reinforces Taylor-Gooby and Zinn's ideas and asserts that supporters of a "technico-scientific perspective" (2013, p. 27) believe that risk is an objective reality, able to be measured and quantified and is independent of nature.

Taylor-Gooby and Zinn (2006) position researchers using a *Rational actor* perspective close to the *Scientific-technical* perspective in their model. They posit that these commentators believe that human behaviour results from conscious choice where the likelihood and severity of outcomes is assessed by valuing hazards and opportunities differently.

Another perspective on Taylor-Gooby and Zinn's (2006) continuum is those who investigate risk using a range of *Cognitive/learning* ideas where the central theme is that risks are a real human experience and humans are rational creatures capable of choice and having the capacity to learn. Within the *Cognitive/learning* perspective, are those who investigate the ideas of *Psychometric and modified Cognitive/learning* and *Affect-influenced Cognitive/learning*. Taylor-Gooby and Zinn assert that researchers who explore *Psychometric and modified Cognitive/learning* perspective of risk investigate the ideas that people taking risks gather feedback from their environment, develop mental models to assist their understanding and then modify their behaviour accordingly. The *Affect-influenced Cognitive/learning* perspective involves people's

use of emotionally-based and rational judgements and measures the amount of disjunction between them when making decisions (Taylor-Gooby & Zinn, 2006).

People with these perspectives within the *psychological approach* conceive of risk perception and responses to risk with varying degrees of individualistic terms and have realist ontologies where risk is seen as quantifiable and being independent of nature. However, the *sociological approach* which follows in the upper-right quadrant of their continuum model, does not focus on the individual and involves collective accounts of risk. This approach is more pertinent to this planned research and will now be discussed.

2.3.1 Sociological approach to risk

As can be seen in Figure 2.2, the *sociological approach* is sub-divided by Taylor-Gooby and Zinn (2006) into the *Psychometric-cultural and Social Amplification of Risk Framework* (*SARF*), *Risk society*, *Sociocultural mainstream* investigators and lastly, those that have the *Governmentality* perspective.

While all these approaches use a *sociological approach,* Taylor-Gooby and Zinn (2006) assert that the researchers employing *Psychometric-cultural* and *SARF* perspectives use quantitative methodologies, assume that risk is subjectively defined by individuals and their investigations are carried out within the two dimensions of dread and familiarity. Furthermore, they assert that the *SARF* perspective is interdisciplinary and uses aspects of the *psychological* and *sociological* approaches. Within this perspective the flow of information about risk is investigated, where a risk event is interpreted by individuals or groups within a society and then communicated to others who in turn interpret and communicate the information to other members of the society. Kasperson (1992) is a supporter of this perspective because he believes it provides a more "holistic" (p.157) approach to risk investigations.

The *SARF* perspective is followed by the *Risk society* investigators on Taylor-Gooby and Zinn's (2006) continuum. They assert that within the *Risk society* perspective, research is carried out at either an individual or institutional level. They contend that Giddens is the main commentator studying *Risk society* at an individualist perspective; specifically, how individuals manage risk in the context of their own lives. Baron Anthony Giddens is an Emeritus Professor at The London School of Economics (Times Higher Education, n.d.) and emphasises the importance of individual responsibility within society. He argues that members of this *Risk society* are moving toward a "reflexive modernisation" (1999, p.6) where citizens are becoming instinctively aware of their individual roles in risk situations within society. Taylor-Gooby and Zinn assert that

Giddens research compares to that of Beck because he studies *Risk society* research at the institutional level.

Ulrich Beck (1994, 2008), who was a German Professor of sociology at the Ludwig Maximilian University in Munich until his death in 2015 (Ludwig Maximilian University of Munich, n.d.), researched the positive and negative effects of risk within populations. He identified the concept of the "calculus of risk" (1994, p.3) as important and described this as the need to "accept hazards as the dark side of progress" (1994, p.3). He believed that there needed to be better communication between scientists and the public to improve the public perception of socio-scientific issues and risk.

At the extreme end of their continuum Taylor-Gooby and Zinn identify the perspective of *Governmentality*. Here, they describe the central idea being investigated by risk researchers is the influence and power of institutional authority exerted within a society. Lupton (2013) asserts that these commentators, like the French philosopher Michel Foucault, investigate risk within the context of surveillance and regulation of populations.

Each of these sociological approaches have their strengths, investigating the individual, then giving way to the collective view of risk and the growing influence of societal factors. However, the perspective that appears to be most fruitful in order to identify a pathway for this proposed research is that of the *Sociocultural mainstream.* Rather than investigating how individuals manage risk in their own lives or how to improve communication between scientists and the public, as in the views of *Risk society*, or adopting the extreme *Governmentality* perspectives, it appears that the *Sociocultural mainstream* perspective may offer an opportunity to shed light on the "common consciousness" (Durkheim, 1984, p.38). This perspective seems to be the most fruitful for this research because it investigates the differing ideas that groups of people in a society have.

Taylor-Gooby and Zinn (2006) believe that the key theme investigated in the *Sociocultural mainstream* perspective is the way in which people see themselves and others. Additionally, such investigations include researching how this perspective influences peoples' interactions, where the social construction of "Otherness" (p. 402) is seen as central to human culture and the notions of risk are used to establish boundaries between self and other.

Lupton, a sociology research Professor at the University of Canberra with an interest in the *Sociocultural mainstream* perspective (University of Canberra, n.d.), contends that the concept of risk today is used loosely by citizens to mean "a threat, hazard, danger or harm" (Lupton,

2013, p. 10). She argues that changes in scientific thinking and rationality have focussed more attention on the concept of risk. Additionally, she maintains that the development of digital technologies has increased interest in the concept of risk as the ease of statistical manipulation of data has increased. Furthermore, she believes that the media's frequency of reporting on examples of risk play an important role in how the public perceive risks as well as how they should be managed. As an example, she cites everyday risks, such as work accidents (which kill or injure many people annually) receiving little attention than far less frequently occurring risks such as plane crashes (which result in far fewer deaths). Lupton identified Mary Douglas as advancing the *Sociocultural mainstream* perspective and argues that Douglas has been a pivotal figure in sociocultural analysis for over 50 years where individuals' values and biases are investigated.

There are other researchers who adopt this *Sociocultural mainstream* perspective. For example, Grinyer (1995), Kolstø (2001), and Wynne (1992), all of whose work on a binary of attitudes formed about risk between scientists and lay people, has value because they have produced empirical data. However, this research will draw on the work of Mary Douglas (1978, 1997, 1999, 2003) because her work focussed on how different cultural groups within a society can be identified thus providing a way to investigate the "collective or common consciousness" (Durkheim, 1984, p.38).

In this project the researcher is interested in investigating peoples' perceptions about which strategies should be implemented, and the associated risks involved, to best protect our unique biodiversity from the threat posed by introduced pest species. Biodiversity rescue is a risk issue that is collectively discussed by many New Zealanders. In fact, the Secretary for the Environment, Vicky Robertson, stated in the introduction of the *Statement of Intent 2016-2020* (Ministry for the Environment [MfE], 2016) that she believed that New Zealanders collectively feel a connection to this distinctive biodiversity as it "goes to the heart of who we are as Kiwis" (p.5).

2.3.2 The sociocultural perspective of risk

Mary Douglas's research focus was the importance of social groups and the boundaries between self and other when discussing risk situations. Douglas (2003a) asserts that risk has come into prominence in recent times and has "become central to our behaviour" (p.15) because of the development of a global society. Lupton (2013) supports this idea and believes globalisation has

improved "inter-community discourse and a sense of vulnerability in being part of a world system" (p.65).

Unlike Beck (1994), who believed better communication between scientists and the public would improve the public perception of risk, Douglas stressed the importance of culture when analysing risk. She believed it was pointless to provide improved communication to citizens, stating:

> [c]onflicts would easily be resolved if at all times the persons in disagreement were open to persuasion. But there are times when no new facts will shift the positions that have been taken up. When disagreement is so deeply entrenched the protagonists to a serious debate seem to be acting irrationally. But no, there are reasons for their intransigence, reasons which go deep into their loyalties and moral principles. (1999, p. 411)

She asserted that this intransigence arises because when citizens hold deep-seated views about risk situations, additional information will not persuade them to change their minds, because their views are embedded in their cultural bias and their social groupings within society. Throughout her research, she emphasised the cultural relativity of judgements about risk and argued that citizens, "[w]hen faced with estimating probability and credibility, they come already primed with culturally learned assumptions and weightings" (Douglas, 2003a, p.58).

To investigate risk, Douglas identified different types of social groups within any society. Douglas (1999) asserted that "four types of cultural bias are potentially always present in any group of persons and that all four are at war with each other" (p.411). She designed a grid/group typology of social relationships to analyse these four groups, arguing that by having just four groups and two dimensions, a "parsimonious model of organisations" (p. 411) could be developed. Douglas's initial grid/group typology, developed in her 1978 essay entitled *Cultural Bias,* is displayed in Figure 2.3. In this initial typology, the four types of social groups she identified were given letters and names. These letters and names changed and evolved over time and this evolution is further discussed in Chapter 4 where a proposed analysis framework is described.

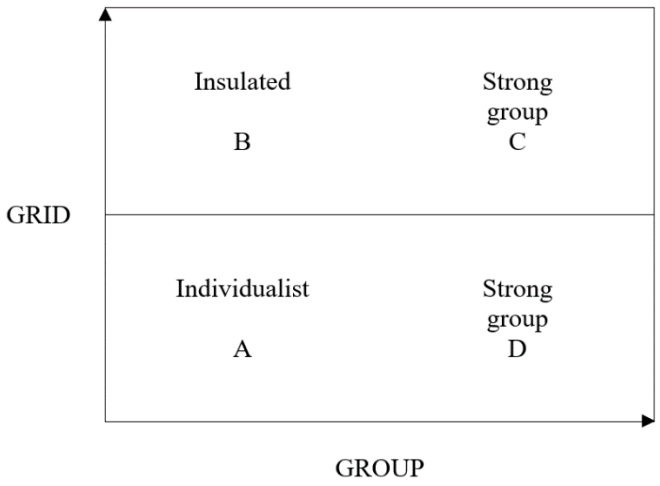

Figure 2.3. The initial typology displaying the four types of social groups (from Douglas,1978, p.7).

Douglas (1978) named the vertical dimensions of the diagram as **grid** and the horizontal dimension as **group**, where the grid dimension indicated increasing degrees of autonomy, laws or rules within a society and the group dimension indicated increasing degrees of incorporation into bounded units. She argued that each group formed by these two dimensions could be identified by multiple characteristics and named the grid/group typology a "polythetic method" (p.15) of classification. This term means that rather than requiring all these characteristics to be present in every member of any group, only some of the characteristics were necessary to define the members.

Furthermore, Douglas (1997) asserted that each of the four groups identified in her typology consisted of a collection of people who shared a similar point of view, or cultural bias about a specific topic. Moreover, she believed that it was necessary to think of this cultural bias "as essentially a dialogue that allocates praise and blame. Then focus on the blame" (p. 129). This was because Douglas asserted that the intercultural dialogue was "agonistic" (p.129), where blaming was central and political. Interestingly, the term agnostic was first used by Scott and Fredericson (1951) in their biological investigations with mice and has a broader meaning than aggressive because it includes threats and posturing between members of the same species over limited environmental resources.

Douglas (1997) used this typology to develop her ideas of the cultural theory of risk. Within the typology, she asserted that one of the cultural types, identified as 'C' in Figure 2.3, was anchored in hierarchical ideas where control of information was important. She added that this cultural type had bureaucratic goals where disaster and risk were accepted, and such acceptance allowed the long-term view to risk situations and the justification of decisions objectively. Douglas believed the second cultural type was essentially the radical conscience of a community and this

group held reformist objectives. This cultural type is identified as 'D'. She argued that this group believed that risks were concealed, and the public were misled about these risks by experts. She asserted that this cultural type was accused by the other cultural types as amplifying dangers about risky situations. The third cultural type Douglas described and identified as 'A', had materialistic goals and short-term, market-driven viewpoints. This cultural type was believed to be unconcerned about the misfortunes of others and described risk situations within technical terms and meanings. The fourth group, which Douglas identified as 'B' was described as insulated from society in that they believed they were powerless to influence risk situations and had an attitude of resignation.

Rayner (Oxford Martin School-University of Oxford, n.d.), who is currently a Professor of Science and Civilization at Oxford University and whose PhD was supervised by Douglas, supported her ideas and believed that her grid/group typology was a useful tool for investigating risk within society at a fixed time or for charting changes over time, as it indicated the differences between societal groups. He posited that Douglas subscribed to the "*stability hypothesis*" (1992, p. 107, italics in original), as she believed that once an individual has developed a cultural bias, they would be inclined to remain within that group. For example, they might seek friends, jobs and join clubs and associations with like-minded people within their cultural type. However, Rayner argued for an alternative viewpoint, which he named the "*mobility hypothesis*" (p. 107, italics in original) and believed that his hypothesis enabled Douglas's cultural theory to become more dynamic. He argued that within any society, the context of the argument that created the cultural bias within an individual was paramount and stated that individuals can shift from one group to another as they "flit like butterflies from context to context, changing the nature of their arguments as they do so" (p.107).

Using Rayner's (1992) hypotheses it would be interesting to explore if New Zealand students' views of risk remain stable or are mobile when responding to the issue of a biodiversity rescue strategy.

There has been some risk research carried out in New Zealand. While the researcher does not make claim to an exhaustive list, an example of this risk research was conducted by Gulliver and Fanslow (2016). They investigated the personal risks involved in cases of family violence and developed conceptual models to identify relationships between the risks of intimate partner violence (IPV) and other forms of violence in the community as well as identifying reasons for IPV. In another example Seville and Metcalfe (2005) developed a hazard risk assessment for Land Transport New Zealand (a Crown Entity). They developed computer-generated models to

produce a framework that could predict potential damage to roading in New Zealand. In addition, their framework had the capacity to build a database of risk factors like flooding, wild-fires and seismic events in different areas of New Zealand and provides a potential mechanism to allow the allocation of resources to contribute to a system of sustainable land transport. They concluded that such a framework would be beneficial but funding its establishment would be an issue. In a further development, nine case studies of different district councils' transport processes were investigated by Hill, Henning, Smith and Dever-Tod (2010). They found that there was little evidence that any risk management strategies had been implemented and recommended that Land Transport New Zealand develop a standard risk register which could be provided to district councils to outline best practice guidelines.

In another example of recent risk research in New Zealand, Kaiser et al. (2017) who investigate risk at the Institute of Geological and Nuclear Sciences (GNS) investigated the damage resulting from a 2016 earthquake in Kaikōura in the South Island of New Zealand. Parenthetically, there are many potential geological risks because New Zealand sits astride two of the world's major tectonic plates, the Pacific Plate and the Australian Plate (GNS Science – Te Pū Ao, n.d.). In their report Kaiser et al. produced an overview which focussed on seismological aspects of the earthquake and used back projections methods to derive insights into the evolution of the ruptures in the earth around Kaikōura caused by the earthquake.

All these examples of risk research in New Zealand were carried out using the psychological approach and a *Scientific-technical* perspective as identified by Taylor-Gooby and Zinn (2006), and collected data using quantitative methodologies. There does not appear to be any research carried out in New Zealand to qualitatively investigate views of risk when responding to the issue of a biodiversity rescue strategy. Therefore, it would appear that there is scope for researching people's perceptions of risk in a qualitative manner.

2.3.3 Further development of the ideas of Mary Douglas

Other researchers have developed Douglas's framework further to assist their understandings about how groups in society interpret danger and risk (Tansey & O'Riordan, 1999). For example, Michiel Schwarz, who is currently a cultural sociologist, based at the Academy of Architecture at the Amsterdam University of the Arts (Amsterdam University of the Arts, n.d.) and Michael Thompson, who is a senior researcher at the Stein Rokkan Centre for Social Research, University of Bergen, Norway (International Institute for Applied Systems Analysis, n.d.), developed Douglas's original grid/group typology in 1990 into two dimensions of sociality and four

rationalities. It appears that an investigation of their ideas about these two dimensions could offer potential for further research into the "common consciousness" (Durkheim, 1984, p.38) of risk because their work adds a further aspect to Douglas's work. Their ideas are displayed in Figure 2.4.

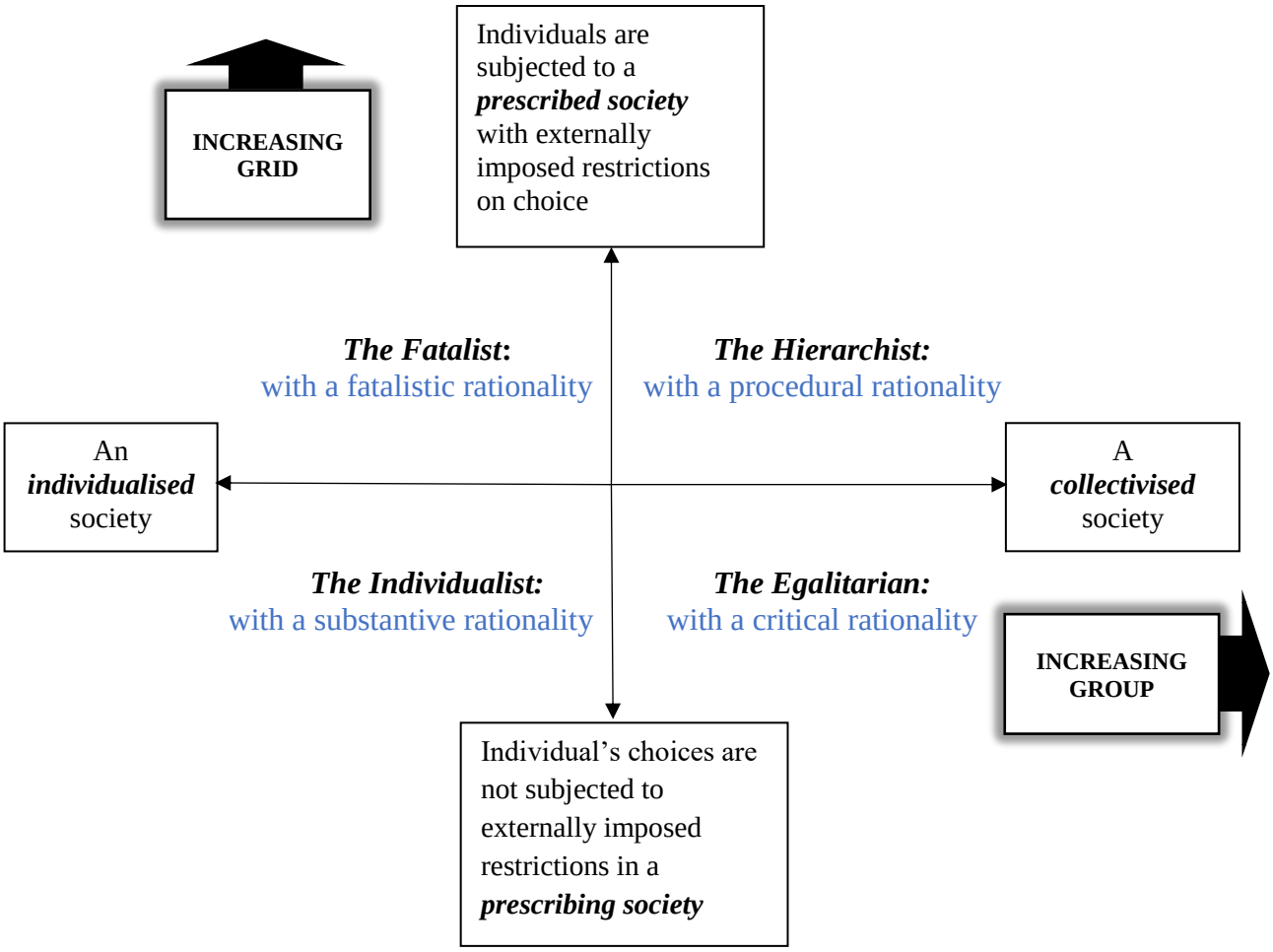

Figure 2.4. The grid/group ideas, displaying two dimensions of sociality and four rationalities (from Schwarz and Thompson,1990, p.7).

Schwarz and Thompson (1990) believed that their modified framework displayed "cultural pluralism" (p.12), because the four groups with their individual rationalities identified four different cultures and they argued that this "pluralism" could be used to explain the different opinions people held about risk within any society.

Schwarz and Thompson (1990) based their framework ideas on the two questions, "Who am I" and "How should I behave?" (p.6). The changes they made to the original typology proposed by Douglas were that they altered the grid and group lines to make four quadrants, they changed some of the titles of the cultural groups and adding further expressions, such as the *prescribing*

or *prescribed society*. Although Schwarz and Thompson did not justify their decisions for these changes, the researcher's opinion is that perhaps they believed that the altered names and expressions better reflected and described each way of life within their typology, which proved useful for their research. Their alterations and additions could prove fruitful for this proposed research as well.

In developing their framework, Schwarz and Thompson (1990) argued that a person's identity was determined by their relationships to groups ("*Who am I?', p.6*) on the horizontal axis, while their behaviour ("*How should I behave?,p.6*) was shaped by the "extent of the social prescriptions" (p. 6), or a society's rules to produce the grid dimension on the vertical axis of their framework. They believed that these two dimensions of sociality generated four forms of social relationships or rationalities within their grid/group framework. They named these four forms of social relationships or rationalities the "*fatalistic rationality*," the "*procedural rationality*," the "*critical rationality*" and the "*substantive rationality*" (pp. 6-8).

Schwarz and Thompson (1990) identified the fatalist group as showing a *fatalistic rationality* and described these individuals as believing that humans have no power to influence the future and having an attitude of resignation. Their second group were named the hierarchists, and Schwarz and Thompson identified these individuals as displaying a *procedural rationality*. They believed that these individuals demonstrated decision-making behaviour that was the outcome of appropriate deliberation and were concerned with who does what, rather than evaluating the outcomes. The third group, Schwarz and Thompson named the egalitarians and they identified these individuals as having a *critical rationality*, describing these individuals as believing that claims to knowledge should be criticised and subjected to tests which may falsify them. The final group that Schwarz and Thompson identified were the individualists, who they argued displayed a *substantive rationality* whose focus was the achievement of specific goals.

Other international researchers have studied these ideas, such as James Tansey, who is an Associate Professor at the University of British Columbia (Saunder School of Business, n.d.) and Tim O'Riordan (OBE), who is Emeritus Professor of Environmental Sciences at the University of East Anglia (University of East Anglia, n.d.). In 1999 using Schwarz and Thompson's (1990) idea of the different rationalities, they asserted that the views of any particular individual are shaped by the nature of the social group to which they identify. They further opined that "attitudes and judgements about risks and about the pattern of social justice and responsible government are set in cultural relationships, namely the expectations and value systems of people belonging to the distinctive groups" (Tansey & ORiordan, 1999, p. 71).

Moreover, Tansey and O'Riordon believe that risks are constructed, and judgements formed about these risks depending on the social context. Therefore, in order to understand these risks, they should not be reduced to concerns about for example, safety, because the risks are inseparable from the wider social context.

As well as investigating students' views within a social context, the researcher is interested in exploring the mechanisms these students use to communicate their "common consciousness" (Durkheim, 1984, p.38) views about risk. Researchers in the United States of America (USA), Kahan (2010, 2012) and Kahan, Jenkins-Smith and Braman (2011), have investigated mechanisms individuals use to communicate their risk views. The researcher considers that their ideas about such communication methods may be able to be used to add a further dimension to the proposed research.

Kahan (2010, 2012) and Kahan, Jenkins-Smith and Braman (2011) conducted risk research using an adaptation of Douglas' grid/group ideas. Dan Kahan is the Elizabeth K. Dollard Professor of Law and Professor of Psychology at Yale Law School (Yale University, n.d.), Hank Jenkins-Smith is a George Lynn Cross Research Professor in the Political Science Department at the University of Oklahoma (The University of Oklahoma, n.d.), and Donald Braman is an Associate Professor of Law at The George Washington University Law School (The George Washington University, n.d.).

Using Douglas's cultural theory grid/group ideas and the theories of the psychometric paradigm supporters such as Slovic (1987), Kahan et al. (2011) proposed a theoretical framework which they named the *Cultural Cognition of Risk*. Like Beck (1994), they advocate that scientists have a responsibility to inform the public about science ideas clearly but must "attend to the cultural meaning as well as the scientific content of information" (2011, p.169). Kahan argues that this is because people tend to advocate any position that reinforces their connection to other like-minded people.

In Kahan et al.'s (2011) view, "cultural cognition refers to the tendency of individuals to fit their perceptions of risk and related factual beliefs to their shared moral evaluations of putatively dangerous activities" (p.148). They assert that their cultural cognition framework or map enables analysis of the tendency of individuals to form beliefs about the risks of disputed issues that match the values that define their cultural identities.

This cultural cognition framework or map has two continuous attitudinal scales, rather than the four cultural groups developed by Douglas in her grid/group typology. The vertical scale Kahan

named the "hierarchy-egalitarianism" (2012, p.8) continuum and the horizontal scale the "individualism-communitarianism" (p.8) continuum. Kahan argues that these continuous scales allow researchers to plot a unique co-ordinate or "cultural space" (p.9) onto a cultural cognition map after aggregating participants' Likert-scale questionnaire responses. His cultural cognition map which displayed the two continua is presented in Figure 2.5.

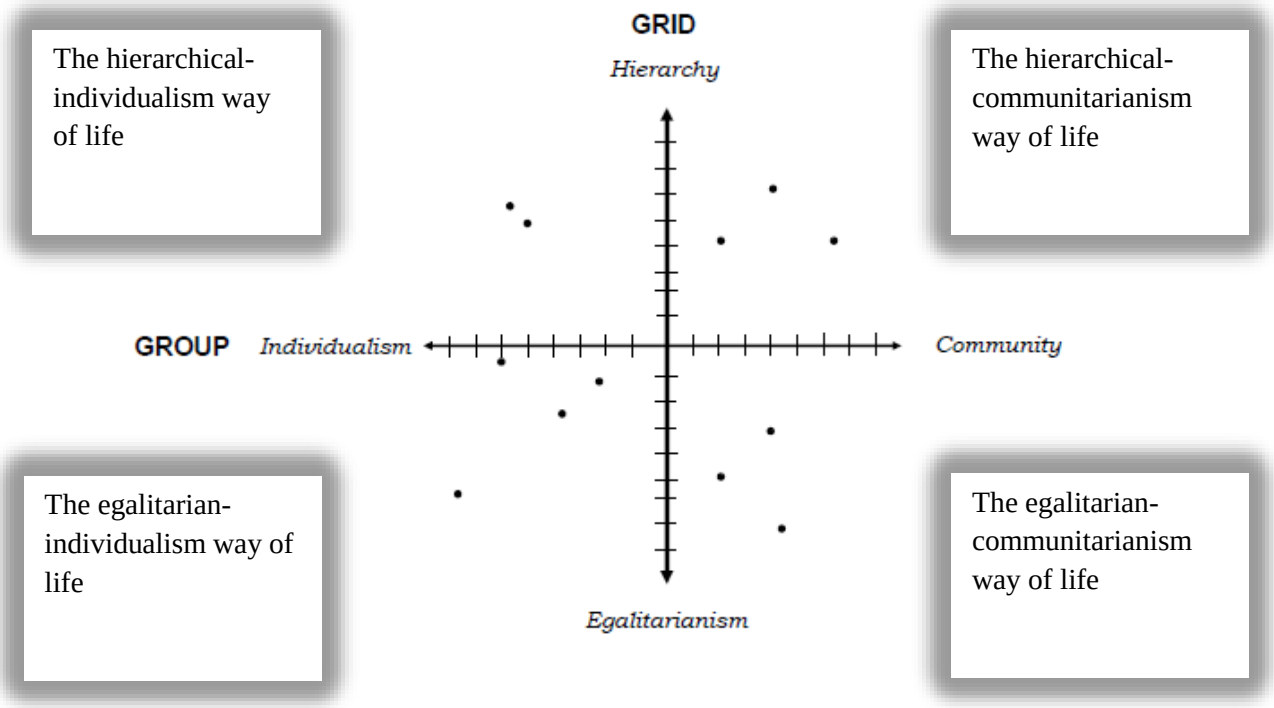

Figure 2.5. The Cultural Cognition Map showing the four ways of life (from Kahan, 2012, p.9).

Kahan (2012) argued that within his cultural cognition map, the intersection of the two continuous scales resulted in four ways of life, which he named "hierarchical-individualism, hierarchical-communitarianism, egalitarian-individualism and egalitarian-communitarianism" (p.10).

In their study, Kahan et al. investigated the perceptions of 1500 American adults with an average age of 47 years and unspecified tertiary education, about the socio-scientific issues of climate change, the disposal of nuclear waste and the permitting of concealed possession of handguns and found that members of any society could be categorised into one of the four ways of life. While their research has been conducted using quantitative methods and only in the USA, it could be fruitful to examine if their risk ideas could be used in a qualitative study to unpick the "common consciousness" (Durkheim, 1984, p.38) of students' ideas about a New Zealand risk issue. Furthermore, it would appear that no qualitative investigations of secondary students' view of risk seem to have been investigated in New Zealand.

2.4 Using Douglas's grid/group ideas to communicate risk perceptions

As well as developing their cultural cognition framework or map, Kahan (2012) and Kahan et al. (2011) also assert that people use a range of communication mechanisms that identify ways they communicate their commitment to a particular cultural bias. These mechanisms could be fruitful to unpick the "common consciousness" (Durkheim, 1984, p.38) when the students in this proposed research communicate their views of risk.

Kahan et al. (2011) posit that the range of communication mechanisms used by individuals reinforce their cultural cognition way of life and that "individuals are psychologically disposed to believe that behaviour they (and their peers) find honourable is socially beneficial and behaviour they find base socially detrimental" (p. 148). Their position links to the ideas of Douglas who described the intercultural dialogue as "agnostic" (1997, p. 129). Additionally, Kahan et al. believe these mechanisms are common across all four ways of life. Kahan and Kahan et al. named these mechanisms: *narrative framing, cultural credibility, identity affirmation, biased assimilation* and *cultural availability.*

Kahan et al. (2011) believe that the first mechanism, *narrative framing* occurs when individuals assimilate new information within pre-existing narrative frameworks. This strategy is displayed by individuals when the new information is "culturally congenial" (p.170) and adds meaning to their existing ideas.

The second mechanism employed by individuals is identified by Kahan et al. (2011) as *cultural credibility*. This mechanism is displayed when an individual accepts views from experts who these individuals perceive as sharing their world view or values, and therefore find trustworthy.

Kahan et al. (2011) argue that the third cultural cognition mechanism, *identity affirmation* is displayed by individuals who have been shown risk information consistent with their cultural values. However, these same individuals dismiss information which does not support their values.

The fourth mechanism described by Kahan (2012) is *biased assimilation*. This mechanism is an unconscious motivation by individuals to persist in their beliefs by selectively choosing evidence that reinforces these beliefs, while dismissing those beliefs that oppose them as non-credible.

Cultural availability is the final cultural cognition mechanism described by Kahan (2012). He asserts that this mechanism is displayed when individuals take more notice of facts and remember more details about a contentious issue if these details fit their pre-existing beliefs. He

adds however, that these same individuals react dismissively toward information that threatens their cultural values.

There does not appear to be any research into interpreting the communication mechanisms used by secondary students in New Zealand when justifying their risk positions. The mechanisms proposed by Kahan (2012) could provide a way for the researcher to interpret the manner in which the students in this study communicate their commitment to a particular cultural bias when responding to the complex issue of deciding which strategies should be implemented to best protect New Zealand's unique biodiversity from the threat posed by introduced pest species. Consequently, it would be useful to investigate ways of interpreting students' communication mechanisms used within this study.

The importance of encouraging scientific literacy in all citizens has been increasingly seen as necessary for finding solutions to the science-related dilemmas and the associated risks involved that are facing the modern world (OECD, 2016). The role of education in teaching the awareness of environmental issues and their associated risks, such as deciding how best to protect New Zealand's unique and distinctive biodiversity from the threat posed by introduced pest species, as well as the reformation of science education will now be discussed.

2.5 Scientific literacy and reforming science education

It is widely recognised within science education communities that improving scientific literacy in students is an important goal (Uno & Bybee, 1994). There is also widespread belief that the concept is difficult to define because its meaning is different for different groups of people (Bingle & Gaskell, 1994; Holbrook & Rannikmae, 2007). Hurd (1998) opines that the first ideas about the importance of encouraging scientific literacy can be found as far back as the 1500s with the introduction of modern science into western civilisation, so these ideas are not new. Like Ravetz's ideas about post-normal science (see p. 19), Hurd also believes that today's science research is becoming "hybridized" (p. 409) into blended fields such as biogeochemistry and is more "transdisciplinary" (p. 409) as it deals more with broader forms of research. Levinson (2013) supports these ideas and believes that today the emphasis in science education needs to include an awareness of the rapid changes in science and technology and "the meaning of being a citizen in a global world" (p. 99).

Ravetz (2006a) asserts that science education internationally needs to be reformed. Rather than just a focus on improving scientific literacy, he stresses urgency in the need for change in science education to encourage awareness in students that our modern science-based civilisation faces

two major problems. The first problem he believes, is that most people accept that our present lifestyle is unsustainable, and the environment cannot continue to cope with the damage inflicted on it by current human activity. Secondly, he opines that there is growing awareness of how much, as a civilisation, that we don't know and that there are "unknown unknowns" (2006a, p.4). Ravetz argues that risk is inherent as "almost anything we do, consume or are exposed to has some risks" (1997, p.6). He also asserts that in previous times people believed that nature was there to be exploited and controlled. Ravetz adds that there was also a general belief amongst most people in these previous times, that the Earth was an infinite source of raw materials, a bottomless dump for all our wastes and that the fields of science and technology could solve any problems that arose. But now he argues that there is a growing and widespread feeling amongst people of uncertainty about the capacity of science and technology to solve emerging issues and their associated risks in a rapidly changing world, like the sustainability of the Earth (Ravetz, 1997, 2006a). In fact, he believes this problem is so urgent in his book *The No-Nonsense Guide to Science*, he opined that "[f]or a long time science had been seen as the way to the real salvation of humanity; now it is also recognized as a possible instrument of our destruction" (2006b, p.8).

Funtowicz and Ravetz argue that "post-normal" (1992, p. 253) science requires the input of an "extended peer community" (p. 254). They believe that this type of science creates a new sort of practice comprising scientists, professionals and interested lay-people, where everyone interested in discussing novel situations are included in the discourse using "extended facts" (p. 254) to potentially solve these issues, along with their inherent risks. Ravetz (1997) suggests that the types of questions asked in science classes to foster an awareness of scientific uncertainties inherent in many of today's risk issues needs to change from "what/how" and "how/why" to "what-if" (p. 5), and opines that if this becomes the focus question, students will be more encouraged to confront problems and appreciate the complexity of the issues. He believes that rather than approaching topics as a set of isolated facts, the "what-if" (p.5) approach will encourage an appreciation of the connectedness of the sciences, technology and society. Ravetz (2006a) also argues that teachers should discuss the certain and stable science knowledge, as has been carried out in past curricula, as well as this uncertain knowledge which is open to doubt and debate.

An example of encouraging an awareness of the connectedness of the sciences, technology and society is found in *The New Zealand Curriculum* (Ministry of Education [MoE], 2007a). The Principle of *Coherence* identifies the need to offer "all students a broad education that makes

links within and across learning areas, provides for coherent transitions, and opens up pathways to further learning" (p.9).

As well as having these broad educational goals, *The New Zealand Curriculum* (MoE, 2007a) also contains eight learning areas, including the science learning area. The broad focus of this learning area is for students to investigate the world so they "can participate as critical, informed and responsible citizens in a society in which science plays a significant role" (MoE, 2007a, p.17), which echoes both Levinson's (2013) and Ravetz's (1997, 2006b) views.

Guided by this broad focus, the science learning area is divided into four content/contextual strands and an overarching *Nature of Science* strand which promotes the development of students' scientific skills, attitudes and values. This strand also enables students to "make links between scientific knowledge and everyday decisions and actions" (MoE, 2007a, p.28).

The four content/contextual science strands are called, *Planet Earth and Beyond, Physical World, Material World* and *Living World* (MoE, 2007a, p.28). Signalled within the *Living World* strand is the importance of learning about New Zealand's unique biodiversity. For example, a statement within the *Living World* strand describes that as a result of learning related to this strand, students should to be able to "make more informed decisions" (MoE, 2007a, p.28) about "the sustainability of New Zealand's unique fauna and flora and distinctive ecosystems" (MoE, 2007a, p.28).

But, nowhere in the science curriculum is teaching scientific literacy specifically mentioned. The potential risks involved in protecting and rescuing New Zealand's unique biodiversity are also missing. The researcher believes that these ideas could be implied in the *Living World* strand in the statement "make informed decisions" (MoE, 2007a, p.28). Where *risk* is specifically mentioned in *The New Zealand Curriculum* (MoE, 2007b) document, it is in the context of personal safety in both the Technology and the Health and Physical Education learning areas and as an aspect of financial capability in the mathematics learning area. It appears therefore, that risk awareness teaching in the Science learning area has been overlooked in *The New Zealand Curriculum* (MoE, 2007b).

However, the New Zealand situation differs from both the Australian and the UK National Curriculum documents where risk education is embedded in multiple curriculum areas. For example, in the Australian curriculum, teaching an awareness of risk is mentioned in the Science, Technology, Geography, Outdoor Education and Mathematics learning areas (The Australian Curriculum, n.d.). For example, teaching about risk issues is discussed in the general introduction

to the science area where it is stated that there is a need to encourage students to "devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes" (p.36). Furthermore, teaching about risk issues is mentioned multiple times in the strand *Science as a Human Endeavour* within each of the biology, chemistry, earth science and physics learning areas where it is stated that the teaching of science needs to include the idea that the "application of science may provide great benefits to individuals, the community and environment, but may also pose risks and have unintended consequences" (pp. 52-73).

The United Kingdom National curriculum programmes of study are divided into four key stages. Within this document risk awareness education is also embedded into multiple curriculum areas, such as Science, Citizenship, Design and Technology as well as the Mathematics learning areas (The National Curriculum, n.d.). As an example, in the Science learning area within both Key Stages 3 and 4, teaching about risk issues is mentioned. At Key Stage 4, the curriculum document states there is a need for students to "evaluate risks both in practical science and in the wider societal context, including perception of risk" (p.70).

As the concept of risk is already embedded in some curricula, but overlooked in the New Zealand Science curriculum, there is space to explore a new way of thinking about developing young people's understanding of this concept of risk while learning about how science works in our modern society, for instance, ideas upheld by Ravetz (1997, 2006b). Such an approach is encouraged both by Sadler and Zeidler (2004) and Morin, Simonneaux and Tytler (2017), who believe that the promotion of an appreciation for the interdependence of science and society and the inherent risks, should be integrated into science programmes as fundamental components. Their ideas will now be discussed.

2.6 The socio-scientific issues/Socially acute questions approach to science

Sadler and Zeidler (2004) believe that a method of improving science education for students and to promote understanding of the interdependence of science and society and their inherent risks, is to introduce them to socio-scientific issues using authentic contexts. Sadler and Zeidler describe socio-scientific issues (SSI) as "social dilemmas with conceptual ties to science" (p.387). Kolstø (2001) believes that socio-scientific issues are complex, controversial and risky issues that are difficult to resolve partly because "the science involved is normally frontier science for which consensus has not yet been reached" (p. 877).

Their ideas are similar to Morin, Simonneaux, Simonneaux and Tytler (2013) who along with Morin et al. (2017) promote the introduction of socially acute question approach (SAQ). They

argue that SAQs are SSIs that also "raise questions about social values and practices" (2013, p. 158) and include aspects from the fields of economics, politics along with stakeholder perspectives and as such, could represent Ravetz's (1997, 2006b) notion of post-normal science education.

Both Sadler and Zeidler (2004) and Morin et al. (2017) support the inclusion of SSIs/SAQs as an important approach to science education, because of the increasing incidence, as well as the scientific and cultural significance, of many socio-scientific issues involving risk and confronting society. They argue that negotiating such issues involves students understanding the science content, processing information, considering ethical and moral aspects and justifying their position on the issue.

Oulton, Day, Dillon and Grace (2004) support these ideas and also believe that by learning to negotiate such socio-scientific issues as students, they will be more likely to participate in these types of discussions as adults. Furthermore, Lewis and Leach (2006) also believe that teaching students about socio-scientific issues should be integrated into science programmes and argue such issues provide a way of improving their skills that are part of scientific literacy. They describe these skills as the development of students' ability to engage in social issues and form reasoned and justifiable views. Lewis and Leach believe that the role of the school curriculum is to support the development of students' ability to engage in reasoned discussions about socio-scientific issues and thereby prepare "young people for future engagement with the social consequences of scientific development" (p. 1284). They investigated the attitudes of 200 student participants, aged between 14-16-years in the United Kingdom about the social consequences of gene technology. They found that when using carefully designed and contextualised intervention strategies which provided specific scientific content, students could engage in reasoned discussions about socio-scientific issues.

In a further example, Evagorou, Jimenez-Aleixandre and Osborne (2012) argue that science can involve controversial issues and that engaging in these issues can allow students to become critical consumers of science information, thus enabling them to see the connections between science and everyday life. Like Sadler and Zeidler (2004), they believe that socio-scientific issues are often ill-structured with conflicting explanations and involve moral and ethical concepts. Because of this, Evagorou et al. assert that socio-scientific issues are different from the usual topics that are presented in science classrooms.

It could be argued that there appears to be ample support for the implementation of the teaching of post-normal science using the SSI/SAQ approach to assist students to develop an appreciation of the connectedness of the sciences, technology and society as asserted by Funtowicz and Ravetz (1992). This approach to teaching would promote a new type of science teaching where students would be encouraged to participate in the formation of an "extended peer community" (p. 254) around risk issues as part of their development in being citizens of the world.

The researcher believes that the eradication of introduced pests to rescue the depleting and indigenous biodiversity within forests is a "post-normal" (Funtowiz & Ravetz, 1992, p.253) SSI/SAQ of importance to **all** New Zealanders. The issue is important because of the potential risks encompassed in the implementation of different methods of eradication of these introduced pests. However, there does not appear to be any research in New Zealand into this issue. Consequently, there is potential for research to be carried out to investigate New Zealand secondary students' views of risk when they respond to the issue of a biodiversity rescue strategy, which is the aim of this project.

2.7 Justification of the research questions

This chapter has argued that in our largely industrialised and technology-based society we are increasingly confronted with complex risk issues. A discussion of the changing meaning of risk, and the differing theoretical perspectives involved in investigating risk was provided. Central to this discussion were Douglas's (1978) ideas who holds sociocultural views about risk. She developed a grid/group typology of four cultures that she contends any society contains. Rayner (1992), believed her typology was useful for investigating the range of risk views and proposed two hypotheses to support her ideas. These were the *stability* hypothesis, which describes how individuals remain within a social group, and compares to the *mobility* hypothesis, which states that individuals move from one group to another, depending on the context. It is argued that the grid/group typology Douglas developed may provide a framework for research to be carried out to investigate both consistency and the range of views about a risk issue using qualitative methods. However, there does not appear to be any research interpreting such views in New Zealand.

Douglas's (1978) typology was later modified by Schwarz and Thompson (1990) to incorporate the two dimensions of sociality and four rationalities. It is argued that a sociocultural perspective of risk, like those adopted by Douglas and Schwarz and Thompson may provide a way to investigate student perceptions because there was no attempt by these authors to describe how

each of the four cultures could be identified. Therefore, there appears to be a need to investigate a way of analysing people's perceptions of risk in a detailed manner when discussing a biodiversity rescue strategy in New Zealand.

Consequently, the following over-arching research question will be investigated:

> What are New Zealand secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy?

Within this chapter the sociocultural perspective was followed by a discussion of the Cultural Cognition of Risk ideas of Kahan (2010, 2012) and Kahan, Jenkins-Smith and Braman (2011). Their ideas include a range of mechanisms that may provide a way of interpreting the communication strategies used by students within this project. Using a quantitative methodology, they investigated U.S.A. adult participants' views. However, the researcher may be able to modify their mechanisms to investigate the communication strategies employed by secondary students in this study. Furthermore, there does not appear to be any research in New Zealand of the mechanisms students use to communicate their perceptions of the potential risks encompassed in the implementation of different methods of eradication of introduced pests in order to rescue the indigenous biodiversity.

Consequently, the following sub-questions will also be investigated:

> How could these students' responses be qualitatively analysed?
>
> What is the range of views expressed about a biodiversity rescue strategy?
>
> How consistent are students' views of risk across a range of contexts?
>
> What mechanisms do students employ to communicate their views and allow meaning-making when justifying their positions about a biodiversity rescue?

Finally, an analysis of three curricula involving the teaching and learning of risk issues were discussed. This was followed by identifying the use of the SSI/SAQ approach to introduce "post-normal science" (Funtowicz & Ravetz, 1992, p. 253) contexts that could be employed to implement this learning and as such may have implications for teaching.

The following chapter will discuss the research design employed in this project.

Chapter Three
RESEARCH DESIGN

3.1 Introduction

The aim of this project was to explore secondary school-aged students' perceptions of risk when investigating a biodiversity rescue and the mechanisms they use when communicating their ideas. The over-arching research question that guided this research was:

> What are New Zealand secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy?

Additionally, the following sub-questions will also be investigated:

> How could these students' responses be qualitatively analysed?
>
> What is the range of views expressed about a biodiversity rescue strategy?
>
> How consistent are students' views of risk across a range of contexts?
>
> What mechanisms do students employ to communicate their views and allow meaning-making when justifying their positions about a biodiversity rescue?

This chapter describes the research design underpinning this project. In Section 3.2 the choice of research design for this project is justified. The timeline of the research is discussed and displayed in Section 3.3. Sampling methods used in this research, and the selection of the schools is described in Section 3.4. The people involved in the research are discussed in Section 3.5. Methods used to generate the data, and their justification for use are discussed in Section 3.6. Section 3.7 discusses how the data were analysed. The establishment of trustworthiness is discussed in Section 3.8. Section 3.9 discusses how ethical issues of informed consent and confidentiality were managed. Additionally, this section also describes how the identification and amelioration of power relationships were carried out in this study. Finally, Section 3.10 provides a summary of this chapter.

3.2 Choice of research design

Sarantakos (2013) opines that all forms of social research are diverse, complex and "packaged in paradigms" (p.29). He asserts that the ontological parameter, or the nature of reality within the research gives the study its focus, and in turn informs the epistemology. The epistemological

parameter, or the nature of the knowledge that underpins the research, informs the methodology, which in turn guides the instruments used to gather the data for the research.

Since the research in this project was exploratory, an interpretive-qualitative research design that allowed for the researcher's interpretation of students' ideas was chosen. Such a perspective has an empathetic focus and follows a naturalistic approach, as it aims to understand and not just measure students' ideas (Merriam, 1998). This project used an interpretive perspective because the researcher wished to acquire a deeper understanding of individual students' ideas about risk to "discover how people construct meaning in natural settings" (Neuman, 2011, p. 102). Such naturalistic inquiries assume that there are multiple and inter-related realities (Guba, 1981; Sarantakos, 2013). Additionally, Guba asserts that such research aims to develop idiographic knowledge which directs attention to the specifics of particular cases, rather than the nomothetic, generalisable knowledge typical of quantitative research. In this research, there was a desire to gather a wide range of ideas from the New Zealand student participants about the particular case of their risk perceptions about using a poison as a biodiversity rescue method.

A constructionist ontological perspective underpins this research design, which assumes that there is neither an objective reality or truth, rather truth is constructed (Sarantakos, 2013). This perspective holds that individuals develop subjective, multiple and varied meanings of their experiences to make sense of their world (Creswell, 2003). Using this perspective in this project enabled the researcher to investigate and interpret the complexity and diversity of participants' views about risks involved when discussing ideas about a biodiversity rescue.

In order to investigate and interpret the diversity of participants' views, within this project, the design is underpinned by an epistemological perspective based on the view that reality is constructed by individuals in social situations as they interact with and make sense of their world (Merriam, 1998). In this study the social situation being investigated was the issue of risk when using 1080 to control possums in New Zealand. Furthermore, the researcher was interested in investigating the multiplicity of student views, not privileging one over another, which was consistent with the views of Douglas (1978, 1999).

The characteristics of a qualitative methodology were appropriate for this study. Merriam (1998) argues that the focus of a qualitative approach is the identification of patterns within data as well as the explanation of social phenomena, with as little disruption of the natural setting as possible. These characteristics are also identified by Punch who asserts that qualitative research should be "reflective of everyday life of individuals" (2006, p. 141). In this study, the researcher was

interested in investigating the depth and breadth of students' perceptions of risk and the variety of mechanisms they used to communicate their ideas about the rescue of New Zealand's unique biodiversity. Moreover, Denzin and Lincoln (2005) argue that the qualitative researcher is like a *'bricoleur'*, a quiltmaker that weaves different pieces of data together to produce an interpretive structure resulting in a "sequence of representations connecting the parts to the whole" (p.6). The data generated within this project were analysed to enable the construction of a bricolage of the participants' views. Moreover, a qualitative methodology was needed to enable the researcher to gather wide-ranging, rich and detailed data. Tools are needed to gather this data. Punch (2006) considered the study of "spoken and written representations and records of human experiences" (p. 168) as suitable tools to gather detailed, and a variety of views.

The spoken and written tools that Punch (2006) argued were suitable to gather data within this research were questionnaires and semi-structured interviews, which were then analysed. These tools allowed for a range of detailed data to be gathered without greatly disturbing the natural school setting the students were working in, because these types of activities are not uncommon in classrooms.

There was an unavoidable relationship between the researcher and the researched in this project. This relationship was the consequence of the researcher being the primary instrument for data generation and because the data were interpreted through the researcher's lens. However, these relationships are characteristics of an interpretive, qualitative research design (Merriam, 1998).

3.3 Timeline of the project

This research began with a decision about the type of research chosen, the presentation of the research proposal and an ethics application to the University of Auckland Human Participant Ethics Committee (UAHPEC). Once ethics was granted, organisations and participants were selected and visited.

Within this project there were two phases of data generation. During phase one each teacher delivered a unit of work prepared by the researcher. This unit of work included a range of New Zealanders' positive and negative views about the use of 1080 to eradicate pest species to assist the students' understanding. This was then followed by the student participants answering a questionnaire (see Appendix 1). In phase two of this project the researcher conducted interviews with selected Year 12 biology students. An outline for this research is displayed in Table 3.1.

Table 3.1
Outline of research design

Phase	Dates	Research activity
ONE	Oct. 2014	Submission of provisional proposal and ethics application.
	Nov. 2014	Ethics granted by University of Auckland Human Participants Ethics Committee (UAHPEC).
	Dec. 2014	Selection of schools, initial visits to Principals, delivery of participant information sheets and collection of consent forms.
	Dec. 2014–Jan. 2015	Literature review began. Development of a unit of work by the researcher which was provided to the participating schools.
	April 2015	Pilot study of the questionnaire and the unit of work.
	Aug.–Sept. 2015	PowerPoint display/videos about New Zealand's unique biodiversity situation and a biodiversity rescue strategy delivered by each teacher.
	Sept. 2015	Year 12 students within both an urban and a rural school completed a questionnaire containing five images about the use of 1080 as a biodiversity rescue method. This questionnaire was used to generate data about these students' views.
	Oct. 2015	Reminder emails sent to participating schools about the collection of completed questionnaires.
TWO	Oct. 2015	Semi-structured individual interviews were conducted to probe for further understanding of students' perceptions of risk, with a selection of the Year 12 students, in an urban and a rural school.
	Jan.–Dec. 2016	Literature review continued. Research and development of an analytical framework.
	Feb. 2016	Transcription of student interviews by University approved transcriber.
	May 2017–Oct. 2018	Literature review, analysis of data and writing up of research findings.

3.4 Sampling and selection

A significant issue when carrying out a research project is deciding on the types of organisations, as well as the nature, characteristics and number of participants from whom to collect data for the study. Sampling of participants is used in research because complete coverage within the area of interest is not possible (Sarantakos, 2013).

There are two types of sampling methods, probability and purposive, or non-probability. For this project purposive sampling was used because this method allowed participants to be chosen that could best answer the research question (Punch, 2006). The selection of the organisations, the participants and the sampling methods used to generate data in this research, will now be discussed.

3.4.1 Selection of schools

Purposive sampling was used to select the secondary schools that the researcher was interested in using for her study. Locations of these potential schools were identified from the Ministry of Education Review Office (ERO) website (http://www.ero.govt.nz). In New Zealand, the ERO publishes reports on all schools from early childhood through to secondary, along with reviews on their character and current educational practices. The researcher used this information to establish equivalency criteria to aid in the choice of schools. These criteria were: location, school type, size, and assessment type offered. Using these criteria, two similar-sized schools were identified that were both within an area that was accessible to the researcher. This criterion was important because she was conducting the research part-time while working full-time. Both schools selected were state-run, multicultural, co-educational secondary schools that offered similar assessments. The point of difference was that one school was rural and one was urban to represent the views of the different communities in New Zealand. Once potential schools were identified, the next stage involved an informal, preliminary visit to selected schools to discuss the project with each of the Principals.

3.4.2 Sampling of participants

Student participant selection was also by purposive sampling. This enabled students to be chosen based on the specific criteria of the course being studied and their year level within each school. The first criterion was students studying senior biology, and second that they were studying at Year 12. The participants chosen were Year 12 biology students because the research question was about a conservation issue, which relates to the New Zealand curriculum they were studying.

These students were all entered in a National Certificate of Educational Achievement (NCEA) biology level 2 course and were being offered an assessment that aligned with the research topic (New Zealand Qualifications Authority, 2017). This meant that the collection of data could be included as part of this assessment, therefore minimizing the intrusion into the students' learning time.

Purposive sampling was also used to select individual students to interview, based on the types of responses they made within their questionnaire. This criterion was used to enable the researcher to probe the students' who had displayed interesting ideas, or responses that the researcher wished to clarify, to further explore their expressions of risk.

3.5 People involved

Both schools were situated within the South Auckland district of the North Island of New Zealand. At the time of the research, the rural school had a total roll of 1261 students while the urban school had a total roll of 900. Both school populations comprised students from Years 9 to 13, and contained a mix of European, Māori and Pacifika ethnicities and both schools offered level 2 NCEA assessments as displayed in Table 3.2.

Table 3.2
Description of the two South Auckland schools selected (Ministry of Education, n.d.)

Descriptor	**School 1**	**School 2**
Location	Urban	Rural
Total roll	900	1,261
School population	Years 9–13	Years 9–13
Ethnic mix of student population	65% European 23% Māori 4% Pacifika 8% Other ethnicities	25% European 31% Māori 22% Pacifika 22% Other ethnicities
Total number of Year 12 biology students	74	47
Number of Year 12 biology students who gave consent	35 (47% of urban total)	31 (66% of rural total)
Final number of participants	22	18
Number of Year 12 biology students who were interviewed	15	14

Of the 74 students who were present at the urban school Year 12 biology class, 35 gave their consent to participate, representing 47% of these students. Of the 47 Year 12 biology students who were present at the rural school 31 gave their consent, representing 66% of these students.

Thirteen of these urban students changed their minds about participating or did not return their questionnaire, leaving a total of 22 participants. In the rural school, of the 31 students who initially gave consent, 13 changed their minds leaving a total of 18 participants. This meant that there was a combined total of 40 participants from both schools. This combined total comprised 16 boys (11 urban and 5 rural) and 24 girls (11 urban and 13 rural). In the urban school 15 students were interviewed and in the rural school 14, giving an overall total of 29 students who were interviewed.

3.6 Data Generation

Merriam (1998) argues that "data are nothing more than ordinary bits and pieces of information found in the environment" (p. 69). She asserts that data can either be easily generated and measured, like school size or be more difficult to generate and measure, like feelings and ideas. This second type of data – the ideas of the students – was what that the researcher wished to investigate. As a result, in this study two types of qualitative data generating strategies were employed. These two strategies to generate data were questionnaires and semi-structured interviews, which will now be discussed.

3.6.1 Questionnaires

Questionnaires are commonly used in social science research and are a familiar item to most people (Sarantakos, 2013). There are three main formats of questionnaires. The first format is structured, where there is no flexibility in giving the answers. The second format is open-ended, where there is little structure and the participants can respond as they wish, allowing them to express themselves freely and creatively and might offer the researcher information not foreseen previously. The third format of questionnaire is semi-structured and contains elements of the two forms (Sarantakos, 2013).

Within this project, a semi-structured questionnaire, in the form of a booklet was used by the researcher to generate data about the students' views about the use of 1080 in New Zealand as a biodiversity rescue strategy. A questionnaire was used because it enabled a large amount of data to be gathered quickly (Cohen, Manion, & Morrison, 2000). Presenting the questionnaire in a booklet format to the students was also chosen because the researcher believed that this would be a familiar arrangement to the secondary students. These questionnaires were distributed to the biology students by their teachers towards the end of each group of biology students' lessons. They were completed during a fifteen-minute period, to avoid being too intrusive on the students' learning time.

To construct the questionnaire, firstly the researcher searched for pertinent images about the risks involved with the use of 1080, that might be included. The images that formed the questionnaire used in this project (see Appendix 1) were copied from different sources from the internet. The internet sources for these images are provided in Appendix 2.

The images were chosen because they were all related to the use of 1080 in New Zealand and might stimulate students' expressions of their views of risk. The context of the first image in the questionnaire is a helicopter with a bucket suspended beneath, flying over a forested area and

distributing 1080 pellets. It was chosen because in New Zealand the use of helicopters to ferry cargo, fight forest fires or aerially spread fertilisers and pesticides is a common sight. In this image, the helicopter is distributing blue/green pellets of 1080 into a forested area. This method of pellet dispersal is a technique used in remote or inaccessible areas within New Zealand. The potential risks that the students might discuss after viewing the helicopter image could include the risk of the pellets being dispersed in the wrong area or being spilled. Additionally, the risk of the helicopter crashing could be a risk the students might discuss.

The second image was the common brushtail possum (*Trichosurus vulpecula*). It was chosen because the possum is considered by many New Zealanders to be a major pest in New Zealand. These animals have breed rapidly since their introduction in 1837 and their numbers are estimated to be between 50 and 70 million throughout the country (Hutching, 2015). With no natural predators in New Zealand possums have spread uncontrollably. As discussed in Chapter 1, possums eat the fruit, flowers, seeds and leaves of many native forest and commercial species. They also feed on a variety of native bats, insects, snails, as well as the eggs and chicks of native birds. Additionally, they are the main wildlife reservoir of bTB. As a result, the common brushtail possum is considered a huge risk to New Zealand's biodiversity and economy (Hutching). This image was included into the questionnaire because the researcher wanted to explore the students' views of this animal.

The third image was of a deer lying on a forest floor. This image was chosen because deer are a common introduced mammal found in forested areas in New Zealand. They are considered to be a pest species by some New Zealanders, because they compete with native species for food, and therefore a risk, while others might view them as a resource. They also can be a reservoir for bTB. As with all mammals, they are susceptible to 1080. The risk perceptions that the students might also discuss could be related to the idea that these animals can die by accidental poisoning after ingesting the chemical when feeding on foliage.

The fourth image was a stoat in a forested area beside a walkway. It was chosen because in New Zealand many of the forested areas are accessible for recreational use and walkways are frequently provided to protect the forest floor from foot traffic damage. The image may therefore have been familiar to the students. Stoats are one of several introduced pest-predator species found in New Zealand forests. As stoats are carnivores, they eat birds, their eggs and chicks and potentially risk the biodiversity of forests. Stoats can also die from secondary poisoning after eating prey, such as mice and rats, if that had been previously poisoned by 1080. The researcher chose this image of the stoat to investigate if the students might discuss the risks they perceived

around these issues. The final image was a poster advertising a warning of 1080 use in an area of forest within New Zealand. This image was chosen because 1080 is a commonly used pesticide used in New Zealand forests to control introduced mammalian pests. The sign can be frequently encountered by hunters, trappers and bush-walkers when using areas where 1080 is to be distributed. The spread of 1080 can potentially pose risks to these members of society if they do not heed the sign or do not see the information.

In order to generate data, the same two open-ended questions were placed beneath each image. The question construction provided a simple and consistent format between the five images. It was decided to keep the format uncomplicated, meaning that the language would be familiar, appropriate, accessible and unambiguous to Year 12 biology students and the researcher hoped would be easy to respond. Additionally, the researcher deliberately used words of a general nature within the questions, to ensure the students were not directed when giving their responses. The questions required students to write a sentence or more, to enable them to express their thoughts as simply or in as complex a manner as they wished (Cohen, Manion, & Morrison, 2000). It was hoped that this questionnaire format would provide a measure of respondents' opinions, attitudes, feelings and perceptions about the risk issues of using 1080 in New Zealand. The questions that formed the questionnaire are found in Appendix 1.

A small-scale pilot study was conducted by the researcher at her school with her class of Year 12 biology students. The questionnaires were administered to ascertain the types of responses generated, the suitability for use with Year 12 students and to check for potential issues prior to their delivery to the two schools. As a result of this pilot study, the questions were found to be suitable and no changes were made. No data from the pilot study were used in this research.

3.6.2 Student interviews

Merriam (1998) asserts that group or individual interviewing can be used in social science research when the researcher wishes to find out what a participant is thinking in detail. Just as there are three main methods of questionnaires, so there are three main types of interview formats (Sarantakos, 2013). The first type is the structured interview which uses structured questions. In these interviews, responses are fixed and prescribed and allow for no spontaneity by the participants or the researcher. The second type of interview format is unstructured. Here open-ended questions are used, the structure is flexible, so the order and wording can freely change. The third format is semi-structured interviews. These interviews contain elements of both the

other two where the structure depends on the research topic and the participants responses (Sarantakos, 2013).

In this research, semi-structured questions were used during the interviews because they can encourage a conversational flow and allow more normal interactions to occur between the interviewer and participant. Additionally, they give freedom to the participants to express their ideas, as well as giving the researcher the flexibility to further probe the participants' views that may emerge during the interview (Sarantakos, 2013). The semi-structured questions asked during the interviews in this project were designed in a qualitative style. These questions were designed to seek clarification of any misunderstandings found within the written responses by the students and to provide opportunities to record spontaneous answers (McNeill & Chapman, 2005; Punch, 2006). Additionally, the style of questions was adapted from Merriam (1998) to allow the researcher to probe for deeper understandings. For example, "hypothetical, devil's advocate, ideal position and interpretive questions" (p. 77) were asked during these interviews. Hypothetical questions were used to ask the participants to speculate about a particular situation, or what something might be like. As an example, '*If funds were unlimited, do you believe New Zealand could solve the pest problem?*' Devil's advocate questions were asked because the issue of risk to rescue New Zealand's biodiversity is controversial and allowed the researcher to probe the participants views in a deeper way. As an example, these types of questions could be used to ask the participant to consider an opposing view. Ideal position questions were asked to probe the participants to consider what the best case for New Zealand might be, in their opinion. Finally, interpretive questions were asked because they provide an opportunity for further clarification of a point or issue that the participant alluded to in their earlier response (Merriam,). A list of the questions asked is included in Appendix 3.

These semi-structured interviews were held during school hours at each school, to ensure the surroundings were familiar and the time convenient for the participants. The time taken for each interview was approximately 30 minutes. Despite the researcher wanting to interview particular students of interest, what happened on the day of each interview was that each teacher chose the students. This decision was based on which students were present on the day and which students the teacher decided to release from class. The venue was also chosen by each biology teacher. Only those students who had given their consent were interviewed.

3.7 Data analysis

Data analysis is a "process of making sense out of the data" (Merriam, 1998, p. 192). Huberman and Miles (2002) assert that in a qualitative study the analysis "involves shuttling among data reduction, display, and preliminary and verified conclusions" (p.396). Merriam's (1998) specific four-step data analysis process, which is largely iterative was adopted. This process was used because it seemed to the researcher to be the most appropriate method of "making meaning" (Merriam, 1998, p. 178) of the two types of data that had been collected. These data analysis steps are: *data description, category construction, data display* and *thinking about data* (Merriam, 1998) and will now be discussed.

3.7.1 Data description

The first step of the data analysis process was data description by compression and refers to grouping similar responses together to begin to build meaning (Merriam, 1998). During this step, the student responses to the open-ended questions asked in the questionnaire were read and similar responses were grouped together. At this step, just the questionnaire was used to allow the researcher to form the initial categorisations of similar student responses, to begin the analysis process. This enabled the researcher to begin the construction of similar themes.

3.7.2 Category construction

The second step of the data analysis process identified by Merriam (1998) is category construction. This step refers to the constructing of themes or categories by the researcher based on her interpretation of the data in a systematic way, by continuous comparison of similar participant responses. Merriam identified five guidelines to ensure the efficacy of this constant comparative method during data analysis. She opined that the construction of the categories should reflect the purpose of the research, be exhaustive, mutually exclusive, sensitive to what is in the data and conceptually congruent.

Initially, the researcher used the broad ideas from Myths of Nature analysis tool, first proposed by Douglas (1978) to construct the categories to reflect the research purpose. However, after the initial grouping of the categories, the researcher looked further at the data and determined that a deeper and more fine-grained analysis was possible. Therefore, this initial tool was adapted by the researcher. This adaptation combined Douglas's ideas with those proposed by Schwarz and Thompson (1990), Steg and Sievers (2000) and Thompson, Ellis and Wildavsky (1990) and is discussed in Chapter 4. This new risk analysis tool identifies four Cultural Types named *Nature Benign, Nature Tolerant, Nature Ephemeral* and *Nature Capricious.* Within this new risk

analysis tool, each Cultural Type has five characteristics called: View of nature, View of Earth's resources, People's needs, Perception of environmental risk and Risk management strategy.

Within this step of the data analysis process, the researcher continued to compare the students' responses in an iterative way. This enabled the identification of "recurring regularities" (Merriam, 1998, p.180) for each of the five images given to the students within the questionnaire. The transcribed interviews were also included in this step. This allowed the researcher to add depth of meaning to, or clarification of, the students' questionnaire responses.

Moreover, during this step, the researcher developed an indicative word list for each of the five characteristics for each Cultural Type. These lists were developed by identifying key words found within student responses, which then enabled the categorisation of each data set of students' responses for each image (Appendix 4, Appendix 5 and Appendix 6). Further iterations ensured the lists relating to each characteristic within each Cultural Type were exhaustive, so all student responses were included. These word identifier lists were then compared between each Cultural Type to ensure that each unit of data would fit into only one category and so were mutually exclusive. Where data could be placed into more than one category, the researcher returned to the participant responses to refine the common word identifiers, until they became mutually exclusive. It should be noted that the word identifiers for *Nature Capricious*, one of the four Cultural Types were identified differently during this process and will be explained in Chapter 5.

Following this process, the researcher re-read both the questionnaire responses and the transcribed student interviews to allow a deeper interpretation of the data as well as to justify each category placement. As a result, changes to the placement of some of the students' responses occurred if this re-reading caused the researcher to question and re-think the initial categorisation. At the end of this process, a common word identifier list was constructed (see Appendix 7). Words that were common to more than one image within each Cultural Type in this word identifier list were highlighted to identify recurring words or phrases, as part of this category construction phase (Merriam, 1998).

Additionally, to strengthen the analysis of the data during this category construction phase, the researcher also investigated the mechanisms the students used within their responses to communicate their individual views about risk. This additional analysis revealed that students used identifiable mechanisms to communicate their ideas. As examples, they told stories and recalled events that had happened to them or they knew about, to assist their explanations.

Therefore, these common mechanisms the students used to communicate their ideas were also used to analyse the data. These communication mechanisms are based on the ideas of Kahan (2012), were first discussed in Chapter 2 and will be further explained in Chapters 4 and 7.

3.7.3 Data display

The next step in Merriam's (1998) data analysis process was data display. This step involved the categorising of the student responses. Here, the students' responses were entered into the newly developed risk analysis tool for each Cultural Type, ensuring that the data were conceptually congruent.

3.7.4 Thinking about data

The final step in this data analysis process was that conclusions were drawn based on the data analysed. Using combined data from the questionnaires and the interviews ensured the categories identified within the risk analysis tool were valid, and the conclusions were supported.

3.8 Trustworthiness

Merriam opines that "[a]ll research is concerned with producing valid and reliable knowledge" (1998, p. 198). Sarantakos (2013) concurs with these ideas and asserts that in quantitative research validity measures its accuracy and relevance. He also argues that quantitative research reflects the quality of the instruments used, as well as the researcher's ability to provide findings that are reliable, in that they agree with the conceptual values of the research design. However, in an interpretive methodological procedure, validity and reliability are not appropriate and instead the term trustworthiness is used, and involves the strategies of credibility, transferability, dependability and confirmability (Denzin & Lincoln, 2005; Guba, 1981; Shenton, 2004). These strategies are used because in qualitative research, no single account of social reality is fully explanatory, rather multiple realities are possible (Bryman, 2004). Each of these strategies will now be discussed in turn.

3.8.1 Credibility

Credibility in qualitative research design parallels internal validity in quantitative research and refers to the believability of the findings. Internal validity is a key criterion addressed by quantitative researchers when seeking to ensure their study measures what they intended (Bryman, 2004). Merriam (1998) argues qualitative researchers need to ask the question "how congruent are the findings with reality" (p. 201) to assure credibility. The strategies of peer

scrutiny and frequent debriefing sessions were used in this project. These two strategies will now be discussed.

The researcher used the strategy of peer scrutiny to enhance this project's credibility (Shenton, 2004). Her two supervisors also coded a sample of participants' responses to authenticate the common word identifiers and the category selection process and to ensure the researcher had been sensitive in her interpretation of the data. When disagreement was encountered, each example was discussed, and agreement reached.

A further method to promote credibility is the use of frequent debriefing sessions (Shenton, 2004). These debriefing sessions were used regularly throughout this research. When such sessions were held, the researcher and her two supervisors used this space for the discussion of evolving ideas and alternative approaches that could be employed by the researcher. The sessions also enabled the supervisors to draw attention to possible flaws in the research methodology, probe for further information to clarify ideas or to assist the researcher to recognise her own biases.

3.8.2 Transferability

Transferability parallels external validity in quantitative research and refers to whether the findings apply to other contexts (Bryman, 2004). However, Lincoln (1995) asserts that findings within qualitative research are typically specific to small scale projects and particular environments, meaning that the conclusions are not generalisable to other situations. But, Merriam (1998) argues that the researcher should provide sufficient and detailed descriptions in a report to enable the reader to determine how closely the research matches their setting and then decide if transferability can occur. Furthermore, Silverman (2005) argues that providing long data extracts or "low-inference descriptions" (p. 221) promotes clarity. This argument is also supported by Shenton (2004) who asserts that providing the reader with "thick description of the phenomenon under scrutiny" (p.69) assists the reader to better understand the analysed data and assess whether the examples given are accurate and clear.

Chapter 3 provides information to enable the reader to decide if transferability can occur. Within this chapter, the setting within which the research was framed, as well as a description of the participants and the tools used to generate data is discussed. Additionally, the researcher believes that the findings chapters in this project provide the reader with examples of students' responses. These were copied verbatim, categorised into one of the Cultural Types or one of the

communication mechanisms, and then discussed, so allowing sufficient and detailed examples for the reader to decide if transferability could occur.

3.8.3 Dependability

Bryman (2004) asserts that dependability aligns with reliability in quantitative research and refers to whether the findings are likely to apply if the research was repeated at another time, in a similar situation He further argues that dependability establishes the merits of the research. Shenton (2004) concurs and argues that providing in-depth reporting of the research processes assures dependability in qualitative research, as it enables a comprehensive understanding of the methods used and their effectiveness for future replicability. Providing a visual "audit trail" (Shenton, 2004, p. 72) is one method of providing dependability. In this study, a data audit diagram in the form of a sequential timeline of the stages followed in this project (Table 3.1), is provided in Section 3.3. This sequential timeline provides details of the two phases of research and the events that occurred within each phase.

3.8.4 Confirmability

Confirmability equivalents objectivity in quantitative research (Bryman, 2004) and refers to whether the researcher has allowed bias to alter the research results. He argues that while complete objectivity is not possible in qualitative research, the researcher needs to have acted in good faith and not allowed personal values to sway their conduct during the research. Chapter 1 of this research states the researcher's position and beliefs. Additionally, a description of the philosophical beliefs underpinning this research are discussed in Section 3.2. Moreover, the methods of data-gathering and analysis are reported in Sections 3.6 and 3.7. This then enables the reader to rely on the data generated and assures the confirmability of research (Lincoln, 1995).

3.9 Ethical considerations

All social science research has ethical dimensions because the research is about people, involves collecting data from people and intrudes to some extent into their lives (Punch, 2006). Ethics defines "what is or is not legitimate to do" (Neuman, 2011, p. 143), as well as requiring researchers to balance the pursuit of new knowledge against protecting the rights of those being studied. Ethics approval was granted by University of Auckland Human Participant Ethics Committee (UAHPEC) on 18 November 2014, Reference Number: 012754. Ethical issues arose in this project. These issues of informed consent, confidentiality and power relationships will now be discussed in turn.

3.9.1 Informed consent

A fundamental ethical principle is that all participants have the right to be fully informed about the type of research, the consequences of this involvement and need to have the opportunity to have any questions answered prior to giving consent (Christians, 2005). Furthermore, participants need to know why they are being asked to participate, as well as knowing what the researcher will require of them and how the results will be used (McNeill & Chapman, 2005; Neuman, 2011; Sarantakos, 2013). Additionally, research participation must be voluntary, and it is not enough to simply obtain permission (Shenton, 2004). Shenton further argues that the opportunity to refuse to participate must be made plain, so ensuring data are collected from those who are prepared to participate freely and willingly.

To begin this project, each secondary school's Principal was approached by phone requesting a formal meeting. During this initial approach, the researcher discussed in general terms the reason that each school was of interest, the year level of students that would be involved, as well as possible methods of generating data. A formal meeting was arranged to allow the researcher to discuss further why each school was of interest and to identify the specific classes within each school that might be involved. During these formal meetings, each of the Principals was given a Participant Information Sheet and Consent Form (Appendix 8 and 9). These forms outlined the voluntary nature of the project and their right to refuse to participate. Additionally, the information sheet included details about the type of research that was going to be carried out and the consequences of their involvement. Similar forms were sent to the biology teachers in both schools. The Year 12 students were informed of the project through their Participant Information Sheets, which discussed the project, what their involvement might require as well as their rights to choose to participate or not.

Information sheets were also sent to the parents to allow transparent communication with the potential participants and their care-givers even though the students were over 16 years of age and could give their own consent. Opportunities were given for all participants to ask questions prior to them signing the consent forms.

3.9.2 Confidentiality

It is crucial to safeguard the identities of participants (Christians, 2005). The researcher gave a commitment to protect the identity of the school and all the participants by disguising any identifying features of the schools, and not identifying the names of any of the student participants when reporting this research project. To protect their confidentiality, each of the

student participants chose a pseudonym which was provided to the researcher on their consent forms and they used that on their questionnaires. These pseudonyms were also used to identify the students during the interviews and are included in the transcripts. Each student was also assigned an alphanumeric code that comprised a letter and two digits, known only to the researcher. The researcher used this code on their questionnaire responses, as well as their interview transcripts. The urban school students were assigned the codes U01 to U22 and the rural school students were assigned the codes R01 to R18.

3.9.3 Power relationships

Kreuger and Neuman (2006) assert that throughout the research process, a relationship involving power and trust exists and ethical issues can involve the abuse of this power and trust. They opine that the power of the researcher is legitimated by their position and authority to conduct the research and this authority must be accompanied by their responsibility to protect the interests of the participants.

The power relationship in interpretive research is identified by Karnieli-Miller, Strier and Pessach (2009) as "low-hierarchical" (p.281), who argue that because of the co-construction of knowledge, the hierarchical relationship is present but not strong. They argue that in the initial stage of the research, during recruitment of participants the power is potentially with the researcher who decides the amount and quality of information given.

To minimise this hierarchical power relationship in this project, the researcher personally approached the Principal at each school, explained her position as a teacher in another school and delivered the Participant Information Sheets. These sheets asked that the Principal give an undertaking that the teachers and student participants at their schools would not be penalised in any way whether they chose to be involved or not. Similar sheets were also delivered to the two biology teachers.

To further minimise this hierarchical power relationship, no direct approach by the researcher to the student participants was made at this early stage of the research. This strategy was used to avoid any potential feeling of coercion by the student participants from the researcher and so their Participant Information Sheets were delivered to them by their biology teacher. These sheets detailed their rights to withdraw their data completely, up to two weeks after collection, if they changed their mind about taking part. Additionally, information was included about their right to withdraw their participation, stop the audio-tape recording during the interview and/or leave the interview, should they be selected.

3.10 Summary

This chapter has outlined and justified the choice of research design for this project. It has argued that an interpretive-qualitative research design was the most suited as it allowed for the study of human behaviour in a naturalistic setting and the generation of data from the perspective of the student participants. A timeline of the phases of the project was also presented.

The use of non-probability purposive sampling to choose the schools and participants was discussed and justified. This was followed by introducing the schools and students who took part in this project. The two methods of data generation, a questionnaire and semi-structured interviews, were described and justified. The data analysis processes were described, where the researcher used a four-step framework adopted from Merriam (1998) to carry out the analysis. A discussion about the establishment of trustworthiness within this project followed. Finally, ethical issues that were encountered were discussed. The development of the analysis framework used in this research will be presented in the next chapter.

Chapter Four
THE DEVELOPMENT OF AN ANALYSIS FRAMEWORK

4.1 Introduction

This chapter discusses how two analysis tools were developed by the researcher to analyse data about students' views of risk about a biodiversity rescue strategy. Firstly, a data analysis framework was developed based on the Grid-Group Cultural Theory developed by Mary Douglas (2003b) and the Myths of Nature ideas of Schwarz and Thompson (1990), Steg and Sievers (2000) and Thompson, Ellis and Wildavsky (1990). Their ideas were used because they contained elements that the researcher believed could be useful to investigate Year 12 students' views within a school setting.

The second tool was based on the ideas of Kahan (2012) and Kahan, Jenkins-Smith and Braman (2011). They developed a series of mechanisms, which the researcher believed may be able to be used to explain how participants communicate their risk ideas to others within a social setting. The researcher believed that using these ideas to develop tools that could analyse students' views at a deeper level was necessary to provide a detailed analysis. It was anticipated that the development of these tools would enable the answering of the overarching research question:

> What are New Zealand secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy?

Additionally, the development of these tools could enable the following sub-question to be answered:

> How could these students' responses be qualitatively analysed?

This chapter begins in Section 4.2 with a discussion of the conceptual foundations of the data analysis framework used in this project. It includes an explanation of the researcher's decision to base this framework on the Grid-Group Cultural Theory, first introduced in Chapter 2. Section 4.3 describes the synthesis of the two conceptual models - the Grid-Group Cultural Theory with the Myths of Nature - employed to develop the analysis framework. Section 4.4 introduces and discusses the development of the Risk Analysis Framework, which was used in this study. Section 4.5 discusses the Cultural Cognition Communication Mechanisms developed by Kahan (2012) and Kahan et al. (2011). These mechanisms could potentially be used to identify how the student participants communicate their risk perceptions within this research and might allow a

way of explaining how these students communicate their risk ideas. Section 4.6 concludes with a summary of this chapter.

4.2 The conceptual foundations of the analysis framework developed for this project

Mary Douglas (1997) believed that culture is at the centre of explanations about human social life. She asserted that everything people do is culturally biased and argued that these biases or shared values and beliefs, and justifications for these preferences, shape inter-personal relationships within societies. Douglas (1997) asserted that:

> All knowledge and everything we talk about is collectively constructed. Language is no private invention. Words are a collective product, and so are meanings. There could not be risks, illnesses, dangers or any reality, knowledge of which is not constructed.
>
> (p. 123)

This quote is significant because in this project, analysing ***what*** students' views of risk are when responding to a social issue is central. In this quote, Douglas explains how she believed that in developing their culture, members within any society influence each other by participating in dialogues and discussing ideas. Furthermore, they build or construct these ideas together to develop a collective meaning. She asserted that in fact, all reality, including ideas about risk, are built and understood collectively by members of any society.

Douglas also postulated that human culture could be classified by investigating the patterns between the two dimensions of social relationships and cultural bias; where social relationships are the types of interactions between people when participating in these dialogues, and cultural bias are their shared values and beliefs. Mamadouh (1999) added further to this proposal. She believed that these patterns were mutually supportive, *interdependent* and reinforced each other, stating that "the cultural bias justifies the social relations which confirm the expectations raised by the cultural bias" (p. 397). For example, a citizen with a hierarchical cultural bias would uphold the importance of tradition and order and support a ranked social system with differentiated roles.

Thompson et al. (1990) supported Douglas's ideas and described this interdependent relationship between cultural bias and social relations as the "compatibility condition" (p.2) and named this interdependence a "way of life" (p.1) or cultural rationality. They asserted that individuals perceive nature in a particular way, and this in turn influences the range of behaviours in which the individual engages, as well as the type of social relationships within which the individual justifies living. Furthermore, they argued that "shared values and beliefs are thus not free to come

together in any which way; they are always closely tied to the social relations they help legitimate" (p. 2), meaning that these social relationships and individuals' cultural bias depend on each other to form their way of life.

In her book *Risk and Blame* first published in 1992 and then republished in 2003, Douglas (2003a) organised these two dimensions of social relations and cultural bias into a typology, or a categorisation of cultural types. Douglas, who firstly trained as an anthropologist, is credited with being the originator of this Grid-Group Cultural Theory as it became known, which she initially designed to investigate cultural diversity both within and between early societies (Mamadouh, 1999). The typology proposed by Douglas is displayed in Figure 4.1, and forms the basis of the analysis framework for this research.

Within the typology developed by Douglas, the grid or vertical dimension indicates increasing degrees of autonomy or rules and the group or horizontal dimension, indicates increasing degrees of incorporation. In her essay *Cultural Bias* (1978), Douglas had named the four groups within the typology as A, B, C and D (see Figure 2.2). However, by 1992 she had changed the names to 'markets, isolates, hierarchies and sects' respectively (see Figure 4.1), as the Grid-Group Cultural Theory evolved.

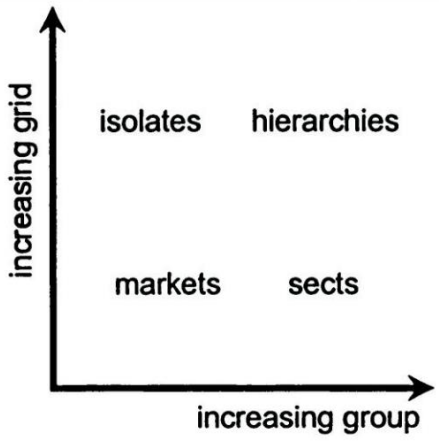

Figure 4.1. The typology using grid/group dimensions (from Douglas, 2003a, p. 178).

Furthermore, Douglas argued that the typology of these four groups was universal as the grid and group dimensions identified the fundamental social nature of human beings. Additionally, the typology explained why conflicts between members within any society are not easily solved, as "a struggle is going on, members of one culture are giving each other reasons for contesting everything that is preferred by the others" (Douglas, 1999, p. 411). This means that supporters of one culture believe their cultural beliefs or bias is correct and the other biases or cultures within society are incorrect in their beliefs. For example, the citizen with a hierarchical

rationality or way of life, supporting a ranked social system with differentiated roles, and upholding the importance of tradition and order, would likely describe another citizen who does not endorse established regulations as a deviant, or apportion blame to this person for problems arising within society.

Additionally, Thompson et al. (1990) argued that "each way of life needs each of its rivals, either to make up for its deficiencies or to exploit, or to define itself against" (p. 4). This quote illustrates that these authors believed that each way of life or cultural type did not agree with any of the others. But, in fact, each needed the others to define itself, because they are interdependent, causing constant disequilibrium. However, they posited that each way of life is not equally represented within a society at any given time and there is a "perpetual dynamic imbalance" (p. 4) between the ways of life, which changes depending on the situation or social context being discussed.

Over the past 40 years, the Grid-Group Cultural Theory has continued to evolve to become an important framework to assist in the understanding of risk (Lupton, 2013). An example is the work of Schwarz and Thompson (1990), who further developed the Grid-Group Cultural Theory ideas. A simplified version of their Grid-Group Cultural theory is displayed in Figure 4.2.

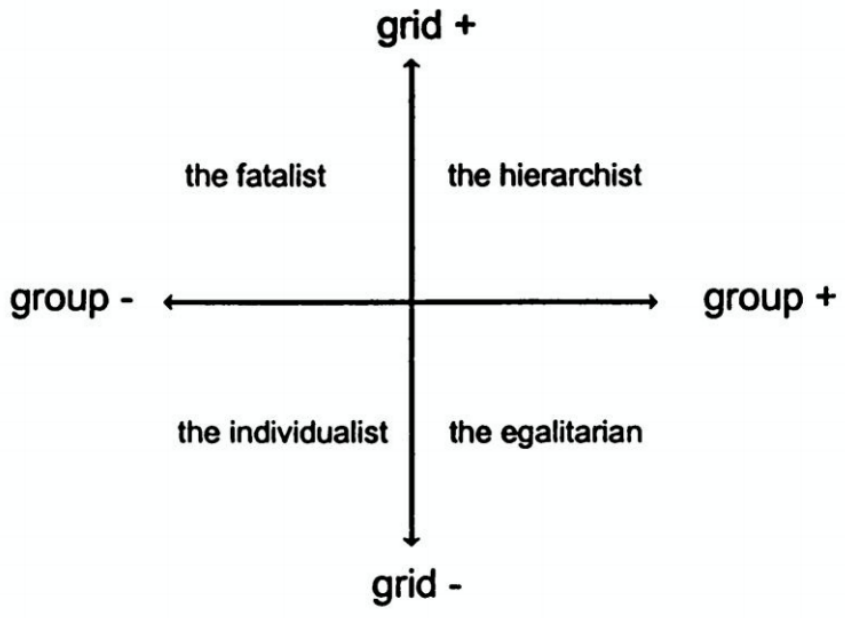

Figure 4.2. The Grid-Group Cultural Theory, displaying the four ways of life or cultural rationalities (adapted from Schwarz and Thompson, 1990, p. 7).

The changes made by Schwarz and Thompson were that they altered the grid and group lines to make four quadrants and changed some of the names used by Douglas in her book *Risk and*

Blame (2003a). For example, the markets way of life described by Douglas in her lower left quadrant has been changed by Schwarz and Thompson to become the individualist rationality, describing a way of life that is relatively free of control by others and a belief in a competitive market. The isolates way of life described by Douglas in the top left quadrant, was re-named as the fatalist rationality, describing an unwillingness to plan ahead and leaving situations to fate. The upper right quadrant name remained the same. Schwarz and Thompson described this hierarchist rationality as having strong group and grid boundaries with division of labour and a ranked social system with differentiated roles. The final quadrant that was labelled as 'sects' by Douglas was re-named as the egalitarian rationality by Schwarz and Thompson. They describe this rationality as a way of life where internal role differentiation within society is minimal, meaning everyone within this social group has equal status, is of equal importance and equality of outcomes for all is valued.

4.3 The synthesis of conceptual models employed to develop the analysis framework used in this project

As well as assisting in the evolution of the original Grid-Group Cultural Theory developed by Douglas, Schwarz and Thompson (1990) also drew on the work of Holling who investigated institutions that managed ecosystems such as fisheries and forests. Holling argued that these institutions, despite being faced with the same environmental issues, utilised one of four management strategies that became known as the "Myths of Nature" (Schwarz & Thompson, 1990, p.4). It is important to note that these four strategies or myths are not about people's differing views of nature, but rather their ideas of how to *manage* nature as a system, so are all anthropocentric in their expression.

Within these four Myths of Nature the different management strategies can be represented by a ball in a landscape, where the ball represents environmentally risky behaviour, and the landscape represents the vulnerability of nature (Steg & Sievers, 2000). These Myths of Nature are displayed in Figure 4.3.

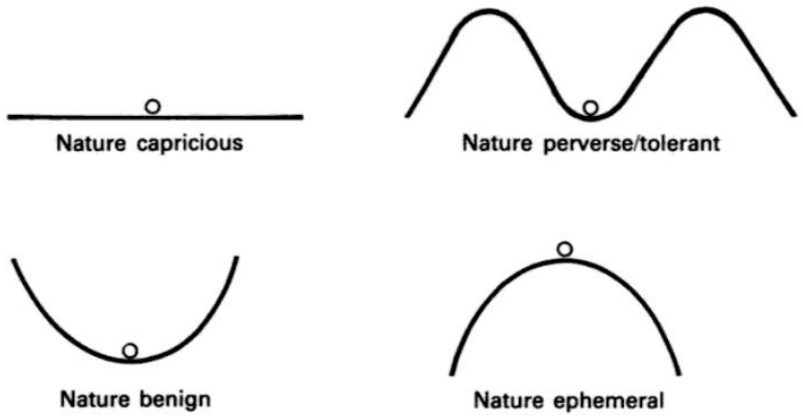

Figure 4.3. The four Myths of Nature (from Schwarz & Thompson, 1990, p. 5).

Just as Douglas (1999) had described the irreconcilable differences between the four social groups she had identified, Schwarz and Thompson (1990) assert that that the holder of each of the views represented by these Myths of Nature, believe themselves to be rational, but appeared irrational to the supporters of the other myths, so the situation was one of "plural rationalities" (p. 5).

In what seems to be one of the only studies to use the Grid-Group theory, Steg and Sievers (2000) have used this theory as an analysis framework for their study of the environmental risks associated with the use of cars in the Netherlands. However, while they are supportive of the Grid-Group Cultural Theory ideas of Douglas and Schwarz and Thompson, Steg and Sievers mainly focussed on the Myths of Nature when constructing their cultural theory analysis framework. In their framework, they listed characteristics they assert are displayed by each of the four groups and these are displayed in Figure 4.4.

Nature Capricious (Fatalist)

- View on nature: none
- View on resources: lottery
- Needs nor resources controllable
- Environmental risk perception: what you don't know can't harm you
- Management strategy: cope

Nature Perverse / Tolerant (Hierarchist)

- View on nature: unstable equilibrium
- View on resources: scarce
- Needs are not, but resources are controllable
- Environmental risk perception: acceptable risks, determined by experts
- Management strategy: regulation and control

Nature Benign (Individualist)

- View on nature: stable/global equilibrium
- View on resources: abundant

Nature Ephemeral (Egalitarian)

- View on nature: precarious balance
- View on resources: depleting

Figure 4.4. The four Myths of Nature with their individual characteristics (from Steg & Sievers, 2000, p.254).

The first Myth of Nature Schwarz and Thompson (1990) and Steg and Sievers (2000) depicted was a flat landscape, where the ball could roll uncontrollably. This myth is represented in Figure 4.5 and is named '*Nature Capricious'.*

Figure 4.5. Nature Capricious (from Schwarz & Thompson, 1990, p. 9; Steg & Sievers 2000, p.254).

Schwarz and Thompson (1990) proposed that supporters of the *Nature Capricious* myth believe that the world is a random place, a lottery that you can neither influence, learn from nor manage. These individuals believe that life's outcomes are "simply to be enjoyed or endured, but never achieved" (p. 8). Additionally, Thompson et al. (1990) contend that the individual who believes they have no ability to manage their needs (things people want) or resources (where their needs come from) and can only survive by coping, has a *fatalistic* cultural rationality. Adding to this notion, Steg and Sievers (2000) assert that *Nature Capricious* supporters view nature as an unmanageable and unpredictable system, where all events happen by chance. An example of the type of response collected during Steg and Sievers' research into car use who displayed a *Nature Capricious* Myth of Nature, said:

> Problems of car use cannot be solved, we just have to cope (p.259).

This participant's response illustrates the need to cope with an unmanageable situation and displays a *fatalistic* cultural rationality. While recognising that car use is a problem within society, they describe how they believe there is no solution. This participant believes that cars still need to be used as a form of transport but there is no way of managing the problems and therefore citizens must just muddle along and manage best as they can.

This view contrasts with the second Myth of Nature that Schwarz and Thompson (1990) and Steg and Sievers (2000) described. This second myth was illustrated as a ball within a hilly landscape. It is displayed in Figure 4.6 and is named '*Nature Perverse/Tolerant'*.

Figure 4.6. Nature perverse/ tolerant (from Schwarz & Thompson, 1990, p. 9; Steg & Sievers 2000, p.254).

Schwarz and Thompson (1990) proposed that individuals with this second viewpoint support collective regulations and social sanctions. These individuals believe there is a need to be responsible and follow advice generated by experts about environmental risks in order to ensure certainty and predictability of outcomes. Additionally, Steg and Sievers (2000) describe the supporters of a nature perverse/tolerant view as accepting of "acceptable risks" (p.255), or those that experts say are acceptable. They describe these supporters as those who believe that human needs are not controllable. Furthermore, Thompson et al. (1990) assert that for nature perverse/tolerant supporters, the only strategy available for them within society is to control the use of resources by government regulation, within a *hierarchical* framework. Thompson et al. named this strategy "*differential maintenance"* (p. 45, italics in original). They asserted that supporters of this strategy believe that this response was legitimised by viewing nature as a forgiving but vulnerable system, where resources are scarce but controllable within accountable limits. An example of the type of response in Steg and Sievers' research who was a nature perverse/tolerant supporter was:

> Car use is a societal problem (Steg & Sievers, 2000, p.259).

Within this response, the participant has described the environmental issue of car use as an issue for all members of society, and by implication, requiring collective rules and regulations where everyone needs to take responsibility. Examples of collective rules could be requiring car users to be licenced, cars certificated as safe to use and setting speed limits on roads.

Unlike these first two types of social relationships, the supporters of the third Myth of Nature that Schwarz and Thompson (1990) and Steg and Sievers (2000) proposed was that of a ball within a bowl-shaped landscape. This myth is named *'Nature Benign'* and was described by Schwarz and Thompson as one of "global equilibrium" (p. 4). It is displayed in Figure 4.7.

Figure 4.7. Nature Benign (from Schwarz & Thompson, 1990, p. 9; Steg & Sievers 2000, p.254).

Steg and Sievers (2000) describe the supporters of this myth as having *individualistic* social relationships and rejecting any externally imposed restrictions on choice. These supporters believe that technological solutions will be developed to resolve environmental risk issues. Supporters of this myth also believe in actively investigating solutions and so are risk-seeking. Steg and Sievers add that these people view nature as a robust and resilient system, where Earth's resources are abundant and controllable. Moreover, Thompson et al. (1990) posit that these supporters do not believe that there is a need to feel responsible about, or change their behaviour towards the environment. Additionally, Schwarz and Thompson (1990) describe managing institutions supporting this third myth as having a *"laissez-faire"* (p.5, italics in original) free trade attitude, where there is equal opportunity for all in a competitive, market-based system. An example of this type of response displaying a *Nature Benign* Myth of Nature was:

> No use to worry about problems, for new solutions will arise (Steg & Sievers, 2000, p.259).

Within this response the participant has revealed their lack of concern for environmental issues caused by car use, such as pollution of the air, the use of non-renewable resources to construct the car bodies, or the problems of increasing volumes of cars on the roads. Instead, this participant believes that someone, somewhere will solve these issues for them some time in the future and the problem is not their responsibility.

The fourth Myth of Nature described by Schwarz and Thompson (1990) and Steg and Sievers (2000) was portrayed as a ball balancing on a landscape of a steeply sided hill. It is displayed in Figure 4.8 and is named *Nature Ephemeral.*

Figure 4.8. Nature Ephemeral (from Schwarz & Thompson, 1990, p. 9; Steg & Sievers 2000, p.254).

Supporters of the fourth myth view nature as a precarious and unforgiving system and members have an aversion to risk (Steg & Sievers, 2000). They propose trials to mitigate risky environmental behaviours and believe such behaviours should proceed only if there is a certainty that there will be no errors. They also strive for *egalitarian* social relationships and co-operation (Schwarz & Thompson, 1990).

Steg and Sievers (2000) assert that *Nature Ephemeral* supporters' goals are to foster equality of outcomes for present and future generations. Furthermore, they posit that these supporters believe that the Earth's resources are finite and that environmental risks are hidden and irreversible. Consequently, these supporters believe that all citizens should reduce their needs from the environment. An example of the type of response displaying a Nature *Ephemeral* Myth of Nature was:

> Car use is especially disadvantageous for society (Steg & Sievers, 2000, p.259).

This response illustrates this individual's high awareness and feelings of accountability about the damage they believe cars cause to all sections of society including the environment. They describe their aversion towards using cars at all, which could include the environmental pollution they cause, the use of non-renewable resources to fuel them, the damage to roading as well as the injuries caused to people and animals by road accidents.

In a further development of the Grid-Group Cultural Theory, Schwarz and Thompson combined their Myths of Nature ideas with Douglas's ideas. They believed that by combining these two ideas, ecological science, social science and politics could be brought together and could provide a better analysis of risk than Douglas's grid/group typology alone (Schwarz & Thompson, 1990). This synthesis of ideas demonstrates their belief that social values can reinforce views about managing nature in environmentally risky situations and is displayed in Figure 4.9.

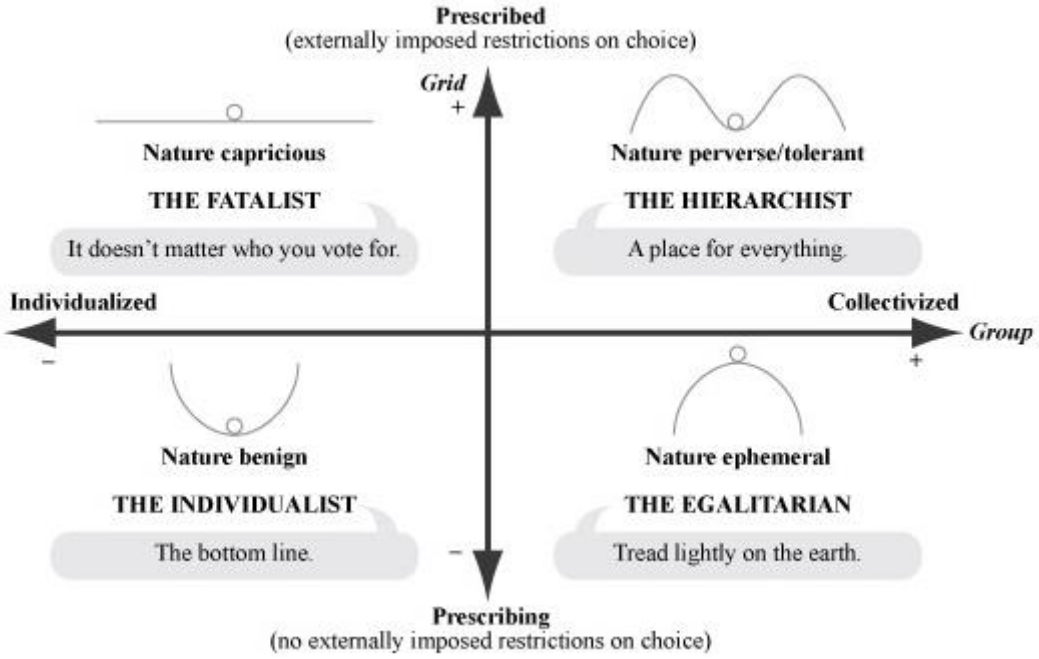

Figure 4.9. The synthesis of the Grid-Group Cultural Theory with the Myths of Nature (from Schwarz & Thompson, 1990, p. 9).

Using this synthesis of the Grid-Group Cultural Theory with the Myths of Nature, Dake and Thompson (1999) carried out research that demonstrated how social values reinforced participants' views. In their study, they asked 220 British householders to complete questionnaires about their lifestyle choices and needs. This study allowed Dake and Thompson to investigate what behavioural strategies these participant households were using to "make ends meet" (p. 417). These questionnaires were then followed by informal guided interviews with 77 of these householders. Using a star-like mapping arrangement to analyse their data, Dake and Thompson argued that their participants displayed either fatalistic, hierarchical, individualistic or egalitarian cultural rationality in their responses. They found that supporters of these four types of rationalities, or ways of life, responded in similar ways to the participants in Steg and Sievers' (2000) research when they discussed their views about their needs. Examples of responses that Dake and Thompson analysed during their research, corresponding with the Myths of Nature that Steg and Sievers identified, are displayed in Table 4.1.

Table 4.1
Examples of the findings of Dake and Thompson (1999) that correspond with the Myths of Nature of Schwarz and Thompson (1990)

Grid-group cultural theory, cultural rationality or way of life	**Respondents' views about needs (Dake & Thompson, 1999, p.421)**	**Corresponding myth of nature (Steg & Sievers, 2000)**
Fatalist	*Few long-term plans made* *Use take-away food*	Nature Capricious
Hierarchist	*Family traditions important* *Eat balanced meals*	Nature Tolerant
Individualist	*Important to look successful (in dress sense)* *Sceptical of food fads*	Nature Benign
Egalitarian	*Use biodegradable products* *Eat simple unprocessed foods*	Nature Ephemeral

Like Steg and Sievers (2000), Dake and Thompson (1999) found that their respondents' views could be classified into the four rationalities or ways of life. Even though the context being investigated was different, the participants responded in similar ways. For example, the *fatalist* response identified in Table 4.1 of "few long-term plans made" (p.421) displays similar attributes as those described by Steg and Sievers for the *Nature Capricious* supporter who believes they have no ability to manage their needs or resources and can only survive by coping. Similarly, the *hierarchist* response of "family traditions important" (p. 421) displays similar traits to the *Nature Tolerant* supporter described by Steg and Sievers, who believes in certainty and predictability of outcomes. Thirdly, the *individualist* response, shown in Table 4.1 analysed by Dake and Thompson about the importance of looking successful, is a similar value to the *Nature Benign* supporters who believe in the acquisition of material things, competition and market-based systems. Finally, the *egalitarian* participant's response declaring that they "use biodegradable products" (p. 421) is similar to the traits of *Nature Ephemeral* supporters identified by Steg and Sievers, who describe these individuals as having a high awareness of, and feelings of accountability towards environmental issues.

Despite the paucity of empirical studies using the Grid-Group Cultural Theory, the researcher proposes that both investigations carried out by Dake and Thompson (1999) and Steg and Sievers (2000) demonstrate that the Grid-Group Cultural Theory and Myths of Nature can reveal a way of analysing ideas of risk in relation to environmental issues. Therefore, the researcher believed that a similar list of characteristics as those used by Steg and Sievers (2000) in their study of environmental risks (see Figure 4.4) would provide suitable components for a framework to

analyse perceptions of risk collected from Year 12 New Zealand biology student participants. However, the researcher believed that Steg and Sievers list of characteristics needed expanding to enable a more detailed analysis of these students' views.

The analysis framework that was developed by the researcher is now presented in Figure 4.10. It is displayed in four different colours to differentiate the variety of theoretical sources used in its construction.

Cultural Type: Nature Capricious

View of Nature: Random system
View of Earth's resources: Uncontrollable chaos
People's needs: Uncontrollable
Perception of environmental risk: Inefficacious cope-ability
Management strategy adopted: Risk absorbers. Attribute luck

Fatalistic rationality:

- *outcomes are never achieved, usually endured, sometimes enjoyed*
- *unpredictable environment*
- *there is no success, just inevitability and luck*
- *blame apportioned to fate*

Hierarchist rationality:

- *ranked, differentiated system with socially imposed roles*
- *regulated environment*
- *strives to achieve order and structure*
- *blame apportioned to rule-breakers*

Cultural Type: Nature Tolerant

View of Nature: Robust but vulnerable system
View of Earth's resources: Scarce but controllable
People's needs: Uncontrollable
Perception of environmental risk: Controllability and responsibility
Management strategy adopted: Risk accepters. Use planning and regulation

grid +

the fatalist

the hierarchist

group -

group +

the individualist

the egalitarian

grid -

Cultural Type: Nature Benign

View of Nature: Robust and stable system
View of Earth's resources: Abundant and controllable
People's needs: Controllable
Perception of environmental risk: Exploitability and equal opportunity
Management strategy adopted: Risk seekers. Use trial and error

Individualistic rationality:

- *competitive, market culture*
- *boundaries are provisional and subject to negotiation*
- *measures success in material terms*
- *blame apportioned to lack of competition*

Egalitarian rationality:

- *communality and co-operation*
- *no internal role differentiation, but support equality for all*
- *critical rejection of the wider society*
- *blame is apportioned to the other rationalities*

Cultural Type: Nature Ephemeral

View of Nature: Precarious and fragile system
View of Earth's resources: Depleting and uncontrollable
People's needs: Controllable
Perception of environmental risk: Equality of outcomes for present and future generations
Management strategy adopted: Risk averse. Use trial without error

The Cultural Type characteristics, individual attributes and rationalities sourced from:

1. Schwarz and Thompson, 1990, pp. 4-10.
2. Steg and Sievers, 2000, pp. 253-255.
3. Thompson et al., 1990, pp. 26-28
4. Researcher's ideas

Figure 4.10. The Risk Analysis Framework, centrally displaying the Grid-Group Cultural Theory, supported by an explanation of the four rationalities. This central display is surrounded by the common characteristics, and individual attributes for each of the four cultural types (adapted from Schwarz & Thompson, 1990; Steg & Sievers, 2000 and Thompson et al., 1990).

4.4 The development of the Risk Analysis Framework

The researcher proposed that by combining the Grid-Group Cultural Theory and the Myths of Nature ideas of Schwarz and Thompson (1990), Steg and Sievers (2000) and Thompson et al. (1990) a more detailed framework would result that could potentially have the capacity to answer the overarching research question:

> What are New Zealand secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy?

Within this more detailed framework the researcher proposed to combine the attributes described by Steg and Sievers and the ways of life or cultural rationalities proposed by Schwarz and Thompson and Thompson et al. She believed that by combining these ideas, the resulting framework, which used the Grid-Group Cultural Theory as its basis, has the potential to differentiate individual students' views as individual Cultural Types. Additionally, it is argued that the students' responses to the individual images within the questionnaire, could be analysed using this framework.

Furthermore, the researcher hoped that this Risk Analysis Framework would have the capacity to enable a secondary research question to be answered, which was:

> How could these students' responses be qualitatively analysed?

The qualitative data for this research had been collected using open-ended questions and semi-structured interviews. This differed from the strategies used by Steg and Sievers (2000) and Dake and Thompson (1999) in their research, where they used the Grid-Group Cultural Theory and the Myths of Nature ideas as the basis of their quantitative analysis. However, the researcher anticipated that the additional elements of the individual attributes and rationalities included in the Risk Analysis Framework, would enable an analysis of qualitative data to be undertaken.

The Risk Analysis Framework is presented in Figure 4.10 and comprises three components. Firstly, the central component of the framework is the simplified Grid-Group Cultural Theory, initially developed by Douglas (2003b) and adapted by Schwarz and Thompson (1990). This central component displays the four ways of life found within any society and is displayed in red. The central positioning of this Grid-Group Cultural Theory is important as it provides the supporting structure upon which the rest of the framework is developed.

Surrounding this central component of the framework are four small boxes with stippled boundaries, which comprise the second component. These four boxes contain the individual cultural rationalities that the researcher summarised from the ideas of Schwarz and Thompson (1990), Steg and Sievers (2000) and Thompson et al. (1990). The position of each box is deliberately located within the overall framework, close to each of the four ways of life of the Grid-Group Cultural Theory to assist a reader understand the components of each rationality.

Finally, the third component is positioned around the outside of the framework and comprises four larger boxes. These four larger boxes contain the common characteristics and the individual attributes of each of the four Cultural Types that encompass the Myths of Nature. These Cultural Types in turn are underpinned by the four rationalities of the Grid-Group Cultural Theory. As an example, the box displaying the individual attributes of the Cultural Type *Nature Capricious* is positioned beside the *Fatalistic Rationality* and has a low group and high grid position on the Grid-Group framework. Additionally, above each of these four boxes is a pictorial display of each relevant Myth of Nature, developed by Schwarz and Thompson (1990). Like the information within the second component (the small individual rationality boxes), the information within the larger boxes displaying each Cultural Type was developed by the researcher synthesising the ideas of Schwarz and Thompson (1990), Steg and Sievers (2000) and Thompson et al. (1990). To assist the reader further, a portion of this typology is displayed and explained in Figure 4.11.

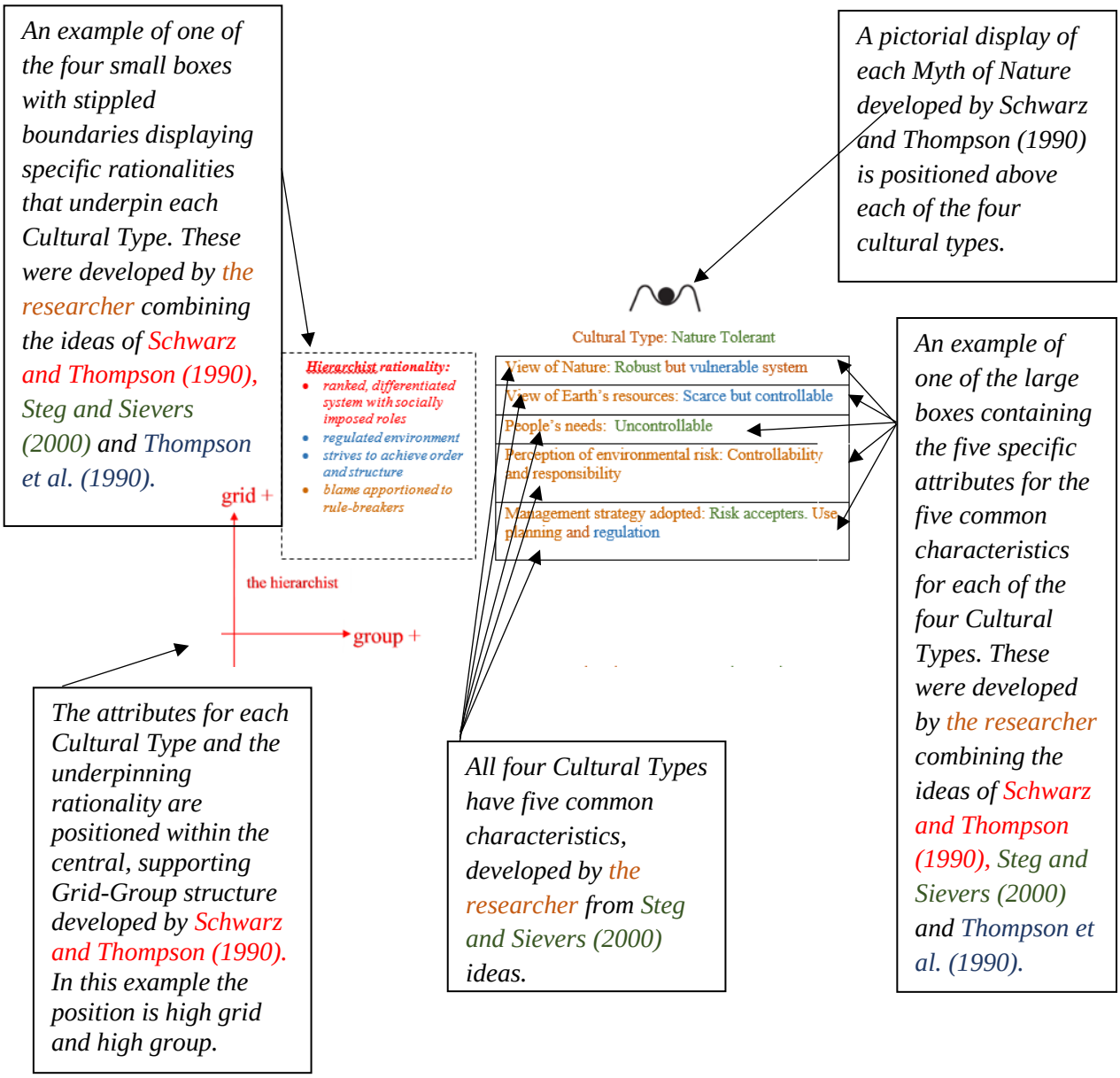

Figure 4.11. A portion of the Risk Analysis Framework, displaying one Cultural Type (in this example it is Nature Tolerant), surrounded by explanatory text boxes to clarify the components of the framework.

The individual and specific attribute information within the four large boxes, within the Risk Analysis Framework was developed by the researcher using a similar format to that used by Steg and Sievers (2000) (see Figure 4.11). Within the framework they used for their investigation, they had developed five characteristics for two of their Myths of Nature, *Nature Capricious* and *Nature Perverse/Tolerant* (see Figure 4.4). However, for the other two Myths of Nature within their framework (*Nature Benign* and *Nature Ephemeral*), they had only identified two characteristics. To ensure consistency within this research, the researcher added characteristics to the *Nature Benign* and *Nature Ephemeral* Myths of Nature. This ensured that all four of the

Myths of Nature had five common characteristics each and supported Douglas's ideas that all four Cultural Types were present in any society and must be treated equally (1999).

Additionally, these four myths were re-named Cultural Types to avoid confusion about the meaning of the words 'myth of nature.' This was because within this framework, the nature ideas have an anthropocentric sense where nature is seen as a system that can be managed and could differ from people's views of nature, which may have a variety of meanings.

Furthermore, the researcher altered the titles of the characteristics from Steg and Sievers (2000) original Myths of Nature ideas to ensure that each Cultural Type was separate, the meanings were more fully explained and there was consistency of language between them. For example, the researcher separated the combined '*needs and resources'* characteristic within Steg and Sievers' ideas into two characteristics to ensure each was distinctive and would therefore enable a more detailed analysis of the students' views within this project. As another example, Steg and Sievers' second Myth of Nature characteristic was called "View on resources" (p. 254) which the researcher modified to 'View of Earth's resources' to aid clarity of meaning and to further highlight the anthropocentric sense of each Cultural Type within the typology.

Additionally, Steg and Sievers described the *Nature Capricious* environmental risk perception attribute as "what you don't know cannot harm you" (2000, p. 254), whereas the researcher developed the phrase 'inefficacious cope-ability' to portray the concept of resignation demonstrated by those with a fatalistic rationality. Moreover, for *Nature Tolerant*, Steg and Sievers described their "view on nature" attribute as "unstable equilibrium" (p. 254), whereas the researcher has re-named this as a 'robust but vulnerable system' to describe nature as a natural system that was mostly in equilibrium but was unstable at times. This is a further example of a change in language to ensure that the attribute descriptors used within the analysis framework would be consistent between the four Cultural Types.

Furthermore, the researcher's development of the Risk Analysis Framework was aided by combining Steg and Sievers' (2000) ideas with those of Schwarz and Thompson (1990) and Thompson et al. (1990). For example, Thompson et al., had described *Nature Benign* supporters' "trial and error" (p. 27) as a risk management strategy. Using their ideas, the researcher decided to develop terms in a similar style to describe all the risk management strategies adopted for each Cultural Type for her framework. So, this *Nature Ephemeral* attribute became 'use trial without error,' as Schwarz and Thompson had described these supporters as allowing trials to proceed "if it is certain there will be no errors" (p.9). A final example of the researcher keeping the style

of attribute descriptors similar is found in Figure 4.10 for the *Nature Capricious* supporters. They were described by Steg and Sievers as having the attribute of "Why bother?" (2000, p. 256) for their risk management strategy, while Schwarz and Thompson had described these supporters as "risk absorbers" (1990, p. 10), which was consistent with the type of attribute descriptors used for the other myths and so was used within the framework.

4.5 Cultural cognition of risk ideas

Like Steg and Sievers (2000), Kahan (2012) and Kahan et al. (2011) have also conducted research about risk. They combined Douglas's (1999) Grid-Group Cultural Theory ideas and the theories of the psychometric paradigm of Paul Slovic (1987), to propose their theoretical framework, which they named the Cultural Cognition of Risk. Within their framework, Kahan and Kahan et al. have identified a variety of communication mechanisms which they argue are a "set of social and psychological processes" (Kahan, 2012, p.739) developed from the psychometric paradigm ideas pioneered by Slovic. They argue that these mechanisms are common across the four world views of *Nature Capricious, Nature Tolerant, Nature Ephemeral* and *Nature Benign,* and identify how individuals communicate their commitment to a particular cultural bias. The researcher believed these could be useful within this research because these mechanisms may allow for a way to identify an added dimension to this project. As explained earlier in this chapter, the researcher believed that the analysis of ***what*** views students have of risk when responding to a social issue is central, as is ***how*** they communicate their ideas about risk to others. It is proposed that analysis of both these questions could enable interpretation of the risk situations presented to students within this project.

The mechanisms Kahan (2012) identified, were named: narrative framing, cultural credibility, identity affirmation, biased assimilation, and cultural availability, and are displayed in Table 4.2.

Table 4.2
Cultural Cognition Communication Mechanisms and their descriptions (summarised from Kahan, 2012)

Cultural cognition communication mechanisms	**Description of each mechanism**
Narrative framing	Individuals display a tendency to assimilate information by fitting it to pre-existing narrative templates or schemes that invest the information with meaning.
Cultural credibility	The tendency of individuals to believe an expert is credible if they share similar cultural values with this individual.
Identity affirmation	When shown information that they associate with a conclusion threatening to their cultural values, individuals tend to react dismissively toward that information. However, when the information supports their values, the individuals are open-minded towards it.
Biased assimilation	The tendency for an individual's beliefs to persist because they selectively choose evidence that reinforces these beliefs and dismiss information that contravenes these beliefs.
Cultural availability	Individuals remember more details when they hear risk information that is consistent with their cultural values. However, they react dismissively toward information that threatens their cultural values.

Kahan (2012) and Kahan et al. (2011) argued that the Cultural Cognition of Risk framework could be used to empirically test the Grid-Group Cultural Theory designed by Douglas (1999). However, unlike Kahan's research where their data were collected via an online survey using quantitative methods, in this research the data were collected using qualitative methods. In this way the participants in this study were able to express their views freely, allowing a wide range of responses to be gathered. It is proposed that exploring these cultural cognition mechanisms within the students' responses, might allow identification of the communication strategies used by them within this study. This is important because the researcher argues that the cultural cognition mechanisms described by Kahan and Kahan et al. will provide an additional dimension to this research and allow a deeper analysis of participants' individual risk perceptions than just the Risk Analysis Framework alone. Additionally, the researcher believes that using both the framework and the cultural cognition mechanisms and will enable a way to more strongly explain the student participant's commitment to a particular cultural way of life.

4.6 Summary

This chapter discussed the development of two analysis tools. The conceptual foundations of the data analysis framework developed for this project was discussed. This discussion was followed by a presentation of the synthesis of conceptual models employed to develop the data

analysis framework used in this project. The Risk Analysis Framework, which was adapted from these models and will be used in this study, was then presented and described (see Figure 4.10). Finally, the Cultural Cognition Communication Mechanisms developed by Kahan (2012) and Kahan et al. (2011), which could be used to identify how participants communicate their risk perceptions could allow a way of more deeply analysing students' risk ideas were presented (see Table 4.2).

It is argued that by using both analytical frameworks, the researcher will be able to more deeply analyse the views held by the student participants in this study and the way in which they justify these. The next three chapters explore the functionality of these tools for analysis of students' questionnaire and interview responses.

Chapter Five
DATA ANALYSIS

5.1 Introduction

This chapter tests the capacity of the Risk Analysis Framework to analyse data generated from 40 Year 12 biology students' perceptions of risk when they hold differing views about a biodiversity rescue. The analysis framework was developed by combining the Grid-Group Cultural Theory originally proposed by Mary Douglas (2003b) and the Myths of Nature ideas of Schwarz and Thompson (1990), Steg and Sievers (2000) and Thompson et al. (1990). This analysis framework was described in Chapter 4.

In this chapter, the entire data set of responses is presented. The capacity of the framework to qualitatively analyse the data by individual Cultural Type is offered and is related to the following research question:

> How could these students' responses be qualitatively analysed?

Additionally, the functionality of the framework to analyse student responses to the five individual risk images (see Appendix 1) is presented. The capacity of the analysis framework to identify a range of views given by students when they respond to the same image is related to the second research question:

> What is the range of views expressed about a biodiversity rescue strategy?

Section 5.2 presents the entire data set of student responses. This presentation includes a discussion of six, in-depth examples of student responses to the questionnaire, to display the capacity of the framework to qualitatively analyse the data. Within this section a demonstration of the polythetic nature of the student responses is also provided. Section 5.3 demonstrates how the framework was used to analyse the range of students' responses to the individual questionnaire images and Section 5.4 summarises this chapter.

5.2 Using the analysis framework to illustrate the variety of Cultural Types within the data set

Figure 5.1 displays all 40 students' responses analysed in terms of the Cultural Types. The purpose of this display is to demonstrate how the framework revealed the variety of students' responses. This is because each Cultural Type has specific attributes and underpinning

rationalities which were displayed in the different student responses. These attributes and rationalities are displayed in Figure 4.10 (p. 75).

Within Table 5.1 the student codes are given in the first column and this is followed by the individual Cultural Types. Listed under each Cultural Type is the name of the image within the questionnaire (Appendix 1) to which the student responded and an analysis revealing their cultural views.

Table 5.1.

Analysis of the entire data set of student responses to the five images.

Student	The student responses to the five images demonstrating the Cultural Types			
	Nature Tolerant	*Nature Benign*	*Nature Ephemeral*	*Nature Capricious*
U01		H, 1080, P, Stoat, Deer		
U02		H, 1080, P, Stoat	Deer	
U03	Stoat, Deer	H, 1080, P		
U04	1080, P, Stoat, Deer	H		
U05	1080, P, Stoat	H, Deer		
U06	1080, P	H, Stoat, Deer		
U07	1080, P, Stoat, Deer	H		
U08	H, 1080, P, Stoat, Deer			
U09	H, P, Stoat		1080, Deer	
U10	H, P, Stoat		1080, Deer	
U11	P, Deer	H, 1080, Stoat		
U12	1080	H, P, Stoat	Deer	
U13	H, P, Deer	1080, Stoat		
U14			H, 1080, P, Stoat, Deer	
U15	H, 1080, P, Deer	Stoat		
U16	1080, P, Stoat, Deer	H		
U17		1080, P, Deer	H, Stoat	
U18			1080	H, P, Stoat, Deer
U19		H, 1080, P, Deer		Stoat
U20			H, 1080, Deer	P, Stoat
U21	P, Deer	H, 1080, Stoat		
U22			1080	H, P, Deer, Stoat
R01	H, 1080, P, Stoat, Deer			
R02		1080, P, Stoat	H, Deer	
R03	1080, Stoat, P	H, Deer		
R04	H, 1080		P, Stoat, Deer	
R05	H, Stoat	1080, P, Deer		
R06	P, Stoat	H, 1080, Deer		
R07	H, 1080, P, Stoat, Deer			
R08	1080, Stoat	H, P, Deer		
R09	H, 1080, P, Stoat, Deer			
R10	H, 1080, P, Stoat, Deer			
R11			H, 1080, P, Stoat, Deer	
R12	H, 1080, P, Stoat, Deer			
R13			H, 1080, P, Stoat, Deer	
R14	H, P, Stoat	Deer	1080	
R15		H, 1080, P, Stoat, Deer		
R16	H, 1080, P, Stoat		Deer	
R17	P, Stoat		H,1080, Deer	
R18	1080, Stoat, Deer	H, P		

Note. H = Helicopter, P = Possum, 1080 = 1080 information in a poster/sign.

The researcher has demonstrated that within Table 5.1 there are clear examples of students' responses displaying particular cultural views. These examples were recognized using the identifying words the students used within their responses. These identifying words are unique to each Cultural Type.

Douglas (1978) described the Grid-Group Cultural Theory she developed as "polythetic" (p. 15). Consequently, students might display some, but not every attribute for each Cultural Type. To illustrate this polythetic nature, the indicative words used by each of the students demonstrating these attributes have been underlined in the following examples. These indicative words are also found in Appendix 4 (*Nature Benign* Cultural Type), Appendix 5 (*Nature Ephemeral* Cultural Type), and Appendix 6 (*Nature Tolerant* Cultural Type). Within the examples, each attribute and the relevant data within a student's response are coded with the same colour to aid the reader.

To illustrate how the framework functions when analysing the student responses, examples from the individual Cultural Types are now discussed and displayed in Figures 5.2, 5.3, 5.4, 5.5. 5.6 and 5.7. Within each of the figures, the left-hand side displays the characteristics and the centre column displays the specific attributes of each Cultural Type. The right-hand column displays individual student responses that the researcher has interpreted as demonstrating each Cultural Type. In these examples, both the questionnaire and the interview responses are included, if the student was interviewed. The questionnaire response is written first followed by the appropriate section of the interview transcript. Figure 5.1 illustrates the layout of these figures.

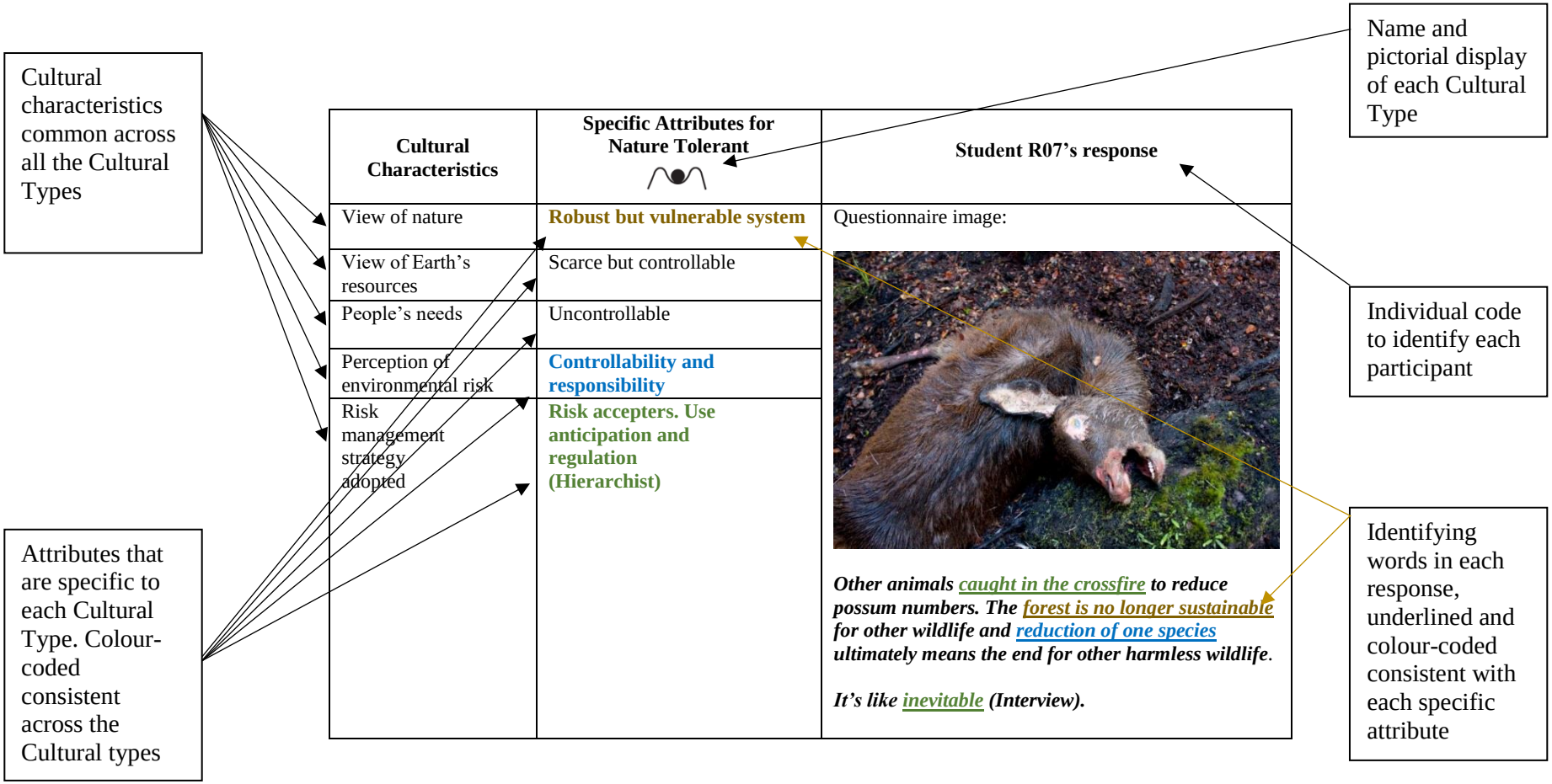

Figure 5.1. An explanation of the generic layout of Figures 5.2, 5.3, 5.4, 5.5 5.6 and 5.7 that illustrate analysed responses.

Six examples of student responses will now be discussed.

5.2.1 Analysis of *Nature Tolerant* attributes using the deer image

Cultural Characteristics	**Specific Attributes for Nature Tolerant**	**Student R07's response**
View of nature	**Robust but vulnerable system**	Questionnaire image: ***Other animals caught in the crossfire to reduce possum numbers. The forest is no longer sustainable for other wildlife and reduction of one species ultimately means the end for other harmless wildlife.*** ***It's like inevitable. (Interview)***
View of Earth's resources	Scarce but controllable	
People's needs	Uncontrollable	
Perception of environmental risk	**Controllability and responsibility**	
Risk management strategy adopted	**Risk accepters. Use anticipation and regulation (Hierarchist)**	

Figure 5.2. Individual attributes identified within the *Nature Tolerant* Cultural Type exemplified by Student R07's analysed response to the dead deer.

The first Cultural Type presented is *Nature Tolerant*. Figure 5.2 presents the analysis of Student R07's responses to the image of a dead deer which contains three of the five attributes of the *Nature Tolerant* Cultural Type. Consequently, within their questionnaire response, Student R07 appeared to express a clear hierarchist rationality.

Student R07 described in their response the need to strive for order and structure by expressing the view that the "*forest is no longer sustainable*". This description seemed to show how they believed that the introduced possums are causing unsustainable damage to forest ecosystems in New Zealand, but without these pests, the forest was robust. By using this phrase about unsustainability, Student R07 appears to have demonstrated their *View of nature* - that the forests are a vulnerable system and are unable to support the "*other harmless wildlife."* Perhaps Student R07 was referring to native animals or even deer as this type of wildlife.

In their *Perception of environmental risk*, it could be interpreted that Student R07 displayed the idea of responsibility toward the removal of possums from the forest by writing about the need

to "*reduce possum numbers.*" As there are an estimated 30 million possums in New Zealand (New Zealand Office of the Parliamentary Commissioner for the Environment, 2011), most of which live in the North Island where the density is estimated to be four possums per hectare (Hutching, 2015), they are numerous. Because of their huge numbers, it is likely that within their local, rural North Island area of New Zealand, this student has observed many possums and supports their control.

However, Student R07 acknowledged that a consequence of this method of possum removal is that "*other animals"* are being killed, expressing that it "*ultimately means the end for other harmless wildlife."* Student R07 does not view deer as a pest species, but as "*harmless*". This acknowledgement of deer deaths is evident both within the questionnaire response when they wrote, "*caught in the crossfire*" and in the interview transcript. In the transcript they referred to the dead deer in the image they believe has been affected by secondary poisoning by 1080 as, "*It's like inevitable."* This implies a *Risk management strategy* that supports regulation about pest control, a hierarchist rationality and shows that Student R07 accepted the risks around this regulation which is consistent with the attributes and rationality of a *Nature Tolerant* Cultural Type.

5.2.2 Analysis of *Nature Tolerant* attributes using the stoat image

Cultural Characteristics	**Specific Attributes for Nature Tolerant**	**Student U04's response**
View of nature	**Robust but vulnerable system**	Questionnaire image: ***Ferrets. Predators. Cause extinction. Vulnerability for birds. Writing this report made me realise that ferrets may look cute, but they definitely aren't. They live to devour our native birds.*** ***Student: Devouring, so just…*** ***Researcher: So, they look harmless, but actually are not?*** ***Student: Yeah. (Interview)***
View of Earth's resources	Scarce but controllable	
People's needs	Uncontrollable	
Perception of environmental risk	**Controllability and responsibility**	
Risk management strategy adopted	Risk accepters. Use anticipation and regulation (Hierarchist)	

Figure 5.3. Individual attributes identified within the *Nature Tolerant* Cultural Type exemplified by Student U04's analysed response to the image of the stoat.

The second example of a *Nature Tolerant* Cultural Type and a hierarchist rationality is presented in Figure 5.3. In this figure the analysis of Student U04's responses to the image of a stoat (which they have named "*ferrets*") contains two of the five possible attributes of the *Nature Tolerant* Cultural Type. Hence, this response is another example of a participant exhibiting *Nature Tolerant* views.

The first Nature Tolerant attribute expressed by Student U04 was their *View of nature*. Within their written response, Student U04 appeared to support a robust but vulnerable view, because they wrote about how stoats are causing *"vulnerability for birds"* within New Zealand forests. Stoats are known to feed on birds (DOC, 2013a). This comment by Student U04 seems to demonstrate that they viewed the forests and the birdlife they contain as a vulnerable system. It is possible that Student U04 believed that stoats pose a significant threat to birdlife in the forests because they also described that stoats "*cause extinction*." Their use of this descriptive language

revealed their strong feelings about the damage that stoats cause to the forest ecosystem. Student U04 may have focussed particularly on the birds within the ecosystem as New Zealand is often referred to as the Land of Birds (Ell, 2015).

Student U04's *Perception of environmental risk* also seemed to demonstrate a hierarchist rationality and a desire to strive for order and structure. In their written response they described stoats as "*predators*", a threat to native bird populations and by inference an animal that could destroy the natural order of the forest. This might display feelings of responsibility toward the forest's bird population that they believed was reducing. Student U04 felt strongly about this issue, because they described the stoats as an animal that could "*devour our native birds.*" Then, during the interview, Student U04 elaborated on this view again, and used the word "*devouring*". Rather than just describing stoats as an animal that eats birds, their decision to use this more evocative language demonstrated their views powerfully.

The analysis of two *Nature Benign* Cultural Type examples will now be discussed.

5.2.3 Analysis of attributes for *Nature Benign* using the image of the helicopter

Cultural Characteristics	**Specific Attributes for Nature Benign**	**Student U07's response**
View of nature	**Robust and stable system**	Questionnaire image: ***1080 poison being thrown into a forest. Because this is how 1080 is distributed and it looks like 1080 pellets.*** ***Researcher: Have you got anything else that you would like to add to that?*** ***Student: No. Oh well how once it's distributed you can't really control where it goes, so it goes everywhere.*** ***Researcher: And do you see that as a threat to New Zealand's environment?*** ***Student: No. (Interview)***
View of Earth's resources	**Abundant and controllable**	
People's needs	Controllable	
Perception of environmental risk	Exploitability and equal opportunity	
Risk management strategy adopted	Risk seeker. Use trial and error (Individualistic)	

Figure 5.4. Individual attributes identified within the *Nature Benign* Cultural Type exemplified by Student U07's analysed response to the image of the helicopter.

The first analysis of a *Nature Benign* Cultural type is of Student U07's response to the image of the helicopter flying over a forested area. This example is displayed in Figure 5.4 and included two attributes of this Cultural Type. Therefore, this response appears to be an example of a participant exhibiting *Nature Benign* views.

Student U07 seemed to display an individualistic rationality and a belief in exploitability as a cultural value. As an example, the first word identifier in this example is *"forest*." Here, Student U07 expressed their *View of nature* as a robust and stable system because they stated that 1080 was being thrown around the forest with no mention of it being a poison or how it could affect

the ecosystem. The use of the word "*thrown"* demonstrated their belief in the resilient nature of forests, which could withstand this method of spreading 1080 poison. Furthermore, they wrote, "*it looks like 1080 pellets*." It is possible that Student U07 may have had some experience with, or prior knowledge about 1080 spreading. The method displayed in the image uses a bucket containing a rotating disc which spreads the 1080 pellets by spinning them into the forest and within the image it is possible to see the blue/green pellets of 1080 against the green of the forest (Environmental Protection Authority of New Zealand, 2014).

During their interview, Student U07 said, *"you can't really control where it goes, so it goes everywhere.*" While they expressed the view that there appeared to be little control of the pellets once they left the bucket beneath the helicopter, they did not believe that 1080 was a threat to the environment because when asked if they saw this as a threat, they replied *"no."* This response implies that they believed that the forest can cope with the addition of 1080 and the ecosystem will remain stable.

The second attribute discussed by Student U07 was their *View of Earth's resources* and pest management, and the word identifier underlined is "*distributed".* They described the spreading of 1080 both in their written response and during the interview. The description used by this student implies that they believed the *Earth's resources* (pest species) to be controllable by people's actions, such as spreading 1080 into forest areas. During the interview, despite acknowledging that they believed the 1080 pellets could spread "*everywhere*", they accepted this distribution method. The language used to describe the spreading of 1080 is factual, and states just how it is carried out, saying "*this is how 1080 is distributed".* Such language suggests that Student U07 had an individualistic view of exploitability, that the forest was there to be managed in such a way because it was a robust and stable system and could withstand 1080 being distributed throughout it.

5.2.4 Analysis of attributes for *Nature Benign* using the image of the possum

Cultural Characteristics	**Specific Attributes for Nature Benign**	**Student R15's response**
View of nature	Robust and stable system	Questionnaire image: ***Pests. A target of 1080. As the 1080 is aimed to kill them.*** ***Learning about what effect that possums have…. Yeah, like the forest filled with wildlife and nature like birdlife and listening to all the birds and then that is kind of slowly dying down with all the birds being killed by pests. (Interview)***
View of Earth's resources	**Abundant and controllable**	
People's needs	Controllable	
Perception of environmental risk	**Exploitability and equal opportunity**	
Risk management strategy adopted	Risk seeker. Use trial and error (Individualistic)	

Figure 5.5. Individual attributes identified within the *Nature Benign* Cultural Type exemplified by Student R15's analysed response to the image of the possum.

The second example of a student exhibiting the Cultural Type *Nature Benign* is Student R15's responses. Figure 5.5 presents the analysis of the student's responses to the possum image. In this analysis two of the five attributes of the *Nature Tolerant* Cultural Type are displayed and consequently, this response seems to also be an example of *Nature Benign* views.

Firstly, Student R15 appeared to display a *Nature Benign* Cultural Type, and an individualistic rationality in their *View of Earth's resources* (the possum) where they believed that possums were abundant and controllable. R15 described these ideas in a non-emotional, factual manner and said "*1080 is aimed to kill them*."

The second attribute that Student R15 seemed to display was when they described the possums as *"Pests*", giving a *Nature Benign Perception of environmental risks*. During the interview Student R15 confirmed their views by repeating the use of the word *"pests.*" They stated that they while carrying out the unit of work about biodiversity rescue at their school, they had learned more about the *"effect that possums have"* and the problems they cause. Their ideas

demonstrated that Student R15 viewed these animals as an unwanted, exploitable species that was controllable by using 1080.

When interviewed, Student R15 discussed how their experiences have changed when visiting New Zealand forests. As part of their interview, they discussed how they believed that some time earlier the forests were filled with *"wildlife"* but believed that recently, the reduction in bird-song heard and numbers of birds seen in these forested areas was a direct result of the large numbers of these animals being killed by pest species. Student R15 expressed this belief by saying "*that is kind of slowly dying down"*. This view seemed to reinforce their *Perception of environmental risk,* that using 1080 to control these pests would enable the forest birds more of an opportunity to survive.

The analysis of two *Nature Ephemeral* Cultural Types will now be discussed.

5.2.5 Analysis of attributes for *Nature Ephemeral* using the image of the 1080 poster

Cultural Characteristics	**Specific Attributes for Nature Ephemeral**	**Student R11's response**
View of nature	**Precious and fragile system**	Questionnaire image: ***Dangerous. Animal cruelty. Death. Pain. Poison. Animal cruelty. Death to innocent animals. Long cruel drawn out deaths. This is a deadly poison that shouldn't be put down. Pests should be culled not forced into horrible death. More than just the pests are being killed. Dangerous.*** ***The dogs, that's why I thought it was cruel. Because, you know, if dogs are to wander and eat bait or eat carcasses that is it for them. (Interview)***
View of Earth's resources	Depleting and uncontrollable	
People's needs	Controllable	
Perception of environmental risk	**Equality of outcomes for present and future generations**	
Risk Management strategy adopted	**Risk averse. Use trial without error (Egalitarian)**	

Figure 5.6. Individual attributes identified within the *Nature Ephemeral* Cultural Type exemplified by Student R11's analysed response to the 1080 warning poster.

In Figure 5.6 the Cultural Type identified is *Nature Ephemeral* and is exemplified by Student R11's response to the image of a 1080 sign. This response implies a demonstration of an egalitarian rationality of communality as it seems to display three attributes within the *Nature Ephemeral* Cultural Type.

Firstly, when displaying their *View of nature*, Student R11 expressed their emotional account of the 1080 poster image in their description of this chemical's effects on the environment. Their use of the word "*dangerous*" implies their belief that nature is a precarious and fragile system that has the potential to become unbalanced by any change and would not recover from the introduction of "*deadly poison"* into the ecosystem. To reinforce this idea of communality and equality for all life forms, they have used the word "*dangerous*" at the beginning and the end of their response.

The second attribute Student R11 described, which was also emotional and fervent, was their perception about equality of outcomes related to *the Environmental risk* of using 1080, which they saw as "*horrible".* Although Student R11 acknowledged that New Zealand has a pest problem and wrote "*pests should be culled*" in their questionnaire response, they did not agree with the use of 1080 to control this pest problem. Rather, they appeared to believe that these pest species should be carefully removed from the forest, but not killed. Culling is the harmless removal of some animals from a herd (Gillingham, 2008) and is a common farming practice in New Zealand. It is possible that Student R11 may have witnessed culling at some stage and this experience has been used to illustrate a way of removing pest species without harming them, so they would not in their view be "*forced*" into "*pain"*-filled and "*drawn out deaths*."

Student R11 appeared to passionately believe that there should be equality of outcomes for all and that animals should be treated compassionately, deserving to live their lives unharmed. This is illustrated in their use of the word "*innocent"* when describing their ideas about the types of deaths due to the ingesting of 1080, experienced by these pest species. Student R11 seemed to believe that humans do not have the right to kill possums or other pest species, but especially that no animals should die using 1080 poison.

The third attribute Student R11 described was their view of *Risk management*. This student seemed to demonstrate their aversion to risk by repeating the terms "*cruelty*" and "*cruel*" four times within the questionnaire response and during the interview. The repetitive use of this emotional term suggested Student R11's belief that 1080 is a "*horrible*" substance and is a "*cruel"* method of pest control. Their risk aversion to 1080 was also conveyed by their belief

that the poison should not be "*put down*", demonstrating that in their view 1080 should not be used as a method of pest control at all, and displayed strong *Nature Ephemeral* views and an egalitarian rationality.

Moreover, Student R11 continued to express their concern during the interview. They commented that any dogs near the 1080 distribution area may be harmed or killed. They believed that this could be caused when dogs either ate bait directly or by secondary poisoning if they were to eat any carcasses poisoned with 1080, saying if they did "*that is it for them.*" Student R11 might have commented about this issue because they had personal knowledge or experience of the effects of 1080 poisoning on dogs, or they may have read this information while carrying out the unit of work. The Royal Forest and Bird Protection Society of New Zealand (2017) acknowledge that all mammals are sensitive to 1080 and dogs particularly so.

5.2.6 Analysis of attributes for *Nature Ephemeral* using the image of the dead deer

Cultural Characteristics	**Specific Attributes for Nature Ephemeral**	**Student R17's response**
View of nature	**Precious and fragile system**	Questionnaire image: ***Death, sad. It looks like the deer died in pain which is disgusting. Death is meant to be peaceful. Forest animals are all vulnerable to 1080. Native birds especially will get poisoned, which is an on-going argument.*** ***(Student not interviewed)***
View of Earth's resources	Depleting and uncontrollable	
People's needs	Controllable	
Perception of environmental risk	**Equality of outcomes for present and future generations**	
Risk Management strategy adopted	**Risk averse. Use trial without error (Egalitarian)**	

Figure 5.7. Individual attributes identified within the *Nature Ephemeral* Cultural Type exemplified by Student R17's analysed response to the image of the dead deer.

The second example of the Cultural Type *Nature Ephemeral* is displayed in Figure 5.7 using Student R17's response to the image of the dead deer. This student was not interviewed, but their response seems to demonstrate an egalitarian rationality of equality of outcomes for all living things and displays three attributes within the *Nature Ephemeral* Cultural Type.

Firstly, Student R17 displayed their *View of nature* of the forest being a fragile system when they expressed their emotional response to the image of the dead deer. This was because while they focussed on the deer being defenceless, they extrapolated this view onto all forest animals being at risk. They described how they believed "*Forest animals are all vulnerable to 1080*."

Then, when Student R17 displayed their *Perception of environmental risk* about the dead deer they epitomised a *Nature Ephemeral* view. They wrote "*pain*" and "*death is meant to be peaceful*" within their response. The word "*death*" was written twice, possibly to emphasise their idea that all living things should have the right to dignity in life and in death and that death should be pain-free.

The third Nature Ephemeral attribute suggested within Student R17's response in Figure 5.7 was their expression of a *Risk management strategy.* They displayed their aversion to the risk of using 1080 in forests by writing *"disgusting" and "poisoned".* Furthermore, they emotionally described the use of 1080 as "*sad.*" Describing how 1080 kills forest animals like this and what is more, that they all die "*in pain*" revealed their distaste about the risk of using this poison. Thus, Student R17's view demonstrates a *Nature Ephemeral* view, supporting a *Risk management* strategy of being risk averse.

5.2.7 Identification of the *Nature Capricious* Cultural Types

It should be noted that when analysing the entire data set, the researcher identified three of the four Cultural Types (*Nature Tolerant, Nature Ephemeral* and *Nature Benign*) when analysing these students' responses. However, when analysing for any expressions of the Cultural Type, *Nature Capricious* the researcher originally encountered problems. This was because there were four students (U18, U19, U20 and U22, see Table 5.1) who had either given very short responses, the written information was just random words, or they had left the response section within the questionnaire blank. Additionally, these four students were not chosen by their teacher to be interviewed, so no further probing of their written responses to seek clarification could occur. Consequently, these responses were initially identified as being unable to be analysed. These four students are displayed in Table 5.2.

Table 5.2.
The four students' responses which were identified as demonstrating the Nature Capricious Cultural Type. The ticks indicate *a Nature Capricious response to the images presented to the students, within the questionnaire. No responses were written by any of these four students about the image of the 1080 sign.*

Student identification code	**Responses to images analysed as the *Nature Capricious* Cultural Type**				
	Helicopter	Possum	Deer	Stoat	1080 sign
U18	✓	✓	✓	✓	
U19				✓	
U20		✓		✓	
U22	✓	✓	✓	✓	

Within these four examples of this Cultural Type, Student **U18** wrote a brief response for the image of the helicopter, which was, "*try to kill some animal*." When responding to the deer they wrote "*Not sure*" and in response to both the possum and the stoat image they wrote "*I don't know. Ugly*." A similar, brief response was given for the image of the stoat by Student **U19** who wrote "*I don't know.*" Student **U20** had only named the animal in the image, for example "*possum*" and "*stoat"* in their response. Finally, Student **U22** wrote "*When the drugs hit hard,*" in response to the images of the possum and the deer. They did not write any response at all to the image of the stoat or the helicopter instead, choosing to leave the questionnaire blank.

While originally no *Nature Capricious* characteristics were evident, on further analysis, the researcher considered that these responses could be examples of a *Nature Capricious* Cultural Type. This change in analysis occurred because of the researcher's further reading of Douglas (2003a) work where she had described this Cultural Type as having an "isolates" (p. 178) way of life and leaving situations to fate. Furthermore, she opined that "the passive non-interactive public is very important" (2003c, p. 1357). She argued that the response "Don't know, is very instructive" (p.1357) as it reveals the strength of the preference of a fatalistic outlook of the *Nature Capricious* Cultural Type. She reasoned that inclusion of the *Nature Capricious* participants in any research gave a space for those who want to respond with "don't know" (p. 1369).

Moreover, Schwarz and Thompson (1990) had identified this Cultural Type as showing a *fatalistic rationality.* They described these individuals as believing that they had no way to influence the future and had an attitude of resignation, which these four students appeared to be demonstrating. Additionally, when developing the analysis framework for use in this study, the researcher had developed the phrase 'inefficacious cope-ability' to portray this concept of

resignation, which these students' responses seemed to reveal. However, as these students provided limited responses, and so were very difficult to analyse, and none were interviewed, thus their positioning within this *Nature Capricious* Cultural Type was cautious.

5.2.8 Summary

An analysis of the entire data set of student responses revealed most students expressed a *Nature Tolerant* hierarchist rationality (see Table 5.1), with 28 students responding in this way to the images. Fourteen where rural and 14 urban students (50% each). There were 23 students who gave *Nature Benign* responses, with eight (35%) rural and 15 (65%) urban students. The least number of responses were those students displaying both a *Nature Ephemeral* egalitarian rationality (with 16 responses to the five images) or a *Nature Capricious* rationality. Slightly less rural than urban students displayed *Nature Ephemeral* views, where seven (44%) were rural and nine (56%) were urban students. The researcher found that there were four expressions of the Cultural Type *Nature Capricious.* These students had all given limited responses, and none happened to be interviewed.

The six analysed examples given (Students R07, U04, U07, R15, R11 and R17) displayed how the student responses can be interpreted using the analysis framework. Two student responses from each Cultural Type were provided as examples of each. Within each analysis, indicative words (See Appendices 4, 5 and 6) were used to identify each Cultural Type. This allowed each Cultural Type attribute to be identified using common cultural characteristics.

The next section discusses how the analysis framework can be used to identify the range of risk views found when students view the same questionnaire image.

5.3 Using the framework to reveal the variety of students' perceptions to each image

To illustrate how the framework was able to analyse a range of responses to each of the five images will now be discussed. These analyses demonstrate how the framework can be used to investigate the range of views given by individual students when they respond to the same image.

In each analysis, one characteristic from within each Cultural Type was chosen on the basis of it having the best examples of data for a particular characteristic. In Figures 5.8, 5.9, 5.10 and 5.11 there are four columns where the first column displays an individual characteristic for a Cultural Type. The next three columns display the attributes and student responses for the three separate Cultural Types.

5.3.1 Analysis of the range of students' perceptions of their *View of nature* when responding to the helicopter image

Figure 5.8 displays three examples of students who responded in a range of different ways to the same helicopter image depending on their individual Cultural Type, in terms of the characteristic *View of nature*.

The first example is from Student U09 who exhibited a *Nature Tolerant* hierarchist rationality because they appeared to believe in the value of striving to achieve order and structure. They displayed their *View of nature* as a robust but vulnerable system by saying, "*I don't think there is much harm to having a 1080 drop"* and therefore believed that the bush ecosystem could withstand the spread of 1080 without causing any damage. This was because they justified their reasoning by saying "*it protects our native lands and animals."*

Cultural Characteristic	Nature Tolerant Attributes and Student U09's Response	Nature Benign Attributes and Student U06's Response	Nature Ephemeral Attributes and Student U14's Response
View of Nature:	**Robust but vulnerable**:	**Robust and stable**:	**Precarious and fragile:**
Questionnaire image:	***I don't think there is much harm to having a 1080 drop, apart from the animals that digest it, the ones that aren't predators or pests. Because it protects our native lands and animals.*** ***Yeah and they apparently use it because it is really harmful towards mammals, but most of our natives are birds and we only have one native mammal which is the bat. (Interview)***	***I think of height and environment. Because climbing, large height and fur [sic] trees everywhere. I can say that the helicopter is dropping 1080 Because that's what I can see from the photograph and that's the method used to drop 1080.*** ***To drop like open and there was like no animals and the birds, houses. It's OK to drop 1080 over there, yeah.*** ***Researcher: So, it's OK to get rid of possums and ferrets?*** ***Student: Yeah. (Interview)***	***Does the helicopter have 1080 in it? Because 1080 can be carried by helicopter.*** ***The risk of it being everywhere, I guess. I think yeah, just the whole thing about that since it's been put in one place if it was it is still going to go around. (Interview)***

Figure 5.8. Three student responses to the helicopter image for the cultural characteristic View of nature displaying the range of responses to the same image.

This view demonstrated a *Nature Tolerant* Cultural Type as it showed that they agreed with the dropping of 1080 over forests, believing its use was tolerable and viewing the action as risk-acceptable. But Student U09 also seemed to demonstrate that they believed the ecosystem was a vulnerable system by acknowledging that secondary poisoning occurred in animals that are not pest species when they wrote about the benefit of 1080 "*apart from the animals that digest it,"* as these animals may also die. This view was further acknowledged during their interview where Student U09 discussed that they believed 1080 to be "*harmful towards mammals*". However, Student U09 believed that as New Zealand does not have any native land mammals other than bats, the use of this control method was acceptable to them. Although this student was living in an urban area where there are no native bats, they may have visited areas of New Zealand forest where bats are found and formed their opinion. Alternatively, they may have read about the lack of effect 1080 has on native bats (Royal Forest and Bird Protection Society of New Zealand, 2017) during their participation in the class activity.

The analysis of *Nature Tolerant* Cultural Types revealed that these students frequently included the words '***our***' and '***native***' when describing the forest, animals or birds within the forest. Student U09 is such an example, writing in their response "*our native lands and animals*." The use of the words "*our native"* by Student U09 implies a feeling of ownership as well as suggesting a sense of belonging to a group. The students' use of this type of language displaying *Nature Tolerant* views was often woven into their argument that the pest problem in New Zealand needed resolving by some sort of regulation, such as the Pest Control Regulations (MfE, 2017). Also, they displayed some measure of acceptance of the risks involved in this type of regulation.

Douglas (1997, 1999) argues that within any society people with hierarchical views demonstrate a strong group and a strong grid culture. The sense of belonging to a group, demonstrated by Student U09, reinforces Douglas's Grid/Group Cultural Theory ideas about people exhibiting hierarchical characteristics. Moreover, Douglas asserts that people with *Nature Tolerant* values display bureaucratic goals and take long term views of risk. Consequently, these people would affiliate strongly with belonging to a group and following rules around issues that they believe in strongly. This rule-following aspect is illustrated by Student U09 when they described the risk of using 1080 as not "*much harm*". This description demonstrated their acceptance of the rules and risks associated with the use of 1080 to control pest species. Therefore, Student U09's responses illustrate a *Nature Tolerant* Cultural Type.

The second example within Figure 5.8 is Student U06's response which displayed a *Nature Benign* individualistic rationality and seemed to express a *View of nature* as a robust and stable system. They stated that the1080 pellets were being dropped in an area which had "*fur [sic] trees everywhere"* and did not describe the action as an environmental risk. They appeared to consider nature to be a stable system by describing the type of environment where 1080 is spread, saying they only thought of "*height and environment",* using factual, not emotional language when they discussed their ideas.

During their interview, Student U06 stated how they believed that it was acceptable to use 1080 in these large *"like open"* areas, believing that these areas were not inhabited by humans or animals. Student U06 viewed these areas as worth protecting and this could be interpreted as showing a belief that the ecosystem was a robust and stable system. When asked if they believed that using 1080 in such areas was reasonable, they replied *"Yeah."* This view links to their *Nature Benign* Cultural Type of a stable environment since using 1080 to control pests and assist native populations to recover, was acceptable to them.

The final example is Student U14's questionnaire response that seemed to demonstrate a *Nature Ephemeral* egalitarian rationality with a *View of nature* as a fragile system. Student U14 expressed concern that the helicopter may be carrying 1080. This question was followed by a reason for their concern, both of which might demonstrate a *View of nature* as a precarious and fragile system. Moreover, during the interview when asked to clarify their written response, Student U14 expressed that they were concerned about 1080 spreading throughout the forest and into other areas, saying "*I think yeah, just the whole thing about that".* They also explained that they were concerned about its spread because they believed that there was "*the risk of it being everywhere*". In this response Student U14 could have been referring to the indiscriminate spread of the 1080 pellets that could affect other areas of the forest, such as streams or waterways, because they also commented, "*that since it's been put in one place, if it was it is still going to go around."* Alternatively, Student U14 may have been referring to the idea that when 1080 is distributed, warnings are given to the people living close to the area. These warnings are given so these people are aware of the poison and can take precautions, such as removing stock or keeping dogs away from the area, to reduce the risk of secondary poisoning (DOC, 2013a). This additional explanation given during the interview enabled the researcher to place their response into the *Nature Ephemeral* Cultural Type as it displayed concern about the risks posed by 1080 being spread throughout the forest and the fragility of nature.

These three examples display how students' responses can vary depending on a person's individual Cultural Type and underlying rationality. They also illustrate how students can respond with a range of views to the same image of the helicopter aerially spreading 1080 within New Zealand forest landscapes.

5.3.2 Analysis of the range of students' perceptions of the characteristic of *Views of Earth's resources* when responding to the stoat image

Figure 5.9 contains three different examples of student responses to the stoat image when they expressed their views related to the cultural characteristic *View of Earth's resources.*

The first example is from Student U05 who seemed to exhibit a *Nature Tolerant* view and a belief that *Earth's resources* are scarce, but controllable when they wrote in their questionnaire response that ferrets/stoats are "*aimed to be killed using 1080."*

Student U05's view was that New Zealand bird populations, a natural resource, are threatened by these "*predator*" species and so are becoming scarce. Additionally, describing the bird population as "*native"* potentially demonstrated their sense of belonging and a *Nature Tolerant* hierarchist rationality with the belief that the environment needs to be managed by using regulation and structure.

Cultural Characteristic	**Nature Tolerant Attributes and Student U05's Response**	**Nature Benign Attributes and Student R02's Response**	**Nature Ephemeral Attributes and Student U17's Response**
View of Earth's resources: Questionnaire image: 	**Scarce but controllable:** ***Ferret. Another predator to NZ native birds. Aimed to be killed using 1080.*** ***If it is like, we are only using it if it's useful for us. So, if it is showing good results that's why we are using it, so I think it's good. (Interview)***	**Abundant and controllable:** ***Pest on ground- easy to get 1080/poisoned. 1080 is scattered across forest land to target these pests.*** ***Yeah. (Interview)***	**Depleting and uncontrollable:** ***They kill rabbits and rats don't they. Cause it's cute. Don't kill it!*** *(Student not interviewed)*

Figure 5.9. Three student responses to the stoat image for the cultural characteristic View of Earth's resources displaying the range of responses to the same image.

During the interview Student U05 also justified the use of 1080 by describing how this substance is used because it "*is showing good results, that's why we are using it".* This phrase demonstrated that Student U05 believed that 1080 is acceptable. Moreover, their acceptance that predator or pest species such as ferrets/stoats need to be controlled was stated during their interview when they said, "*so I think it's good."* This implies that they believed that by controlling the pest species, the "*native birds"* will survive in New Zealand.

Douglas (1999) argued that people with individualistic values describe their risk views using procedural terms and meanings and Student R02's response revealed such use because the information that they wrote was relayed factually and not emotionally. For example, they exhibited support for the elimination of stoats in New Zealand in both their written response and during the interview. In their written response Student R02 used the words "*1080 is scattered across forest land*" to describe a way of removing these abundant but controllable pest species. This non-emotional, factual response to eliminate these pests by Student R02 may have resulted from the fact that stoats are a very common introduced pest found throughout New Zealand (DOC, 2013a). It could be inferred that Student R02 believed that stoats needed to be removed from forests in New Zealand during their interview as when they were asked about their questionnaire response, they only added "*Yeah.*"

The final example of a student's response to the stoat image is Student U17's who seemed to display a *Nature Ephemeral* Cultural Type and an egalitarian rationality, with a strong respect for all life, by exclaiming "*Don't kill it!"* While they acknowledged that stoats eat other species, Student U17 only listed other New Zealand pest species as their prey (rabbits and rats) and did not include any of the native bird species that stoats are also known to eat. Their justification for why they believed stoats should not be killed was because they look "*cute*." Nature Ephemeral supporters exhibit a *Management strategy* of nature that is risk averse and believe in the use of trial without the possibility of error. They view all life as precious and might anthropomorphise images of animals. Describing an animal as "*cute*" is an example of this attribute and also of how students with a similar Cultural Type used common words to explain their views.

These responses given by Students U05, R02 and U17 are all indicative of their individual Cultural Types. They display how students responded with a range of views to the same stoat image.

5.3.3 Analysis of the range of students' perceptions of the characteristic of *Environmental risk* when they viewed the possum image

Figure 5.12 displays three examples of student responses when expressing their view about the cultural characteristic *Perception of environmental risk* as they viewed the possum image. The first example is from Student U09 who seems to have exhibited a *Nature Tolerant* hierarchist rationality by writing in their questionnaire, "*They are harm [sic] to our natives*." This response appears to display a sense of belonging by using the words "*our natives*" as well as a view of responsibility towards the environment as they explained why they believed it was acceptable to remove possums from the New Zealand forest. Student U09 believed that possums were "*pests",* although they did not mention the word possum. Also, they rationalised the use of 1080 as a suitable method to control the spread of possums and so protect the native species against these pests by writing, "*Reason for using1080."* It is possible that Student U09 had additional knowledge about the use of 1080 to come to this conclusion. For example, New Zealand has many endemic species and is the largest user of 1080 in the world (Royal Forest and Bird Protection Society of New Zealand, 2017). During their interview, Student U09 re-read their questionnaire response and chose not to change or elaborate on it, saying "*Yeah",* reiterating their earlier response.

The second example within Figure 5.10 is Student R08's, who appears to have displayed a *Nature Benign* Cultural Type with an individualistic rationality but was not interviewed. However, their written response seemed to demonstrate an individualistic market-driven view, because they believed that possums were an exploitable resource and that it was acceptable to "*shoot possums.*"

Also, Student R08 wrote about how they had experience of their *"sisters[sic]husband"* collecting "*the possum fur to sell afterwards",* which could be a further expression of a market-driven *Nature Benign* view with a *Perception of environmental risk* that supports the view of equal opportunity for all users of the forest. Their explanation about using the possum fur in this way was possibly because they were aware of the additional income to be made through such sales where the possum fibre is often mixed with merino wool to make articles of clothing (Hutching, 2015). Student R08 also described an encounter of "*Going possum shooting at my sisters [sic] place",* using their personal experience of visiting a farm, and described "*when we go there*" in their response. In New Zealand, possum hunting by shooting or trapping is a common rural recreational activity in which anyone can participate. Shooting is an effective method of control in small areas, is a popular sport on private land and is called spot-lighting.

However, shooting is labour intensive, not effective over large areas and a permit is needed to shoot in public spaces (DOC, 2013a).

The final example within Figure 5.10 is Student U14's view about the use of 1080 to control pest species and it seems to demonstrate that they have a *Nature Ephemeral* view towards *Environmental risk* that is risk averse. Student U14's questionnaire response was short, but they appeared to have felt concern for the animal's wellbeing in the image by writing the question, "*Is it around 1080?"* Moreover, they expressed an anthropomorphic view by naming the possum "*he*" and had described it in its habitat, saying, "*he looks like he may be in a forest."*

Cultural Characteristic	**Nature Tolerant Attributes and Student U09's Response**	**Nature Benign Attributes and Student R08's Response**	**Nature Ephemeral Attributes and Student U14's Response**
Perception of Environmental Risk: Questionnaire image: 	**Controllability and responsibility**: ***They are harm [sic]to our natives. Because they are pests. Reason for using 1080.*** ***Yeah. (Interview)***	**Exploitability and equal opportunity:** ***Going possum shooting at my sisters [sic]place. My sisters[sic]husband is a shepherd on a farm and when we go there we can shoot possums. And he collects the possum fur to sell afterwards.*** *(Student not interviewed)*	**Equality of outcomes for present and future generations:** ***Is it around 1080? Because he looks like he may be in a forest.*** ***Yeah, it doesn't deserve it. (Interview)***

Figure 5.10. Three student responses to the possum image for the cultural characteristic Perception of environmental risk displaying the range of responses to the same image.

Douglas (1997, 1999) argues that within any society people with egalitarian views demonstrate a weak grid, strong group culture and were essentially the radical conscience of a community. Consequently, these people would express a strong sense of belonging and a weak sense of following regulations about issues that they believed in strongly. Student U14's explanation of the possum image appears to illustrate this characteristic. By expressing an anthropomorphic view, they have given the possum the same status as other life-forms and did not view the possum as a pest to be eliminated. Additionally, they are questioning the distribution of 1080 within the area of forest in which the possum is displayed, of which someone with a hierarchical *Nature Tolerant* rationality would accept.

Furthermore, during the interview, once a request to expand this short statement was sought, Student U14's *Nature Ephemeral* views became clearer. They expressed their belief that all animals deserve to live without the danger of 1080 poison and not be killed by people's deliberate actions saying, *"Yeah, it doesn't deserve it."* This expression seems to demonstrate a *Perception of environmental risk* that supports a *Nature Ephemeral* view and an equality of outcomes for all. This view might have resulted from the student's knowledge of the way 1080 causes death in mammals, which is by respiratory failure. This method can result in the animal experiencing rapid, laboured breathing, muscle spasms and take several hours for death to occur (Safe for Animals, n.d.).

These three examples have displayed how individual students responded with a range of different views to the same image of the possum sitting on a branch of a tree in a New Zealand forest. Furthermore, the variety between their responses illustrated their Cultural Type and corresponding rationality.

5.3.4 Analysis of the range of students' perceptions of the characteristic of *Risk management* when they responded to the dead deer image

Figure 5.11 contains three examples of student responses when they viewed the image of the dead deer. All three students expressed views related to the cultural characteristic *Risk management strategy* that they thought was acceptable to them, both in their written responses and in their interview.

The first example is from Student U11 who seems to demonstrate a *Nature Tolerant* view and a hierarchist rationality when displaying the attribute of planning and regulation towards managing risks. Student U11 wrote how the deer was an "*Animal that was not meant to be controlled has been killed."* In this way they established that although the possum was the animal that was

"*meant to be controlled*", using 1080, they accepted the risk of its use as a method to control pest species. They also appeared to believe that one of the consequences can be secondary poisoning of other animals, such as deer, that were not the target of the poison. They seemed to justify this death as "*Collateral damage*" demonstrating a rationality that strives to achieve order and seeks a regulated *Environmental risk* strategy, characteristic of a *Nature Tolerant* Cultural Type.

This idea was further reinforced during the interview when they described how they could accept the death of the deer. During the interview Student U11 said, *"it wasn't the intention of the animal to be killed, but it happened."* This view could be a demonstration that Student U11 believed that the spread of the 1080 poison was a planned and not a random event which supports a *Nature Tolerant* person's view of being a risk accepter.

The second example is Student R06's response who appeared to display a *Nature Benign* view and individualistic attributes. In their questionnaire statement they demonstrated that they believed that the deer may have died from a range of causes when they wrote, *"unknown cause of death."* They believed that there was *"little evidence to prove cause of death"* but did not mention any causes at this stage. Student R06 used factual language rather than emotional language to record these views, which are also characteristics of people with a *Nature Benign* view. They also wrote *"The deer has decayed from the picture"* rather than expressing any emotion about the way the deer died. It is likely that Student R06 supported the *Nature Benign* attribute of believing that when you trial something there can be errors and 1080 may or may not be the cause of death. This is an expression of an individualistic rationality and a belief that boundaries are subject to negotiation. In other words, Student R06 was not convinced that 1080 was to blame. During the interview, Student R06 described again how they believed the deer in the image was simply decaying. They justified the reason it looked as it did by saying it had "*just been sitting there for a while*" and that the cause of death "*could have been 1080*" but they still believed that the actual cause of death of the deer was unknown.

Cultural Characteristic	**Nature Tolerant Attributes and Student U11's Response**	**Nature Benign Attributes and Student R06's Response**	**Nature Ephemeral Attributes and Student R11's Response**
Risk Management Strategy: Questionnaire image: 	**Risk accepter. Use planning and regulation. (*Hierarchist*)** ***Collateral damage*. Animal that was not meant to be controlled has been killed.** ***Oh, it is just I guess it wasn't the intention of the animal to be killed, but it happened. Yeah. (Interview)***	**Risk seeker. Use trial and error. *(Individualistic)*** ***Dead deer, unknown cause of death. The deer has decayed from the picture there is little evidence to prove cause of death.*** ***No real clear way, so it could have died naturally and that's just been sitting there for a while. It could have been 1080, but you can't tell. Me and my Dad hunt them, and we had venison for dinner last night. (Interview)***	**Risk averse. Use trial without error. *(Egalitarian)*** ***Animal cruelty. Death. Horrific. Obviously killed by poison as there are no wounds. Because this is gruesome and horrible. I am very against animal cruelty. Wrong. Animal cruelty. 1080 poisons innocent animals.*** ***I don't like the way they die, it's wrong. It is very effective, but it is cruel. (Interview)***

Figure 5.11. Three student responses to the deer image for the cultural characteristic Risk management strategy displaying the range of responses to the same image.

Furthermore, they described how they went deer hunting with their father and ate venison, which demonstrates a risk-seeking view. This is because deer hunting can be risky and involves humans, often wearing camouflage clothing, stalking deer using guns or a bow and arrows in forested areas with limited visibility. Deer hunting, like possum shooting, is a popular recreational sport and is also used by some families in New Zealand to supplement their food sources (Walrond, 2008). Student R06's description used similar language as other students with *Nature Benign* viewpoints, such as discussing hunting, shooting and eating venison. These students were willing to use different strategies, such as 1080 poison or hunting, to manage pests and capture sport animals. Such responses display a trial and error, individualistic rationality where negotiation of rules and boundaries is acceptable.

The final example within Figure 5.11 is from Student R11 who seemed to display a *Nature Ephemeral* view of *Risk management*. Student R11 believed that 1080 killed the deer in the image. They supposed it was not attacked by another animal, trapped or shot and in their questionnaire response they wrote, "*Obviously killed by poison as there are no wounds.*" Student R11 appeared to be against the use of 1080 poison because they called its use "*wrong.*" In their response they have written only the word "*Death",* possibly to give more impact to their statement than had it been written in a sentence, which demonstrated their *Nature Ephemeral* egalitarian rationality and the characteristic of being risk averse because they were against the killing of animals.

During their interview, Student R11 acknowledged that there was a pest problem in New Zealand forests and they described 1080 as a "*very effective*" method of controlling these pest species. However, they reiterated their beliefs that 1080 was a "*cruel*" method of pest control. They maintained their view that the way 1080 caused deaths was unacceptable and called the method "*wrong*."

In their questionnaire response, Student R11 described the deer as an "*innocent*" animal which they rationalised had been killed because of human cruelty because while describing the image they have used the emotional terms, "*gruesome"*, "*horrible*" and "*horrific"* to emphasise their distaste for any forms of mistreatment towards animals by humans. Student R11 strongly expressed their aversion to any forms of cruelty and they viewed the dead deer image as an example of this. By repeating the word "*cruelty*" three times, Student R11 emphatically demonstrated their risk-averse view.

These three examples display how students respond with a range of views to the same image of the dead deer lying in a New Zealand forest. The figure shows how these responses vary, depending on their individual Cultural Type and corresponding rationality.

5.3.5 Analysis of the range of students' perceptions of the characteristic of *People's needs* when responding to the 1080 poster image

The cultural characteristic *People's needs* is an important Cultural Type characteristic that identifies the items that people need from their environment to survive. However, within the entire data set, students expressed this characteristic in a significantly different way. Firstly, this characteristic was only evident when students viewed the 1080 poster image. Secondly, the characteristic only appeared to be evident in students' responses which displayed the Cultural Type *Nature Benign* (Appendix 4). In these ways the cultural characteristic *People's needs* was different from all the other cultural characteristics.

Consequently, as no responses that were analysed as *People's needs* attributes using the other Cultural Types were found, the framework displayed in Figure 5.12 for this characteristic has a modified format. Within this figure, while there are three different students' responses and all of the student responses for this characteristic were identified as being within the *Nature Benign* Cultural Type.

Cultural Characteristic	**Only the Nature Benign Attribute with three Student Responses**		
People's needs: Questionnaire image of poster: 	Controllable: ***It's a warning sign. Not much else. It's a sign. It informs people.*** ***It's not there to scare people is it? It is not trying to scare people away from going there. It is not saying keep away from it. It is just warning people that the 1080 has been used in the area and they are entering at their own risk basically and they've been informed of all the risks. So, if they decided to take them to court they've been told they've had ample opportunity to be informed.*** ***(Interview)*** *Student R06*	Controllable: ***Listen to it duh. Because it's a warning. There are causes[sic] to alert people of the poison present. It's a sign warning people of.*** ***It's just informative I reckon. Like they do put things out there to alert people that 1080 has been there and it is like they do take precautions to say, hey be careful and yeah.*** ***(Interview)*** *Student R05*	Controllable: ***It is a warning about 1080. It is written information.*** ***Pretty much the same view.*** ***(Interview)*** *Student U11*

Figure 5.12. Three student responses to the 1080 poster image for the cultural characteristic People's needs displaying the range of responses to the same image. All of these responses are within the Nature Benign Cultural Type.

The first example within Figure 5.12 of a response that could be interpreted as displaying a *People's needs* characteristic that is controllable, and a *Nature Benign* individualistic rationality is from Student R06. They appeared to demonstrate this view by writing that the image of the 1080 poster was simply a "*warning sign*" that "*informs people."* This response implied a belief that the words within the sign delivered a simple, straight-forward message that needed to be observed by those people working, tramping or hunting within the area of 1080 distribution. It displayed a sense of controllability of people's behaviour and enabled an individualistic rationalistic view to be identified. As with previous *Nature Benign* responses, Student R06's view was stated in a factual, rather than an emotional manner.

During the interview, this student further elaborated on their written response and described how the sign was not erected to "*scare people".* Student R06 added that the sign did not say "*keep away*" from the area where 1080 is distributed but, if people used the area, they did so "*at their own risk".* Consequently, Student R06 believed that people would not be able to hold anyone else accountable or take them "*to court*" should there be any issues, because people should be responsible for themselves.

The second example within Figure 5.12 of this characteristic is from Student R05. As with Student R06, this student also expressed their views factually. They seemed to believe that the information on the sign was self-evident and gave a clear message through the sign about the necessity of controlling people's actions. They described how they believed that the "*sign*" was erected to inform citizens of the presence of 1080 poison, saying "*Listen to it duh",* meaning they believed that people should read and follow the instructions. Within their written response, Student R05 justified this view by remarking that, *"There are causes [sic] to alert people of the poison present."* This justification appeared to demonstrate their belief that people's actions and needs are controllable and that by using signs such as the one displayed in the 1080 poster image, citizens can remain informed and safe. Their view that people need to be informed is a key aspect of this rationality and this concept was reiterated during their interview, where the ideas of the sign being "*informative*" and precautionary were described by Student R05 saying it was there "*to alert people"* and that citizens should *"hey be careful".*

The final example is Student U11. As with the previous two *Nature Benign* examples, Student U11 wrote a factual description about the 1080 poster image. This response could be interpreted as a third example of a student who held the view that *People's needs* are controllable. They described the sign as having "*written information"* which should be followed by anyone using the area. As with the previous two examples, this student viewed the sign as giving details about

the poison and the risks involved, which is characteristic of a *Nature Benign* individualistic rationality. During their interview, Student U11 described how their view of this image had not changed, saying that they had "*Pretty much the same view*" and they still believed it contained information about the warning of the distribution of 1080 within a specific area.

These three examples are representative of the whole data set when students expressed a *People's needs* attribute, as only the 1080 poster image was responded to in this way. Moreover, only students with a *Nature Benign* Cultural Type responded to the poster image of 1080 information in a New Zealand forest with the characteristic of *People's needs*. There were no *People's needs* responses found within any of the other Cultural Types for this 1080 poster image, or indeed for any of the other images within the questionnaire. However, these responses do demonstrate that individuals within one Cultural Type use similar language to express their ideas.

5.4 Summary

Within this chapter, illustrations were provided of how the framework functions when the data about Year 12 biology students' perceptions of risk about a biodiversity rescue were qualitatively analysed. Data were able to be analysed to categorise the students' responses into individual attributes within the Cultural Types.

The tool was used in two ways. Initially, a display of the entire data set of student responses was provided. This demonstrated how the range of responses could be analysed and six student examples (R07, U04, U07, R15, R11 and R17) were discussed to show how they held different *Nature Benign*, *Nature Ephemeral* or *Nature Tolerant* Cultural Types. Within these student examples the identifying words were able to be used to distinguish individual attributes within each Cultural Type. Also, the polythetic nature of student responses was demonstrated as they displayed some, but not every attribute for each of these three Cultural Types. In this analysis, the attributes of the *Nature Capricious* Cultural Type were evident with regard to four student responses. These responses were different to the other three Cultural Types in that they gave very short responses, they wrote random words, or they left the response section in the questionnaire blank. Despite these difficulties, these four *Nature Capricious* Cultural Type responses were able to be identified and discussed.

Finally, individual cultural characteristics within each image were analysed, where fifteen examples, three for each characteristic were given to show how the framework was used to investigate the range of views given by individual students.

The researcher argues that individual student responses for all five images can also be investigated using the analysis framework; these will be discussed in the following chapter.

Chapter Six
INDIVIDUAL STUDENT ANALYSIS

6.1 Introduction

In this chapter, the analysis of individual student responses across all the images is reported. These analyses explore the complexity of students' responses and how the framework allows a fine-grained study of perceptions about the environmental risk situation of using 1080 to rescue the biodiversity within New Zealand's forests. The spread of Cultural Types within all the student responses are discussed. Then five students' responses (R12, R13, R14, U01 and U12) are presented to illustrate their perceptions of risk. These five students were identified in Table 5.1 and were chosen by the researcher because they showed a range of perceptions about this issue when confronted with different contexts. Additionally, they each provided sufficient responses to allow fine-grained analysis. Consequently, no *Nature Capricious* Cultural Type responses, which were all very brief or no response was written, were included in this discussion.

Rayner (1992), who was an advocate of Douglas' (1978) grid-group ideas believed that when an individual discussed a specific context, a particular cultural bias or view was displayed. He argued that an individual's cultural bias or view could change depending on the context. Rayner named this idea the "*mobility hypothesis*" (p.107, italics in original). He also opined that Douglas was an advocate of the "*stability hypothesis*" (p. 107, italics in original) because she believed that when an individual developed a cultural bias, they retained that view and did not change. Rayner's ideas will be used to assist the analysis of these four students' responses and is related to the research question:

> How consistent are students' views of risk across a range of contexts?

In Section 6.2 the spread of the 40 student responses within each Cultural Type is presented. Section 6.3 provides the analysis of individual student responses to explore consistent attributes within one Cultural Type, and potentially demonstrate the stability hypothesis supported by Douglas. These student views also appear to demonstrate the polythetic nature of student responses, because they contain more than one attribute for each Cultural Type. In Section 6.4 the analysis of two student's views are investigated where a mixture of Cultural Types is displayed. These examples could support the mobility hypothesis proposed by Rayner. Section 6.5 summarises this chapter.

6.2 The distribution of Cultural Types within the data set

The distribution of Cultural Types displayed within the 40 student responses to the five questionnaire images (see Appendix 1) is presented in Appendix 10. A visual summary of this data is presented in Table 6.1. At the top of Table 6.1 the number of responses to the five questionnaire images of each Cultural Type are displayed. Then, the four Cultural Types are identified below each of these numbers. To assist with the understanding of this table, and to demonstrate the spread of the students' responses, all the codes of the students who displayed *Nature Tolerant* responses are shown in the lower section in magenta. Following this theme, all the codes of the students who displayed *Nature Benign* responses are shown in teal blue/green and all the codes of the students who displayed *Nature Ephemeral* responses are shown in dark green. Finally, all the codes of the students who displayed Nature Capricious responses are shown in brown. Appendix 10 also displays these student responses as well, but individually.

In Table 6.1 it can be seen that the students' responses were spread from providing all their responses to the questionnaire images within one Cultural Type (so would be recorded in the 'five' column), to responding within more than one Cultural Type. It can be seen within Table 6.1 six students' responses (U08, R01, R07, R09, R10 and R12) are consistently *Nature Tolerant*, as all their responses were within that Cultural Type and are displayed in magenta. Two students (U01 and R15) displayed only *Nature Benign* attributes in their responses (and are displayed in teal) and three students (U14, R11 and R13) displayed only *Nature Ephemeral* attributes within their responses (and are displayed in dark green). Meaning, in total, eleven students displayed responses consistently within one Cultural type. No Nature Capricious responses were recorded in the 'five responses' column.

Table 6.1 shows that having three responses to the images within one Cultural Type was common, as a total of 20 students' responses are recorded with this number. As mentioned earlier, four student responses in total, were identified within the data set displaying *Nature Capricious* attributes (displayed in brown).

Table 6.1.

The distribution of student responses across the Cultural Types to illustrate consistency of response. Colour coding is used to add clarity to the information. The Nature Tolerant responses are displayed in magenta, the Nature Benign responses are displayed in teal, the Nature Ephemeral responses are displayed in dark green and the Nature Capricious responses are displayed in brown. The total responses within each Cultural Type are displayed in brackets for each list.

Distribution of responses across each Cultural Type, to illustrate degrees of consistency																			
One response within that Cultural Type				*Two responses within that Cultural Type*				*Three responses within that Cultural Type*				*Four responses within that Cultural Type*				*Five responses within that Cultural Type*			
NT	*NB*	*NE*	*NC*	*NT*	*NB*	*NE*	*NC*	*NT*	*NB*	*NE*	*NC*	*NT*	*NB*	*NE*	*NC*	*NT*	*NB*	*NE*	*NC*
U12	**U04**	**U02**	**U19**	**U03**	**U05**	**U09**	**U20**	**U05**	**U03**	**U20**	**(0)**	**U04**	**U02**	**(0)**	**U18**	**U08**	**U01**	**U14**	**(0)**
(1)	**U07**	**U12**	**(1)**	**U06**	**U13**	**U10**	**(1)**	**U09**	**U06**	**R04**		**U07**	**U19**		**U22**	**R01**	**R15**	**R11**	
	U15	**U18**		**U11**	**R03**	**U17**		**U10**	**U11**	**R17**		**U15**	**(2)**		**(2)**	**R07**	**(2)**	**R13**	
	U16	**U22**		**U21**	**R18**	**R02**		**U13**	**U12**	**(3)**		**U16**				**R09**		**(3)**	
	R14	**R14**		**R04**	**(4)**	**(4)**		**R03**	**U17**			**R16**				**R10**			
	(5)	**R16**		**R05**				**R14**	**U21**			**(5)**				**R12**			
		(6)		**R06**				**R18**	**R02**							**(6)**			
				R08				**(7)**	**R05**										
				R17					**R06**										
				(9)					**R08**										
									(10)										

Note. NT = Nature Tolerant; NB = Nature Benign; NE = Nature Ephemeral; NC = Nature Capricious; NT = Nature Tolerant.

6.3 Analysis of individual student responses across the images

In this section, three students' responses (R12, R13 and U01) are analysed to provide examples of a fine-grained analysis of their perceptions about the environmental risk situation of using 1080. These three students were identified in Table 5.1 and were chosen because they each appeared to display consistent attributes of the Cultural Types *Nature Tolerant, Nature Ephemeral* and *Nature Benign* respectively.

Each figure that follows provides a detailed analysis of these student responses. The following explanation describes the components of these figures. In the three individual analyses, each student's responses to the five questionnaire images are presented in one table. The images are displayed in the left-hand column of each figure and are presented in the same order as in the questionnaire. The common characteristics and specific attributes of each Cultural Type are displayed across the top of each figure. Each attribute has been colour-coded consistently throughout this thesis. The student responses are listed below the attributes for each image. Figure 6.1 provides a generic arrangement of these three figures.

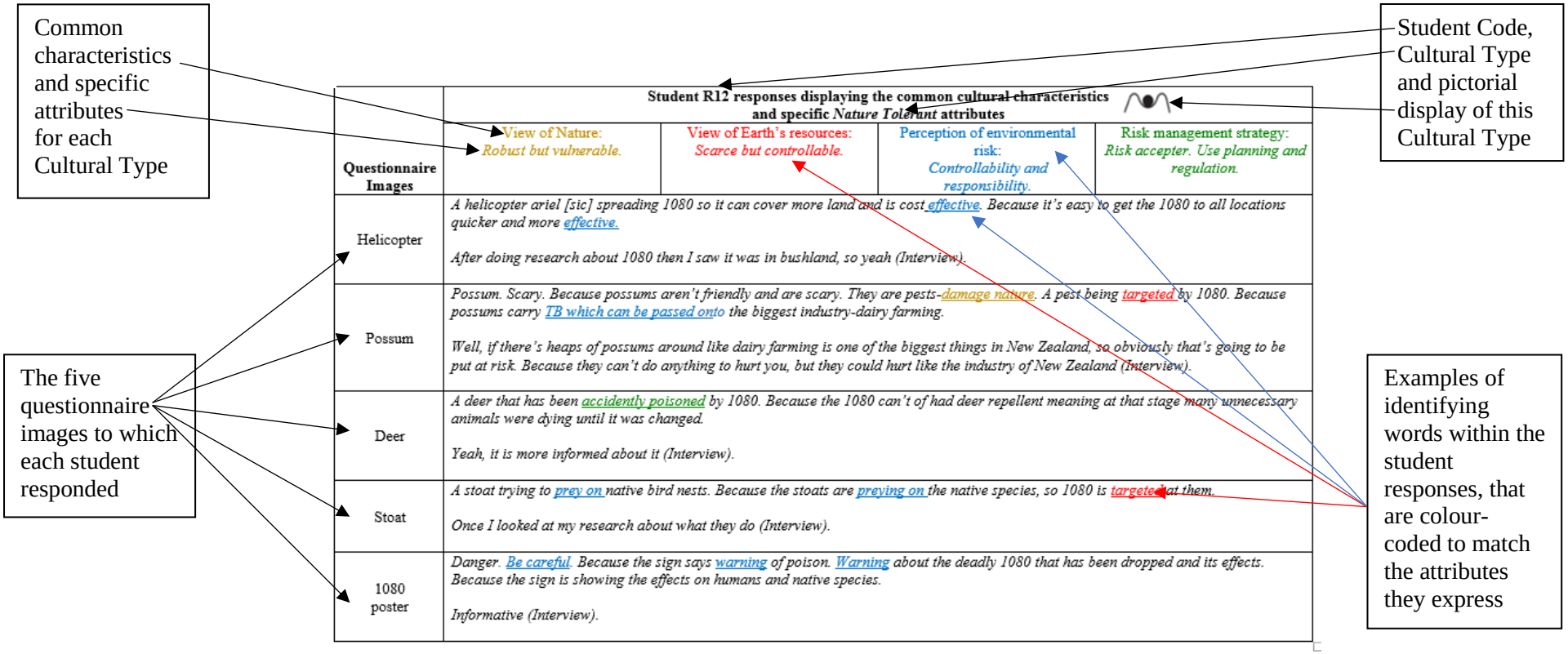

Figure 6.1. An explanation of the layout of the tables for the analysed responses of Students R12, R13 and U01.

Each student's questionnaire response is provided, displaying their individual Cultural Type and has been colour-coded to match the corresponding attribute(s) identified at the top of each figure. Highlighting each response type in this way gives an overall visual summary for each student. The word identifiers have been underlined to illustrate analysis. Interview data have also been included.

6.3.1 Individual analysis of Student R12 – *Nature Tolerant*

Figure 6.2 displays Student R12's responses which seemed to demonstrate consistent *Nature Tolerant* attributes and a hierarchist rationality of striving to achieve order and structure. Four different attributes were found within Student R12's responses to the five questionnaire images, all within the *Nature Tolerant* Cultural Type.

The first image analysed is the helicopter. Student R12 described the process of aerial spreading of 1080 in forested areas as an acceptable, "*cost effective*" method. They described aerial spreading as an efficient technique as it could "*cover more land,"* and the helicopter could travel *"to all locations quicker."* This appears to display a *Nature Tolerant Perception about environmental risk* of controllability and responsibility in their belief that the use of 1080 is the best way of poisoning pest animals in this situation.

This student's view was reiterated during the interview, where they described how once they realised that the helicopter was spreading 1080 over "*bushland*," their idea about the effectiveness of this method did not change but could be assumed was deepened. This view may be the result of Student R12 living rurally, so they had previous knowledge about the method of spreading 1080 throughout inaccessible areas by DOC in New Zealand (Operational Solutions for Primary Industries, 2013; Royal Forest and Bird Protection Society of New Zealand, 2017).

Questionnaire Images	**Student R12 responses displaying the common cultural characteristics and specific *Nature Tolerant* attributes**			
	View of Nature: *Robust but vulnerable.*	View of Earth's resources: *Scarce but controllable.*	Perception of environmental risk: *Controllability and responsibility.*	Risk management strategy: *Risk accepter. Use planning and regulation.*
Helicopter	*A helicopter ariel [sic] spreading 1080 so it can cover more land and is cost effective. Because it's easy to get the 1080 to all locations quicker and more effective.* *After doing research about 1080 then I saw it was in bushland, so yeah. (Interview)*			
Possum	*Possum. Scary. Because possums aren't friendly and are scary. They are pests-damage nature. A pest being targeted by 1080. Because possums carry TB which can be passed onto the biggest industry-dairy farming.* *Well, if there's heaps of possums around like dairy farming is one of the biggest things in New Zealand, so obviously that's going to be put at risk. Because they can't do anything to hurt you, but they could hurt like the industry of New Zealand. (Interview)*			
Deer	*A deer that has been accidently poisoned by 1080. Because the 1080 can't of had deer repellent meaning at that stage many unnecessary animals were dying until it was changed.* *Yeah, it is more informed about it. (Interview)*			
Stoat	*A stoat trying to prey on native bird nests. Because the stoats are preying on the native species, so 1080 is targeted at them.* *Once I looked at my research about what they do. (Interview)*			
1080 poster	*Danger. Be careful. Because the sign says warning of poison. Warning about the deadly 1080 that has been dropped and its effects. Because the sign is showing the effects on humans and native species.* *Informative. (Interview)*			

Figure 6.2. Student R12's analysed responses exemplifying their Nature Tolerant attributes and a hierarchist rationality.

The possum was the second image analysed and three different *Nature Tolerant* attributes were found. Firstly, Student R12 described possums as animals that "*damage nature*." This potentially illustrated a hierarchist rationality of striving to regain the natural order within the forest ecosystem because they viewed nature as being vulnerable to the damage that possums cause in New Zealand.

Student R12's second hierarchist view about this image is that *Earth's resources* are scarce, but controllable. This is because the student viewed possums as a "*pest"* that needed to be controlled to protect New Zealand's "*nature*" from being damaged and described possums as being "*targeted by 1080*."

The third *Nature Tolerant* attribute that seemed to be illustrated by Student R12 was when they described their *Perception of environmental risk*, and demonstrated a responsible and controllable view. This was because Student R12 described that while possums were not a threat to people, they did pose a threat to the dairy industry by carrying bTB, which they viewed as "*scary."* This view was expanded during the interview, where the student provided additional information about the importance of the dairy industry in New Zealand.

Student R12's response to the deer image also displayed a *Nature Tolerant* rationality with a risk-accepting *Management strategy*. This student described and appeared to accept the fact that the deer died from secondary poisoning, writing it had been "*accidently poisoned by 1080*." Student R12 provided additional information related to policy changes that they knew about that have occurred in New Zealand around the management of 1080. The information might have been about the regulatory changes to the use of 1080 that occurred in 2007 (Environmental Protection Authority of New Zealand, 2014). They commented about the introduction of deer repellents to some baits to reduce such accidental poisonings, writing "*many unnecessary animals were dying until it was changed*," seemingly illustrating their acceptance of the risks associated with the use of 1080. Moreover, this interview response illustrated that Student R12's views remained resolute and did not change, but that they had become more informed about the issue of secondary poisoning.

Two *Nature Tolerant* attributes were identified in Student R12's response to the stoat image. Firstly, they described how they believed that stoats *"prey on native bird nests,"* which might be a demonstration of a hierarchical rationality of responsibility towards *Environmental risk*. Secondly, Student R12 agreed that 1080 should be *"targeted at them,"* which seems to display their *View of Earth's resources*; how stoats need controlling. This could be interpreted as

demonstrating a *Nature Tolerant* rationality and a feeling of the importance of achieving order within the forest ecosystem by removing these pest species. During their interview, they described how their view was enhanced by the research they carried out about the use and effectiveness of 1080 to control pest species.

The final image that Student R12 described was the 1080 poster image. By using the words "*warning*" and "*danger*," they seemed to display an *Environmental risk perception* that demonstrated a belief in the controllability of people's actions around the distribution and use of 1080. The concept of responsibility appeared to be demonstrated when they wrote that humans need to "*be careful"* around the poison and heed warning signs describing the effects of the poison. Their response also showed that Student R12 displayed *Nature Tolerant* attributes and a hierarchist rationality of responsibility, because they described the poster as "*informative*" when interviewed.

Douglas (1999) argues that people with *Nature Tolerant* views within any society demonstrate a strong group and a strong grid culture. These features could be interpreted as being displayed within Student R12's responses because they included the words "*New Zealand"* and "*native*" when describing the forest. This use of this language demonstrated a strong sense of belonging to a group. Also, they argued that regulation of the pest problem by 1080 in New Zealand was necessary and effective, which demonstrated a strong sense of a belief in following rules and the need to regulate society. Thompson et al. (1990) also assert that hierarchists support a regulated environment and a belief in order and structure within society. Consequently, people with *Nature Tolerant* views and a hierarchist rationality would affiliate strongly with belonging to a group and following rules, around issues that they believe in strongly, which are beliefs present in attributes illustrated by Student R12.

6.3.2 Individual analysis of Student R13 – *Nature Ephemeral*

Student R13's responses were chosen because they appeared to be an example of a student who illustrated a consistent *Nature Ephemeral* Cultural Type and an egalitarian rationality. Four attributes were identified in the five questionnaire images and these are presented in Figure 6.3. When responding to the helicopter image, Student R13's written response to the questionnaire image was not clear, despite providing some statistical information. However, when they were interviewed, Student R13 explained their concern was about 1080 falling into streams and rivers, which suggested that it was an illustration of a *View of nature* that is a precarious and fragile

system. These are the characteristics of an egalitarian rationality which view Earth's nature as a finite system which can easily be damaged and is not repairable.

The second image Student R13 responded to was the possum. In their questionnaire response, this student focussed on the possum's adaptations and described how the animal had "*Large nails/claws/large ears."* However, they also acknowledged that possums preyed on birds, so initially this response was classified as a *Nature Tolerant* response by the researcher. However, during the interview, Student R13 focussed on their belief that possums were simply "*cute,*" with no mention of them preying on birds, so the response was re-classified as holding a risk averse, egalitarian *Risk management strategy* and a *Nature Ephemeral* view, believing in equality of life for all species. This interpretation was made since their earlier ideas of predation were minor in their reasoning and the ideas of quality of life appeared as more important.

The dead deer was the third image responded to by Student R13 where they described the death of the deer as a "*tragedy*." This could be interpreted as an illustration of a *Nature Ephemeral* view and an egalitarian rationality, with an equality of outcomes *Perception of environmental risk* in their response, as this student appeared to believe that all forms of life have the right to live peacefully. During the interview they expressed their view that the deer "*should be avoiding it and still continuing to walk around*" because they did not believe that 1080 should be in the deer's habitat. This response might illustrate they viewed *Earth's resources* (the deer) as depleting and their death as uncontrollable, which is a *Nature Ephemeral* attribute.

When commenting about the stoat, as with the possum response, Student R13 focussed on the personal attributes of the animal. Like the possum, they anthropomorphised the stoat by finding it "*adorable*" that it was able to carry a large animal. They have used the word "*cute"* twice, once in the written response, and again during the interview which could be interpreted as demonstrating a *Nature Ephemeral Risk management strategy* that is risk averse.

Questionnaire Images	Student R13 responses displaying the common cultural characteristics and *Nature Ephemeral* attributes			
	View of nature: *Precarious and fragile.*	View of Earth's resources *Depleting and uncontrollable.*	Perception of environmental risk: *Equality of outcomes for present and future generations.*	Risk management strategy: *Risk averse. Use trial without error.*
Helicopter	*2% of NZ land gets annual doses of 1080 by air. 1080 gets delivered to forests as photograph is showing.* *1080 gets dropped over rough natural terrain and falls into waterways. (Interview)*			
Possum	*Large nails/claws/large ears. These feature[sic] may be used for hunting prey and listening for danger. Possums are main predator to native birds. A 1080 article says it.* *I thought they were just a cute little animal. (Interview)*			
Deer	*A dead deer. The eyes are clowded[sic] and the head is not placed right. Other animals such as deer are dying from eating 1080.* *It's one of many animals, I mean it is still a tragedy that a deer dies because it's not that an animal should not be dying from it. It should be avoiding it and still continuing to walk around. (Interview)*			
Stoat	*Cute and looking for food. It is holding it's self [sic] up on a piece of wood and looking over it. Stoats are one of the three targeted species for 1080. As said in a 1080 article.* *Yeah, I still found that one adorable though. It's so funny when you see them in the photos and they are like carrying an animal twice its size, how do you do that? But yeah, it's still cute. (Interview)*			
1080 poster	*Should not touch or eat. There is a death and warning sign. 1080 is dropped in NZ waterways (streams). No waterways are avoided in the image.* *In this image, it shows like it doesn't show any streams that have been avoided or anything. Like the animals and fish in the waterways aren't being avoided, it is still being just dropped there. They are not avoiding it at all. (Interview)*			

Figure 6.3. Student R13's analysed responses exemplifying their Nature Ephemeral attributes and an egalitarian rationality.

Student R13 appeared to focus more on the stoat's features that they found aesthetically pleasing, rather than thinking of the animal in a negative way, that is in terms of its predation on native species.

The final image commented on by Student R13 was the 1080 poster. Two *Nature Ephemeral* attributes seemed to be discussed by Student R13. Firstly, they described how people "*should not touch or eat," * possibly demonstrating a risk averse *Management strategy* by discussing the caution they believed needed to be displayed around 1080.

The second attribute identified Student R13's potential *Nature Ephemeral View of nature* as a fragile and precarious system when they expressed their concern about the waterways within the image. Their concern about the possible contamination of streams by 1080 was further elaborated on during the interview where Student R13 believed that "*the animals and fish in the waterways aren't being avoided."* These comments were repeated three times and demonstrated an egalitarian rationality with a belief that nature is fragile and cannot tolerate such contamination.

Douglas (1999) argues that within any society, a weak grid and strong group culture is demonstrated by people with egalitarian views. Moreover, Thompson et al. (1990) assert that egalitarians would critically reject the wider society views. Subsequently, these people would express a weak sense of following rules and laws and a strong sense of belonging to a group of like-minded people about issues that they believed in strongly such as being risk averse towards the use of 1080.

Student R13's explanations used emotional language and their description of the possum, stoat and deer images seemingly illustrated the characteristics described by Douglas (1999). This can be seen in the way that Student R13 expressed an anthropomorphic view of the possum and stoat as "*cute*" or "*adorable*" animals. Also, they focussed on the adaptive features of the possum, and the stoat as assisting them when "*looking for food"* despite recognising that they were both predators. Describing both animals in this way demonstrated a *Nature Ephemeral* egalitarian rationality that considers all organisms to be equal. Furthermore, Student R13 described the death of the deer as a tragedy, using emotion to describe how the head of the deer had eyes that were "*clowded*" [sic] and the head "*is not placed right*." Student R13 also expressed concern about the distribution of 1080 into waterways within the forested areas and the effect of this on the variety of aquatic life. Expressing concern in this way is an example of a *Nature Ephemeral* attribute and an egalitarian rationality. It supports the ideas of Thompson et al. (1990) because Student R13 wrote "*they are not avoiding it at all,"* showing that the student saw the distributor

of 1080 as someone ('they') who did not view nature as a fragile system and Student R13 did not agree with their views.

6.3.3 Individual analysis of Student U01 – *Nature Benign*

Student U01 is an example of a student who seems to illustrate a consistent *Nature Benign* Cultural Type and an individualistic rationality. Four attributes were identified in the five questionnaire images and these are presented in Figure 6.4.

The first image Student U01 commented on was the helicopter flying over a forested area and three attributes were identified. Firstly, Student U01 focussed on the method used to distribute 1080 by writing "*A helicopter drooping [sic] 1080,"* seemingly revealing a *Nature Benign* Cultural Type with a belief that *Earth's resources*, or the numbers of animals and plants in the forest, are controllable by using pesticides to remove the pest species that harm them.

Secondly, Student U01 appeared to display another *Nature Benign* attribute by factually describing the environment where 1080 was distributed as "*forest."* This description possibly demonstrated a robust and stable *View of nature* because the environment is described as an exploitable resource, rather than in emotional terms, such as beautiful, special or threatened. Finally, Student U01 appeared to reveal an individualistic rationality during their interview by describing their dislike of 1080 as a biodiversity control method as it could affect people's abilities to profit from hunting forest animals, which they believed to be an exploitable resource. During the interview they said, "*I think it is pretty bad"* as they believed that it interfered with people trying to "*hunt and stuff and kills the way they make their income."* Student U01 believed this view strongly, because they added *"Yeah, so if they try and kill herd [sic] and sell it to people no one will buy it because they know it has been with 1080 in it."*

For the second image, the possum, both Student U01's questionnaire and interview responses displayed a factual account of the image. For example, the possum was described simply as a "*pest*" that should be removed from the forest.

Questionnaire Images	**Student U01 responses displaying the common cultural characteristics and *Nature Benign* attributes**			
	View of nature: *Robust and stable.*	View of Earth's resources: *Abundant and controllable.*	Perception of environmental risk: *Exploitability and equal opportunity.*	Risk management strategy: *Risk seeker. Use trial and error.*
Helicopter	*A helicopter drooping [sic] 1080 in a forest. Cause I've done the research.* *I think it is pretty bad. Like people go into forests and try and hunt and stuff and kills the way they make their income. Yeah, so if they try and kill herd [sic] and sell it to people no one will buy it because they know it has been with 1080 in it. (Interview)*			
Possum	*A pest that DOC is trying to target with 1080. I did research.* *Like organisations like DOC and things that are trying to… that's their target. (Interview)*			
Deer	*Food. Men going hunting.* *A food, like a dead animal. Somebody probably hunted it. I think, just men going hunting. Yeah, like photos. Took a photo of a dead animal. (Interview)*			
Stoat	*A pest being targeted by DOC. Research.* *Yeah. It's a pest that they're trying to target. (Interview)*			
1080 poster	*Stick laws. All the strick laws [sic]. A warning sign for 1080 in the area. Research.* *Yeah. A warning sign that is saying there's 1080 in this one forest, so like, stay away. I done research on like water supplies. Like they done like a thing on like seeing how much 1080 was in people's water supplies and didn't really say there was much and even if there was 1080 in it, it wouldn't really harm you even if you drunk heaps. Yes, it's not a worry. (Interview)*			

Figure 6.4. Student U01's analysed responses exemplifying their Nature Benign attributes and an individualistic rationality.

There was no mention about why this removal should occur or any display of responsibility about the removal of pests such as the possum to protect the natural/native environment. Instead their responses appeared to focus on the idea of the possum as a New Zealand pest species as well as the steps taken to eradicate this animal. This idea was revealed in their response, which was "*organisations like DOC and things that are trying to… that's their target."* A response such as this could be described as an attribute of a *Nature Benign* Cultural Type and an individualistic rationality where success is measured in material rather than emotional terms.

When discussing the deer image in the questionnaire, Student U01's wrote *"Food. Men going hunting."* This idea was elaborated further during the interview where Student U01 appeared to express their exploitability *Perception of environmental risk*. They seemingly displayed a *Nature Benign* Cultural Type because they described the deer image in relation to hunting for food and people taking photographs of this experience. This hunting view was similar to their helicopter image view, where they also described people hunting in forests as an income source.

When responding to the questionnaire, Student U01's reaction to the stoat image was that they had learnt from "*Research*" that it was *"A pest being targeted by DOC."* Student U01's view potentially displays a *Nature Benign* attribute and an individualistic rationality where their *Perception of environmental risk* is that of exploitability. They viewed the stoat as an animal that needed to be removed from the New Zealand forests, a view that was also expressed during their interview. As with the possum image, Student U01 gave a factual account of their belief that stoats are a pest that New Zealand's DOC is tasked with eliminating. Again, the focus was on pest elimination. This materially-focussed view demonstrated an individualistic rationality.

The final image was the 1080 poster. Initially Student U01's response was coded as displaying *Nature Tolerant* attributes and a hierarchist rationality. This was because Student U01 had mostly commented on the strict laws and the idea that the sign provided a warning to citizens and these ideas had been identified as *Nature Tolerant* responses. However, when Student U01 was interviewed, they elaborated on their views about the sign giving information, saying people needed to "*stay away*." This response suggests that *People's needs* are controllable, and they are responsible for themselves, which is a *Nature Benign* view. Also, they disclosed their lack of concern about 1080 use, saying "*it wouldn't really harm you even if you drunk heaps. Yes, it's not a worry."* Consequently, their comment was re-coded as a *Nature Benign* Cultural Type with a risk seeking strategy and an individualistic rationality where individuals independently decide what is right for them, rather than a risk-accepting view of a hierarchist rationality, which would focus on what is good for all members of society.

By discussing their ideas in this way, Student U01 seems to have demonstrated a *Nature Benign* Cultural Type with weak group and weak grid culture which Douglas (1999) maintains that people with an individualist rationality display within any society. Student U01 displayed little sense of belonging to a group by using the words *"I," "their"* "*people"* and "*the*y." For example, "***I** think, just men going hunting*," "***their** income*," "*Like **people** go into forests,"* and "***they** done like a thing."* It is argued that this characteristic is different to a *Nature Tolerant* view, where people have strong group affiliations and are inclusive in their descriptions and use words such as "*our," "us"* and "*we*."

Douglas (1997) posited that the language of risk used by people holding an individualist rationality contains procedural or factual terms. Student U01's explanations seemed to exemplify this feature because they were written in a detached manner. For example, they identified the stoats and possums as simply "*pest*" species and 1080 in water as "*not a worry*," rather than expressing any feelings towards the images they described. Furthermore, Schwarz and Thompson (1990) argue that people with an individualistic rationality believe in a competitive, market culture. This was illustrated by Student U01's belief in people's right to exploit forest animals, in this case deer, by hunting them and selling the meat.

These three examples of students' responses displayed strong responses within their individual Cultural Types for all five questionnaire images and therefore exemplify the stability hypothesis proposed by Rayner (1992). In each of these examples, all three students demonstrated consistent and established views within one Cultural Type. Student R12 displayed *Nature Tolerant* views with strong group and group rationalities, using words such as "our" or "we" in their responses. In contrast, Student R13 displayed *Nature Ephemeral* views with weak grid, but strong group rationalities. Their focus was on equality of outcomes for all forms of life and they displayed a strong aversion to being affected by *Environmental risk*. Finally, Student U01 displayed strong *Nature Benign* views and an individualistic rationality. This was demonstrated in their competitive market cultural ideas.

Now examples of students from the data set who displayed views showing a variety of Cultural Types within their responses, will be discussed.

6.4 Individual analysis of students displaying a variety of Cultural Types

Twenty-five students within the data set displayed a combination of two or three of the Cultural Types, *Nature Benign, Nature Ephemeral* or *Nature Tolerant*, as displayed in Table 5.1 (p. 85). The analysis of their views appears to demonstrate that students' perceptions of risk can vary,

and that more than one attribute can be displayed both within one context/image and between contexts/images. For example, Student U04, described the images of the 1080 poster, the possum, deer and stoat using *Nature Tolerant,* hierarchist rationalities and the helicopter image using a *Nature Benign,* individualistic rationality. Within their responses the number of images identified within each Cultural Type was unique to each student, so each student demonstrated their exclusive interpretation of their risk perception.

As seen in Table 5.1 (p. 85), there are two students, one urban and one rural (U12 and R14) who both demonstrated attributes from all three Cultural Types. Therefore, the layout of the data analysis of these two student's responses are different from the previous three and are provided in Figures 6.5 and 6.6.

For consistency, in these figures the colour-coding of the attributes is identical to the previous examples and the identifying words are also underlined in the same manner. The difference is that the three Cultural Types are displayed across the top of Figures 6.5 and 6.6. The student responses to the five images within the questionnaire are listed below.

The following analyses are examples of the two students who displayed responses across all three Cultural Types.

6.4.1 Analysis of Student R14's responses

The first example is Student R14's response who appeared to display *Nature Tolerant* attributes when responding to three of the images (helicopter, possum and stoat). However, they seemed to display *Nature Ephemeral* views when responding to the image of the 1080 poster and then *Nature Benign* views when responding to the deer image. It appears that this student demonstrated a variety of risk perceptions.

When responding to the deer image, Student R14 described how "*the dead deer makes me think of people hunting."* This response suggested a *Nature Benign* Cultural Type, with an individualistic rationality of exploitability and a competitive market culture since Student R14 believed that forest resources are there for humans to use and exploit. This view was re-stated during the interview, when they said "*Yeah*."

However, when they commented on the helicopter, possum and stoat images, this student's view differed, as they seemed to demonstrate *Nature Tolerant* attributes and a hierarchical rationality. For example, when responding to the image of the helicopter distributing 1080, Student R14 wrote how they believed this method was "*an effective way of spreading it*" and believed that

1080 was needed to control pest species. During the interview, Student R14 stated that they believed that "*1080 is not really poisonous to humans as much."* In these responses Student R14 appeared to display a *Nature Tolerant* view of demonstrating responsibility towards citizens and the environment when spreading 1080, as they had described the effectiveness of the distribution of 1080 by helicopter. During the interview, Student R14 also described how this method of distribution was a relatively safe method for humans to use saying "*1080 is not really poisonous to humans*."

A similar *Nature Tolerant* hierarchist rationality could be interpreted as being evident in Student R14's response to the image of the possum. In their questionnaire they described how they considered possums to be a pest species in the New Zealand forest because they predated on other wildlife in the forests. This was evident in their response when they stated, "*possums are a pest to other animals in NZ. Pest control in NZ. Because possums are a common pest in NZ."* This response appeared to demonstrate their belief that possums need to be controlled. Furthermore, this belief was reiterated in the interview and potentially illustrated a perception of controllability concerning the *Environmental risk* the possums pose. The researcher argues that this extensive response demonstrates the concept of responsibility, rather than just using the word "*pes*t" as a *Nature Benign* supporter with a matter-of-fact, individualistic, rationality might describe.

Student R14's responses displaying their Cultural Types		
One *Nature Benign* attribute to: *Perception of environmental risk: Exploitability.*	One *Nature Tolerant* attribute to: *Perception of environmental risk: Controllability and responsibility.*	Two *Nature Ephemeral* attributes to: *Risk management strategy: Risk averse.* *View of nature: Precarious and fragile.*
Response to questionnaire image of deer: *Something to do with hunting to [sic] much. Because the dead deer makes me think of people hunting to [sic] much.* *So, you thought it might have been hunting? (Researcher)* *Yeah. (Interview)*	**Response to questionnaire image of helicopter:** *Spreading 1080 around the forest. Because it looks like an effective way of spreading it.* *Yes, because 1080 is not really poisonous to humans as much. (Interview)* **Response to questionnaire image of possum:** *Possums in the trees and bushes. Because possums are a pest to other animals in NZ. Pest control in NZ. Because possums are a common pest in NZ.* *You still see possums as a pest? (Researcher)* *Yeah (Interview).* **Response to questionnaire image of stoat:** *The pest that eats kiwis eggs and stops reproduction of our famous icon the kiwi. Because a stote [sic] is a pest to the kiwis.* *Stoat is a pest in NZ, needs to be controlled. Because pests are not needed.* *Yeah, stoat or something. (Interview)*	**Response to questionnaire image of 1080 poster***:* *1080 is a bad poison and should not be used. Because the picture shows that 1080 can kill any mammal animals. The 1080 is not safe because of the poisons. Because the signs show this.* *1080 is not safe. (Researcher)* *Yeah. (Interview)*

Figure 6.5. Student R14's analysed responses exemplifying their Cultural Types for the five questionnaire images.

Likewise, when Student R14 disclosed their view about the stoat image in their questionnaire, they wrote about their belief that these animals are "*a pest in NZ."* This response appears to demonstrate a *Nature Tolerant* Cultural Type with a belief about responsibility towards saving or protecting native fauna. This was because Student R14 described how the stoat was "*not needed*" in New Zealand and "*needs to be controlled*" because they preyed on native species. Their response seems to illustrate Student R14's feeling of responsibility towards "*our famous icon the kiwi,"* which is an example of a hierarchical rationality. Furthermore, Student R14 used words like "*our*" and the example of the Kiwi, New Zealand's national bird, which is internationally recognisable, which could be interpreted as examples of *Nature Tolerant* characteristics.

Finally, Figure 6.5 displays Student R14's response to viewing the image of the 1080 poster. Two attributes, *Risk management* and *View of nature* will now be discussed. In their response, Student R14 seemingly demonstrated a *Nature Ephemeral* Cultural Type and an egalitarian rationality. Student R14's response showed that they supported a risk averse *Management strategy* because they described 1080 as a *"bad poison"* adding emphasis to this opinion by saying it "*should not be used*." They also justified their *Nature Ephemeral View of nature* as a fragile system by describing 1080 as "*not safe"* both in the written response and during the interview, because of the "*poisons*" it contains. This strong *Nature Ephemeral* view of the image of the 1080 poster illustrated Student R14's aversion to the risk of using 1080. It appeared to demonstrate that they believed that the poison should not be trialled/used in the forest, because there was no the guarantee of errors or unintended deaths.

6.4.2 Analysis of Student U12's responses

As shown in Figure 6.6, Student U12 appeared to display *Nature Benign* attributes when responding to three of the images (helicopter, possum and stoat). However, they seemed to display *Nature Tolerant* views when responding to the image of the 1080 poster and then *Nature Ephemeral* views when responding to the image of the dead deer. It appears that this student also demonstrates a variety of risk perceptions in a similar way to Student R14.

When responding to the image of the helicopter, Student U12 seemed to display a *Nature Benign* Cultural Type, an individualistic rationality and a robust and stable *View of nature* when they said, "*They're bombing the forest."* During the interview, Student U12 expanded their view and said, "*I put toxins, like I described it as bombs.*" Here, Student U12 has described their version of how 1080 is distributed over forest areas in New Zealand. This appears to display a

Nature Benign view that nature is a robust and stable system that can withstand "*bombing*." During their interview, Student U12 mentioned that they played video games and that the image of the 1080 poster reminded them of a menu screen. It is possible that this image of the helicopter reminded them of projectiles in a video game, because they have not mentioned whether distributing 1080 using this method it is right or wrong, just the method used.

The second image responded to displaying a *Nature Benig*n Cultural Type was the possum and two attributes were identified. Firstly, Student U12 wrote "*It might be a rodent, looks like one*." Although no identifying words were found within this response, their ideas were expanded and clarified during their interview when they explained "*So a pest here."* It could be inferred that this remark displayed a *Perception of environmental risk* that supported exploitability and eradication of possums because they simply described the possum as a pest. Adding support to this idea during their interview, Student U12 exclaimed that possums were *"not doing anything positive."*

Moreover, during their interview, Student U12 added that possums *"might as well be exterminated.*" Here Student U12 displayed their second *Nature Benign* view towards this animal as it appeared to have little value to them. This implies that Student U12 believed that *Earth's resources*, of which the possum is one, were completely controllable.

The stoat was the third image Student U12 responded to using a *Nature Benign View of Earth's resources*. While Student U12 wrongly identified the stoat in the image as a rodent rather than a mustelid, they believed that stoats were an issue. They also believed that killing them by any means or removing them by being "*shipped off to another country"* to control their numbers, was acceptable. This point was reiterated by Student U12 saying "*I don't see any downsides*" to their removal since they viewed stoats as a problem pest species that was introduced to New Zealand and are "*not ours.*"

Douglas (1999) argues that within any society people with individualist views demonstrate a weak group and weak grid culture. Consequently, there is a low sense of belonging to a group and following established rules around the specific issue being discussed. The researcher considers Student U12's explanation of the stoat image illustrated this characteristic by frequently using the word *"I," "them"* and "*they*." For example, "***They** must be exterminated," "**They**'re rodents," "**I** don't see any downsides to exterminating **them**"* and *"**they** can be killed or like shipped off to another country."*

Additionally, Douglas (1997) argued that people with individualistic values describe their risk views using procedural terms and meanings. The researcher considers Student U12's response to be an example of this rationality because the information that Student U12 wrote was relayed factually and not emotionally. For example, they exhibited strong support for the elimination of stoats in New Zealand in both their written response and during the interview. In both responses Student U12 used the words "*exterminated," "exterminating"* and "*can be killed*" to describe ways of removing these abundant but controllable pest species. Interestingly, this description was similar to how they had described the possum image. The strong response to exterminate these pests by Student U12 may have resulted from the fact that stoats are common pests in New Zealand. In forested areas stoats prey on reptiles, invertebrates and all native bird species, including kiwi populations (Department of Conservation, 2013a). However, stoats are also found in urban areas, such as where Student U12 lives. They are agile hunters and swimmers, so the damage caused by stoats may be familiar and unwanted by them.

When they described the poster image of the 1080 information, Student U12 seemingly displayed *Nature Tolerant* views. Although writing "*IDK*" (I don't know) as their response to the questionnaire, during their interview, Student U12 explained this by saying, "*I was tired, so I couldn't exactly think of a more proper response. It is necessary."* Within their interview, the word "*necessary*" was identified as exhibiting a *Nature Tolerant Perception of environmental risk*. This interview response displayed a feeling of responsibility about use of 1080 and that citizens needed to be informed, regardless of whether they were "*frightened*" by the information or not. Therefore, this exhibits a *Nature Tolerant* Cultural Type and a hierarchist rationality of using regulations to achieve order and control about the environmental risk of using 1080.

Student U12's responses displaying their Cultural Types		
Three *Nature Benign* attributes to: *View of nature: Robust and stable.* *Perception of environmental risk: Exploitability.* *View of Earth's resources: Abundant and controllable.*	One *Nature Tolerant* attribute to: *Perception of environmental risk: Controllability and responsibility.*	Three *Nature Ephemeral* attributes to: *View of nature: Precarious and fragile.* *Perception of environmental risk: Equality of outcomes for present and future generations.* *Risk management strategy: Risk averse.*
Response to questionnaire image of helicopter: *They're bombing the forest. Bombs are projectiles that kill when deployed. Same with this toxin.* *I put in toxins, like I described it as bombs. That concept came to me as I said here, bombs are projectiles that kill when deployed. Toxins work the same and is deployed in the same way, well relatively same way. So that is why I said bombing. (Interview)* **Response to questionnaire image of possum:** *It might be a rodent. Looks like one.* *So, a pest here and they are not doing anything positive, well they might as well be exterminated. (Interview)* **Response to questionnaire image of stoat:** *They must be exterminated. They're rodents and I don't see any downsides to exterminating them.* *Yes. They must be exterminated since as I said we had a class about rodents and what they do here, and I felt they must be exterminated since we learned that these things are not native, so it doesn't matter if they die out here in New Zealand. So, yeah. Because they can be killed or like shipped off to another country because they are not ours. (Interview)*	**Response to questionnaire image of 1080 poster:** *IDK.* *I was tired, so I couldn't exactly think of a more proper response. It is necessary. It doesn't matter if it frightens people, they are better off frightened rather than dead or in the hospital. (Interview)*	**Response to questionnaire image of dead deer:** *The neck. It looks like something broke it back. It must have died painful. 1080 is a slow killer, so it probably felt himself die.* *The second one just showed how wrong it was when I took a better, longer look at it. Like un-natural I mean. Yes, because like most people, when people die I mean real painfully, they tend to die with their eyes open if they don't have enough time to like close it. So, I said painful. (Interview)*

Figure 6.6. Student U12's analysed responses exemplifying their Cultural Types for the five questionnaire images.

Three *Nature Ephemeral* attributes were displayed by Student U12 when responding to the dead deer image. Firstly, Student U12 displayed an emotional *View of nature* response to the image. This was because they focussed on the angle of the neck and explained how they believed that someone or "*something"* had caused this unusual angle. In this response, Student U12 appears to have displayed their *View of nature* as a precarious and fragile system, which is easily unbalanced. They described how they believed the deer's life had ended because it's neck had been deliberately broken, resulting in the "*un-natural*" angle of the deer's neck.

Then, when Student U12 displayed their *Perception of environmental risk* about the dead deer they also seemed to use a *Nature Ephemeral* view. They wrote the words "*painful*" or "*painfully*" repeatedly during their response. This was probably used to emphasise their idea that all living things should have the right to dignity in life and in death and that death should be pain-free. Moreover, they wrote that they believed that the deer *"probably felt himself die."* This also displays a *Perception of environmental risk* that supports an equality of outcomes by anthropomorphising the deer as male ("*himself"*) and that it could feel the pain of their death.

The third *Nature Ephemeral* attribute suggested within Student U12's response in Figure 6.6 was their *Risk management strategy.* They seemed to display their aversion to the risk of using 1080 in forests by writing *"1080 is a slow killer."* During the interview, Student U12 explained this further by comparing the deer's death to that of a person; again, anthropomorphising the deer's death. Furthermore, they described the use of 1080 to kill as "*wrong.*" This description of how 1080 kills slowly revealed their distaste about the risk of using this poison. Student U12's view demonstrates a *Nature Ephemeral* view, supporting a *risk management* strategy of being risk averse.

Both Students R14's and U12's variety of responses are an example of Rayner's (1992) "*mobility hypothesis*" (p.107, italics in original). He argued that specific contexts created the cultural bias within each individual and that their views would change between each context. Moreover, both Student R14 and Student U12 displayed three separate Cultural Types within their responses. This displays a fluidity of choice of Cultural Types and that these students can exhibit different responses in different circumstances.

These responses contrast to Students R12, R13 and U01 who are examples of the "*stability hypothesis*" (p. 107, italics in original). In this hypothesis, Douglas argued that each time an individual developed a cultural bias, they remained within that group, as is illustrated by Students R12, R13 and U01 responses, where these three students' responses were within the *Nature*

Tolerant, Nature Ephemeral and *Nature Benign* Cultural Types respectively. Therefore, it seems that both hypotheses are demonstrated within these students' views.

6.5 Summary

Using the data analysis framework enabled the researcher to analyse the data gathered from the open-ended questions about the five images within the questionnaire and the interviews to illustrate different attributes within three Cultural Types. Analysing the student responses in this fine-grained manner enabled the researcher to identify the students' perceptions of environmental risk about the use of 1080 to rescue New Zealand's unique biodiversity.

Five student responses were analysed within this chapter. The first of the five students analysed was Student R12. This student was considered by the researcher to display strong *Nature Tolerant* attributes because all their responses to the five questionnaire images were identified within this Cultural Type. Student R13's responses were the second set analysed and they were considered to display strong attributes of a *Nature Ephemeral*, egalitarian rationality, because all their responses were identified within this Cultural Type. The researcher considered that the third student (Student U01) displayed strong *Nature Benign* attributes because all their responses were identified within this Cultural Type. All three of these students displayed consistency of views and are examples of the stability hypothesis (Rayner,1992).

Student R14's and Student U12 responses were the last two data sets analysed. It is are argued by the researcher that these two data sets display a variety of Cultural Types. Student R14 displayed *Nature Tolerant* attributes when responding to the images of the helicopter, possum and stoat. However, they displayed *Nature Ephemeral* attributes when responding to the 1080 poster image and *Nature Benign* attributes when responding to the dead deer image. Student U12 also displayed a variety of Cultural Types and responded to the image of 1080 poster with *Nature Tolerant* views. Then they responded with *Nature Ephemeral* views to the dead deer image and *Nature Benign* views when describing the helicopter, possum and stoat.

The variety of Cultural Types these two students displayed depended on the context of the image, demonstrating that not all students display a singular rationality when discussing their perceptions of risk. These two students are examples of the mobility hypothesis supported by Rayner (1992). However, the responses from the Cultural Type *Nature Capricious* were omitted from this analysis because the researcher considered that these responses were too brief to allow an in-depth analysis.

The following chapter presents an analysis of data demonstrating how the students used mechanisms to communicate their views of risk about the issue of biodiversity rescue.

Chapter Seven
RISK COMMUNICATION MECHANISMS

7.1 Introduction

This chapter presents an analysis of data that demonstrates how the student participants used strategies to communicate their views of risk about the issue of biodiversity rescue. The strategies the students used were first proposed by Kahan (2012) in his risk investigations. He named these strategies cultural cognition mechanisms, which were explained in Chapters 2 and 4. Kahan opines that these mechanisms are a set of processes that individuals use when communicating their risk ideas. It is proposed that these mechanisms could have the potential to identify the ways in which individuals conveyed their views within this study. Accordingly, within this chapter the potential of five cultural cognition mechanisms to analyse the risk communication methods employed by the student participants in this study are explored. The communication methods used by each of the students analysed in this chapter link to the individual attributes for the Cultural Type characteristics identified in Chapter 4. The investigation of the communication mechanisms within these students' responses is related to the research question:

> What mechanisms do students employ to communicate their views and allow meaning-making when justifying their positions about a biodiversity rescue?

As previously mentioned, in Chapter 5, p. 85 within the data set, four students were identified as demonstrating a *Nature Capricious* Cultural Type. An example of such a response was Student U18 who wrote "Not sure." Consequently, as these responses to the five questionnaire images were very limited, or missing, they were not included within this chapter about communication mechanisms.

Section 7.2 provides a brief description of the Cultural Cognition communication mechanisms and how Kahan (2012) used these mechanisms within his study. It also describes the differences between his study and this project and how the researcher adapted three of his mechanisms for use in this project. Section 7.3 provides examples of the first communication mechanism called *narrative framing,* adopted from Kahan's ideas. Kahan opines that when using this mechanism, individuals attempt to make meaning of risk information by fitting it into pre-existing narratives. An example from each of the three Cultural Types (*Nature Tolerant, Nature Ephemeral* and *Nature Benign*) is analysed and presented. Section 7.4 provides examples of the second communication mechanism adopted from Kahan's ideas called *cultural credibility*. This section

provides evidence of this mechanism to show that participants tend to believe that an expert is credible if they share similar cultural values with the individual and two students' responses were analysed. Section 7.5 provides examples of the communication mechanism *cultural advocacy*. This section presents ways in which participants communicate their advocation of their Cultural Type. This mechanism was adapted by the researcher from Kahan's ideas about his remaining three communication mechanisms and nine student examples are given. Section 7.6 summarises this chapter.

7.2 Cultural Cognition communication mechanisms

Dan Kahan is a member of the Cultural Cognition Project, based at the Yale Law School in Connecticut, studying risk perceptions (Yale University, n.d.). In 2012, as a member of this project, Kahan gathered empirical data about American adult citizens opinions. He used on-line surveys to investigate their opinions about a variety of social issues such as global warming, nanotechnology, gun control and the death penalty. During these investigations he proposed that there were a set of five communication mechanisms that "connect individuals' risk perceptions to their cultural worldviews" (2012, p.725). The five mechanisms were first discussed in Chapter 4 and are offered again in Table 7.1.

Table 7.1
An outline of the Cultural Cognition Mechanisms (Kahan, 2012).

The five Cultural Cognition communication mechanisms				
Narrative framing:	*Cultural credibility:*	*Identity affirmation:*	*Biased assimilation:*	*Cultural availability:*
Individuals display a tendency to assimilate information by fitting it to pre-existing narrative templates or schemes that invest the information with meaning	Individuals tend to believe an expert is credible if they share similar cultural values with the individual	When shown information associated with a conclusion threatening to their cultural values, individuals *react dismissively* toward that information. However, when the information supports their values, individuals are open-minded towards it	Individual's beliefs persist because they selectively choose evidence that reinforces these beliefs. However, they would *dismiss information* that contravenes these beliefs	Individuals remember more details when they hear risk information that is consistent with their cultural values, but would *react dismissively* toward information if it threatens their cultural values

The researcher believes that these mechanisms could prove to be a useful pedagogical tool as they might allow teachers to reflect on an aspect of their student's learning about values and how these values are formed.

However, there are several differences between Kahan's (2012) investigations and the methods used in this study. Firstly, in this project 40 Year 12 students participated, while Kahan collected data from between 500 and 1,850 adult participants in his surveys. Additionally, open-ended questions and individual interviews were employed to gather qualitative data from participants in this study. The students were free to answer as they saw fit in this project, using as many or as few words in their response as they choose, because this was important for this research, whereas Kahan used a quantitative methodology.

More importantly, Kahan's participants indicated their level of agreement or disagreement to the social issues online, using a six-point cultural cognition scale. For example, one of the questions in these polls was "Our government tries to do too many things for too many people. We should just let people take care of themselves" (2012, p.731). As a result, Kahan was able to identify a dismissive component that individuals could express within three of the five mechanisms he proposed. He named the three mechanisms that contain a dismissive component identity affirmation, biased assimilation and cultural availability. The dismissive components within these mechanisms are underlined and displayed in Table 7.1.

When completing the questionnaires and the interviews in this project, the students were not asked to specifically indicate their level of agreement or disagreement nor were they asked to respond to other viewpoints. The researcher did not need a dismissive component within the responses because the data was gathered using qualitative methods within this study. However, despite these differences, the researcher argues that an adaptation of Kahan's (2012) mechanisms could still be useful to assist with the explanation of how the student participants in this study communicated their ideas about risk to others. Therefore, a modified version of Kahan's communication mechanisms were used in this study and are displayed in Table 7.2.

Table 7.2.
The revised communication mechanisms (adapted from Kahan, 2012).

Revised communication mechanisms		
Narrative framing: Individuals tend to integrate information by fitting pre-existing narratives with new information to invest this information with meaning	*Cultural credibility:* Individuals tend to believe an expert is credible when they share similar cultural values	Cultural Advocacy: Individuals tend to advocate their cultural type by using one or more of these strategies: • Being open-minded towards new information that supports their Cultural Type • Persisting with their beliefs and selectively choosing evidence that reinforces these beliefs • Remembering more details when they hear risk information that is consistent with their Cultural Type

It can be seen in Table 7.2 that the first two communication mechanisms, displayed in the first two columns, are summarised with no change from Kahan's (2012) research. However, the third column contains a modified and nuanced version of his ideas. In this column, three of Kahan's communication mechanisms (*identity affirmation, biased assimilation* and *cultural availability)* have been grouped together under one heading, which the researcher has named *Cultural Advocacy*. Within this new arrangement, the three communication mechanisms originally developed by Kahan have been modified to remove the dismissive portions. Consequently, in this new, adapted mechanism there are three ways that the researcher believes students in this study might have communicated their risk ideas when responding to the questions within the questionnaire and interviews. Any one of these ways, which are now named strategies, that students could employ, may be utilised when participants employ this communication mechanism to advocate for their Cultural Type. These three strategies are that students may be open-minded and accepting of new information that supports their Cultural Type; they may selectively choose information that reinforces their pre-existing beliefs; or they may remember more details when they hear risk information that is consistent with their Cultural Type. The researcher argues that any one or more of these three strategies might be employed by students to communicate their risk ideas when using this mechanism.

Cultural advocacy was chosen as the name of this mechanism because the researcher believed that the three original mechanisms developed by Kahan contained elements of individuals promoting or advocating for their Cultural Type. The following analyses demonstrate the communication mechanisms used by these students that have been modified from Kahan's (2012) ideas.

Figure 7.1 describes the components of the two figures that follow where the communication mechanisms are summarised and adopted from Kahan's ideas (*narrative framing* and *cultural credibility*) along with the corresponding students' responses. The individual communication mechanism is displayed in the left-hand column of each figure. Each of the three Cultural Types are displayed in the second column and student responses for each Cultural Type are listed in the right-hand column. Within these student responses, the relevant words that illustrate the communication mechanism have been underlined and uniquely colour-coded. Quotes from the interviews have also been included to provide further information.

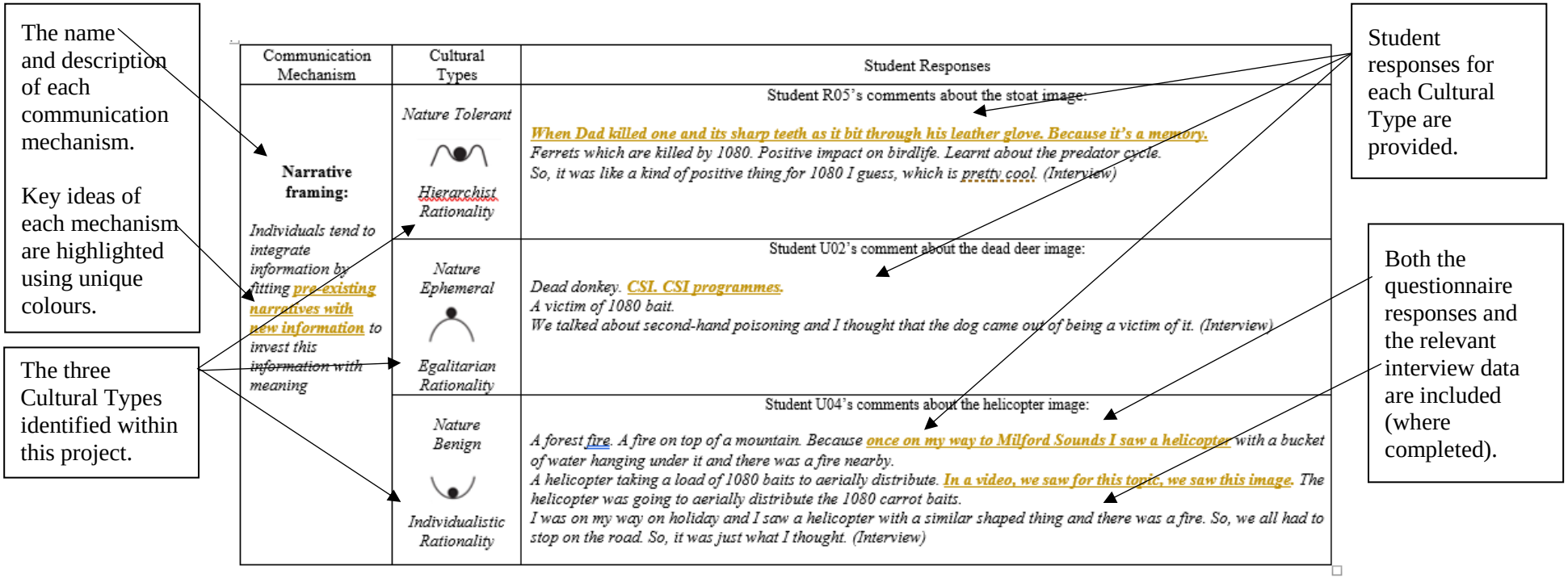

Figure 7.1. A generic exemplar providing a description of the components of the analysis tables for the communication mechanisms *narrative framing* and cultural credibility.

7.3 Analysis of student responses using the communication mechanism *narrative framing*

The communication mechanism *narrative framing* occurs when individuals assimilate information by fitting it to pre-existing narrative templates that invest the information with meaning (Kahan, 2012). Student responses representing three Cultural Types appeared to display this mechanism to justify their individual positions when responding to the questionnaire images. Three indicative examples are displayed in Figure 7.2 and the pertinent sections within their responses, as well as the communication mechanism, are displayed in gold.

Student R05 was the first student response analysed. Their responses displayed *Nature Tolerant* attributes with a robust but vulnerable *View of nature*. These attributes were displayed by them recalling memories of previous events in their responses, which demonstrates the use of communication mechanism *narrative framing*. Student R05 commented about the stoat image (although they confused the image with that of a ferret). They recalled a memory of "*When Dad killed one and its sharp teeth as it bit through his leather glove.*" The key idea within Student R05's memory was that the animal was a vicious predator and a pest and that it had "*sharp teeth*". This memory was then followed by Student R05 writing about killing these pest species using 1080, which they supported, displaying their *Nature Tolerant* Cultural Type. It appears that this memory assisted them to respond with a further description about this pest animal, using the communication strategy *narrative framing*.

In this description they wrote how they believed eliminating pests was necessary because it would have a "*positive impact on birdlife*." Furthermore, they commented that they believed that 1080 was an effective control method and improving conditions for native species was a "*positive thing for 1080 I guess, which is pretty cool.*" When they viewed the stoat image, they initially remembered what had happened to their "*Dad*". Then, Student R05 used this memory, using *narrative framing* to communicate their *Nature Tolerant* Cultural Type ideas which includes having a belief of responsibility towards saving New Zealand's birdlife, by removing the threat to their survival caused by these pest species.

Communication Mechanism	Cultural Types	Student Responses
Narrative framing: *Individuals tend to integrate information by fitting **pre-existing narratives with new information** to invest this information with meaning*	*Nature Tolerant* *Hierarchist Rationality*	Student R05's comments about the stoat image: ***When Dad killed one and its sharp teeth as it bit through his leather glove. Because it's a memory.*** *Ferrets which are killed by 1080. Positive impact on birdlife. Learnt about the predator cycle.* *So, it was like a kind of positive thing for 1080 I guess, which is pretty cool. (Interview)*
	Nature Ephemeral *Egalitarian Rationality*	Student U02's comment about the dead deer image: *Dead donkey. **CSI. CSI programmes.*** *A **victim** of 1080 bait.* *We talked about second-hand poisoning and I thought that the dog came out of being a **victim** of it. (Interview)*
	Nature Benign *Individualistic Rationality*	Student U04's comments about the helicopter image: *A forest fire. A fire on top of a mountain. Because **once on my way to Milford Sounds I saw a helicopter** with a bucket of water hanging under it and there was a fire nearby.* *A helicopter taking a load of 1080 baits to aerially distribute. **In a video, we saw for this topic, we saw this image.** The helicopter was going to aerially distribute the 1080 carrot baits.* *I was on my way on holiday and I saw a helicopter with a similar shaped thing and there was a fire. So, we all had to stop on the road. So, it was just what I thought. (Interview)*

Figure 7.2. Students' responses displaying three Cultural Types using the mechanism narrative framing when communicating their ideas about the images.

The next student's (U02) response demonstrated a *Nature Ephemeral* Cultural Type as they communicated their views about *Earth's resources,* which they believed were depleting and dying in an uncontrollable fashion, using *narrative framing*. When Student U02 responded to the image of the dead deer, which they incorrectly identified as a donkey, they recalled a memory of seeing a television programme called "*CSI.*" Crime Scene Investigation (CSI) is a television series produced by the Columbia Broadcast System (CBS) who released this fictional forensics-crime-drama television series in 2000. The series followed a team of crime-scene investigators as they solved murders by collecting evidence both from the crime scene and from the victims of the crime (Bruckheimer & Zuiker, 2000–2015).

As well as commenting that they had initially thought of this television programme in their response, Student U02 then described the deer as "*a victim of 1080 bait*." Describing the deer in this way perhaps demonstrated how this television series, that centres around victims, influenced their ideas and that they also viewed the deer as a "*victim*" like those in the show they remembered watching.

Then, during their interview, Student U02 described how they had discussed the 1080 issue in class and they thought that dogs could also be a "*victim*" by saying "*we talked about second-hand poisoning and I thought that the dog came out of being a victim of it.*" It might be that Student U02 knew that dogs are particularly susceptible to 1080 poisoning and there is no antidote (Goh, Hodgson, Fearnside, Heller, & Malikides, 2005; Royal Forest and Bird Protection Society of New Zealand, 2017).

Mentioning these two memories demonstrated how Student U02 used the mechanism *narrative framing,* to invest their understanding of the deer image with meaning. They used the word "*victim*" after remembering the television crime series, to describe how they viewed the deer in the image that they believed had been killed via secondary poisoning from 1080. Student U02 recalled thinking about dogs dying in the same way. Using this communication mechanism allowed Student U02's to express their view that all life (including deer and dogs) are part of *Earth's resources* and these animals are being depleted using 1080, a characteristic of the *Nature Ephemeral* Cultural type.

Another student who used the communication mechanism *narrative framing* in their response was Student U04. In this example the mechanism was used to communicate their *Nature Benign* views of *Earth's resources.* When writing about the helicopter image they recalled two previous events that assisted them to communicate these views.

In their response, Student U04 recalled seeing a helicopter while on their way to a holiday destination. They remembered how all the traffic, including them, had to stop on the side of the road while the helicopter manoeuvred past them. This recollection could have influenced Student U04 as they thought that the helicopter image in the questionnaire was also responding to a forest fire. Using the mechanism *narrative framing* they wrote "*once on my way to Milford Sound I saw a helicopter with a bucket of water hanging under it and there was a fire nearby*."

Then, Student U04 described how they recalled watching a video in class about distributing 1080 bait and they remembered seeing the same "*image*" as given to them in the questionnaire. In this response they said, "*the helicopter was going to aerially distribute the 1080 carrot baits."* The researcher believes that Student U04 again used the communication mechanism *narrative framing* to assist them to make sense of the image of the helicopter. Using this mechanism endowed their ideas of how helicopters can distribute resources, both water when they remembered their holiday experience, and 1080 poison when they remembered watching the video in class.

These responses display how these three students used the communication mechanism *narrative framing* to recall events that they had personally and previously experienced. These recollections then seemed to assist these students to make meaning of the images, regardless of their Cultural Types.

The second communication mechanism developed by Kahan (2012) in his Cultural Cognition Project and adopted for this study, called *cultural credibility*, will now be discussed.

Communication Mechanism	Cultural Types	Student Responses
Cultural credibility: Individuals tend to believe an ***expert is credible when they share similar cultural values***	*Nature Tolerant* *Hierarchist Rationality*	Student R09's comments about the helicopter image: *Cleaning the forrest[sic]. Because the chemicals being dropped are killing of [sic] pests.* *This is the most effective way in distributing 1080 through large areas. **After reading articles on 1080** I have learnt that it's nearly impossible over large forrest [sic] areas other than this solution.* *It just seems there is I think there is more positives over getting rid of possums than negatives to losing some mammals. (Interview)*
	Nature Ephemeral *Egalitarian Rationality*	*No Nature Ephemeral student examples were found in the data that displayed this communication mechanism.*
	Nature Benign *Individualistic Rationality*	Student U02's comments about the helicopter image: *Someone transferring resources to one place to the other. Because of the helicopter and what its carrying.* *Spreading aerial 1080 bait. Saw **one of the videos. Eye opening**.* *Because I saw that on **one of the videos**. Yeah, I think it was Graph Voice or something like that. I don't know.* *I think it was just kind of **eye opening what was really happening.** (Interview)*

Figure 7.3. Student responses displaying two Cultural Types using the mechanism cultural credibility when communicating their ideas about the images.

7.4 Analysis of student responses using the communication mechanism *cultural credibility*

Individuals tend to believe an expert is credible and are accepting of their ideas, if they share similar cultural values with them. This is the basis of the communication mechanism Kahan (2012) identified as *cultural credibility*. Students from two of the Cultural Types appear to have used this mechanism to justify their individual positions when responding to the questionnaire images and two indicative examples of student responses are displayed in Figure 7.3. There seemed to be no *Nature Ephemeral* student responses found in the data that displayed this communication mechanism. As with the previous figures, each student's written responses are listed first, followed by their interview data. The pertinent sections within their responses, and communication mechanism, are displayed in crimson.

The first example is from Student R09's response who displayed *Nature Tolerant* views and seemed to use *cultural credibility* to communicate their ideas. They described that "*after reading articles on 1080*" they believed that aerial spreading by helicopter was the "*most effective way*" of eliminating the possum threat from New Zealand's forests. The articles the student referred to had been provided to the teacher by the researcher and were published by New Zealand's DOC.

In New Zealand, DOC is a well-respected government agency formed in 1987, guided by the 1987 Conservation Act and responsible for conserving New Zealand's natural and historic heritage. The Department employs numerous and reputable scientists who research and publish information about conservation issues in New Zealand and are easily contactable via their website (http://www.doc.govt.nz/about-us/).

That Student R09 believed the information published by DOC and found the information credible, was demonstrated further in another response. This was because they described how they knew from the information provided by the teacher, that helicopters were used to spread 1080 over large inaccessible forest areas. Additionally, they thought that this was a beneficial method of controlling pests, which they described as "*cleaning the forrest[sic]*." Moreover, during their interview, they expressed a belief that there were "*more positives over getting rid of possums than negatives to losing some mammals.*" Both these ideas demonstrate Student R09's use of *cultural credibility* as a communication mechanism to describe how they believed that the information provided by experts from DOC about the aerial distribution of 1080 to rescue New Zealand's biodiversity was credible and it influenced their expressions.

Within Figure 7.3 an exemplar of a student who appears to have employed the communication mechanism *cultural credibility* and held *Nature Benign* values is provided. Like Student R09, Student U02 also described the image of the helicopter in their response, which they believed was "*eye opening*." This might show that they believed "*one of the videos*" viewed during the teaching of the topic gave credible information about the aerial spreading of 1080. Several videos were provided to the teacher by the researcher to be viewed by the students. One of those videos was called *1080 Science* (TBfree New Zealand, 2014). The video contained images of helicopters distributing 1080 aerially and potentially was the video to which Student U02 was referring.

TBfree New Zealand is a legitimate organisation tasked alongside DOC to control the spread of possums, and so bTB in New Zealand. This organisation employs expert scientists to monitor the spread of bTB and is controlled by a council made up of primary industry, central and local government representatives, providing support and information about the regulations surrounding stock movement on and between farms. The organisation is readily contactable either through their website (https://www.tbfree.org.nz/contact-us.aspx), by post or by telephone. Contact details appear on the video, which might have assisted Student U02 to find the video credible.

Furthermore, Student U02 described how before watching the video they had not known much about the use of this control method or "*what was really happening*." They appeared to find the video informative and believable, and by describing the scenes as, "*eye-opening*" displayed their use of the mechanism *cultural credibility* to assist their communication of their risk ideas.

These responses display how these students used the communication mechanism *cultural credibility* to believe an expert is credible when they share similar cultural values with the individual. Adding these recollections to their responses assisted these students to make meaning of the images, regardless of their Cultural Types.

No *Nature Ephemeral* views were found within the data analysed. The researcher believes that no evidence of the communication mechanism *cultural credibility* being used by students expressing *Nature Ephemeral* views was found within the data for two possible reasons. Firstly, these students would have either needed to support the pro-1080 stance of New Zealand's DOC and TBfree New Zealand, or else they would have needed to support the anti-1080 stance of the publications rejecting the use of 1080, such as the video called *Poisoning Paradise: Ecocide in New Zealand,* produced by the professional hunting brothers, Clyde and Steve Graf (2015). The pro-1080 information included animals dying from 1080 poison, which Nature Ephemeral

Cultural Types find abhorrent. Similarly, the anti-1080 information included the right to hunt and kill deer for sport, and this stance may have also been abhorrent to the *Nature Ephemeral* Cultural Types within this study.

The third communication mechanism, adapted from the ideas of Kahan (2012), that the researcher has named *cultural advocacy*, will now be discussed.

7.5 Analysis of student responses using the communication mechanism *cultural advocacy*

This mechanism is an adaptation of three of Kahan's (2012) communication mechanisms, which the researcher has grouped together and named *cultural advocacy*. The researcher grouped these together as one new mechanism because Kahan identified a dismissive component within each of these three mechanisms that individuals would express, which the researcher did not find in the responses within this study. This modified communication mechanism *cultural advocacy* is displayed in Figure 7.4 and is a nuanced version of Kahan's ideas. The researcher believes this new mechanism allows a fine-grained analysis of students' responses because it contains three ways in which they might communicate their advocacy or promotion of their Cultural Type.

The following explanation describes the components of this figure. Each of the three strategies that can be used in this mechanism are displayed in the first column and student responses for each of the three Cultural Types are listed in the following columns. Within these student responses, the relevant words that illustrate this communication mechanism have been underlined and uniquely colour-coded. Excerpts from the interviews have also been included to provide further information.

The ways *Cultural Advocacy* can be expressed:	The Three Cultural Types:		
	Nature Tolerant Hierarchist Rationality	*Nature Ephemeral Egalitarian Rationality*	*Nature Benign Individualistic Rationality*
*Being **open-minded** towards new information that supports their Cultural Type*	Student R07's comments about the stoat image: *Other evidence of wildlife targeted by poison 1080. Similar to the previous image, other wildlife is targeted as way of introducing 1080 into their natural habitat which causes a threat to the natural ecosystem. **Stoats poses a threat to native species as they feed on the same food sources. In turn endangers native species survival.*** *Just from how they eat the same resources. (Interview)*	Student R04's comments about the stoat image: *A cute peaceful looking animal, **but it is a pest**. Cause the animal is in an environment that makes it happy. The dangers of **pest** that can attack property that they shouldn't touch. Cause they need food to survive, so will attack farming and create a mess.* *Yeah, **but it was a pest**. (Interview)*	Student U03's comments about the helicopter image: *Helicopter. **There's a helicopter flying in the picture**. They are **dropping 1080 poison**. I know. Well, when I was doing research for the assessment, **I found out how they, I guess put it out into** the forests. Personally, I think 1080 is OK. But yeah, **I guess they don't have to use too much, just enough to keep rats and pests under control.** (Interview)*
***Persisting with their beliefs and selectively choosing evidence** that reinforces these beliefs*	Student R06's comments about the possum image: *A possum. It's a **pest.** They kill chicks and damage trees. **Predator**. Kills native species when other food resources run low. Possums are known **pests.*** *Yes. (Interview)*	Student U09's comments about the dead deer image: ***I won't be sleeping tonight. Cruel. Really disturbing**. Poor animal. I think the picture justifies my reasons. **It's quite upsetting looking at the amount of pain and harm they go through after digesting 1080**. Because the process of death harms them. Painful death.* ***Yeah.** (Interview)*	Student U21's comments about the 1080 poster image: *A **danger sign**. Warning sign. Because of the words used in it show that there is something **dangerous** in the area.1080 is very **dangerous** to other species and other research I have done supports that 1080 is very **dangerous** for other animals. (Student not interviewed)*
***Remembering more details** when they hear risk information that is consistent with their Cultural Type*	Student U07's comments about the 1080 poster image: *Danger. Hazards. Because of the skull and cross symbol. Red font.* ***Do not drink water or fish for trouts [sic] in this area. Because the trouts [sic] could consume poisoned mice and 1080 could be in the water even if it's in low concentrations**.* *Yeah. (Interview)*	Student R11's comments about the 1080 poster image: ***Dangerous. Animal cruelty. Death. Pain. Poison. Animal cruelty. Death to innocent animals. Long cruel drawn out deaths. This is a deadly poison that shouldn't be put down. Pests should be culled not forced into horrible death. More than just the pests are being killed. Dangerous.*** ***The dogs, that's why I thought it was cruel. Because, you know, if dogs are to wander and eat bait or eat carcasses that is it for them.** (Interview)*	Student U17's comments about the 1080 poster image: ***Should I bring a dog on the hike. I need to get a dog. I'm not usually worried. They don't poison where I am. I live in Manurewa.*** *(Student not interviewed)*

Figure 7.4. Student responses within three Cultural Types using the mechanism *cultural advocacy* when communicating their ideas about the images.

7.5.1 Analysis of student responses demonstrating the communication mechanism *cultural advocacy* by being open-minded

Students who demonstrate *cultural advocacy* when justifying their responses can do so by displaying an open-minded view towards new information that affirms their values. Students from all three Cultural Types seemed to use this strategy of open-mindedness as part of this mechanism to justify their individual positions when responding to the questionnaire images and the pertinent sections within three indicative examples are displayed in mauve in Figure 7.4.

The first student's response analysed in Figure 7.4 is Student R07. They appeared to use *cultural advocacy* as a communication mechanism to display a *Nature Tolerant* rationality about the environmental risks associated with the use of 1080 when they described the stoat image.

This student did not seemingly agree with the use of 1080 poison because it "*causes a threat to the natural ecosystem*." However, when given the image of the stoat to comment on, they did agree that stoats caused problems in New Zealand forests because they *"feed on the same food sources*" as native species. This could suggest that they were open-minded towards their removal because they believed that the stoat species "*endangers native species survival."* This response seemed to demonstrate Student R07's open-mindedness and some degree of tolerance towards the removal of pest species. This acceptance was also reiterated during their interview when the said that stoats "*eat the same resources*." Student R07 accepted that stoats were an issue, and used *cultural advocacy* to communicate their open-mindedness about their *Nature Tolerant* values of the need to be responsible when dealing with the environmental risk of rescuing the biodiversity within New Zealand.

The second example of a student who seems to have used *cultural advocacy* by demonstrating open-mindedness in their response was Student R04. They also commented on the stoat image and in their response, they acknowledged that the stoat was "*was a pest.*" They supported a *Nature Ephemeral* perception of environmental risk, believing in equality of outcomes for all forms of life and described the stoat as being in "*an environment that makes it happ*y." Despite this belief, they mentioned the pest status of the stoat twice during their written response and then once again during their interview. This possibly demonstrates that although they held *Nature Ephemeral* views, they were open-minded about the "*dangers of pest that can attack property that they shouldn't touch",* and the need to control these *"pest"* animals.

The final example using the communication mechanism of *cultural advocacy* in their response is Student U03, who demonstrated *Nature Benign* values. In their response to the helicopter

flying over a forest, Student U03 initially stated the obvious by writing "*there's a helicopter flying in the picture*" and justified their response by writing that the helicopter was "*dropping 1080 poison*." Without using any emotional language, this response displays their *Nature Benign View of Earth's resources* as abundant and controllable.

Student U03 appeared to use the strategy of being open-minded in their response about the use of 1080 when they described the helicopter image during their interview. Although they initially appeared to be noncommittal, they later seemed more receptive of the idea about using 1080. In their interview, they said that, "*I found out how they, I guess put it out into the forests"* and then also added that *"they don't have to use too much, just enough to keep rats and pests under control*." This comment possibly demonstrated the use of *cultural advocacy* to communicate their open-mindedness when they found out about the use of this substance and the relatively small amounts used, which was also reiterated when they said, "*1080 is OK*."

7.6 Analysis of student responses demonstrating the communication mechanism *cultural advocacy* by persisting in their beliefs and selectively choosing evidence

The second way that students can demonstrate *cultural advocacy* in their responses is by displaying the strategy of having a persistence of beliefs and selectively choosing evidence that fits with their ideas and values. Students from all three Cultural Types seemed to use this strategy as part of this mechanism to justify their positions when responding to the questionnaire images and the pertinent sections within three indicative examples are displayed in light green in Figure 7.4.

A student who appeared to demonstrate this strategy in their response is Student R06. They described the possum image using a *Nature Tolerant* Cultural Type. In their response, Student R06 described the possum as a "*pest*" and a "*predator*" and this belief persisted throughout their response, where they focussed on the vermin-like aspect of this species. The researcher argues that this repetition is similar to responses by other students displaying different Cultural Types. For example, *Nature Ephemeral* supporters, who might describe the possum by focussing on different aspects, such as the animal's personal attributes, or its ability to care for its young. Alternatively, they might have included information about how the possum was deliberately introduced into New Zealand and is an animal in the wrong habitat, like a *Nature Benign* Cultural Type might describe.

Student R06 used the word "*pest*" at the beginning and at the end of their written response, seemingly to emphasise their point. Then during their interview Student R06 simply stating

"*Yes*", confirming their view, providing a further example of their use of this strategy to communicate their risk ideas by persisting in their beliefs.

The next student who seemingly demonstrated *cultural advocacy* to communicate their views by persisting in their beliefs and selectively choosing evidence was Student U09. This student displayed *Nature Ephemeral* views and emotionally responded to the dead deer image and wrote, "*I won't be sleeping tonight. Cruel. Really disturbing."* By selectively choosing to write about the horror they felt, Student U09 emotionally communicated their *Perceptions of environmental risk*, using *cultural advocacy*. They also chose to communicate their aversion to the risk of using 1080 using this mechanism by writing that they felt the dead deer image was "*upsetting*". Student U09 believed that the animal had consumed poison and that they were looking at an image of "*the amount of pain and harm they go through after digesting 1080*." Furthermore, they described the deer sympathetically as a *"Poor animal"* and felt that the animal had suffered a "*painful death*" and that the image of the dead deer *"justifies my reasons.*"

Throughout their written responses Student U09's views about the deer remained the same. They also included information about their distaste for 1080 as a control method. During their interview their views were reiterated by saying "*Yeah.*" This response demonstrates the use of *cultural advocacy* to communicate Student U09's selectively chosen and persistent views.

The final student who employed *cultural advocacy* using the strategy of persistence in their beliefs and selectively choosing information was Student U21. They responded to the image of the 1080 poster by writing, "*A danger sign. Warning sign. Because of the words used in it show that there is something dangerous in the area.*" In responding to this image, it appears that Student U21 selectively chose to focus on only some of the information presented on the sign and the words "*danger*" or "*dangerous*" were used four times to reinforce these ideas. They emphasised the "*danger"* this substance posed to "*other species*" and "*other animals.*" Despite not being interviewed, Student U21 emphatically communicated their *Nature Benign* view in their written response using this strategy. They selectively chose to write about 1080 as a "*dangerous*" chemical and focussed on the use of this word to persist in their views.

7.7 Analysis of student responses demonstrating the communication mechanism *cultural advocacy* by remembering more details

The final strategy within the communication mechanism *cultural advocacy* is to remember more details when participants hear risk information that is consistent with their cultural values.

Students from all three Cultural Types appeared to use this strategy to justify their individual positions when responding to the questionnaire images.

The first student's responses analysed in Figure 7.4 was Student U07 who displayed *Nature Tolerant* views. Their initial response to the 1080 poster image was to describe what they saw in the image and wrote, "*Danger. Hazards. Because of the skull and cross symbol. Red font*." Then they seemingly used the communication mechanism, *cultural advocacy* to remember more details because they recalled information that was not present on the poster.

This recollection of additional information enabled them to elaborate their ideas in their response as they described their concerns. Student U07 described the possible risk of secondary poisoning to humans either by directly drinking stream water flowing through a forest or eating fish that may be contaminated with 1080 in the stream, by saying "*Do not drink water or fish for trouts [sic] in this area*." Recalling this information enabled Student U07 to make meaning of the information in the poster and allowed them to relay the concerns they had about the use of 1080. The recalled information strengthened their hierarchical rationality, of having a *Perception of environmental risk* that focussed on group responsibility. In this recalled information Student U07 emphasised their concern for others, demonstrating a strong group culture, typical of this *Nature Tolerant* Cultural Type.

The next student also seemed to use the communication mechanism *cultural advocacy* by employing the strategy of remembering additional information to justify their *Nature Ephemeral* Cultural Type. In Student R11's response, they wrote the word "*poison*" which was included in the poster image. Then, using *cultural advocacy* through this strategy, Student R11 expressed their abhorrence towards the use of 1080 in New Zealand by emphatically communicating a large amount of additional information. In fact, they principally used their own recalled ideas to express their absolute aversion about the use of 1080. In their response they wrote "*Dangerous. Animal cruelty. Death. Pain. Poison. Animal cruelty. Death to innocent animals. Long cruel drawn out deaths. This is a deadly poison that shouldn't be put down. Pests should be culled not forced into horrible death. More than just the pests are being killed. Dangerous."*

Then, during the interview, Student R11 used the poster information and focussed on the vulnerability of dogs, again to express their repugnance of 1080. When asked their opinion, they said "*if dogs are to wander and eat bait or eat carcasses that is it for them."* Perhaps they knew about the lack of antidotes available for 1080 poisoning (Goh, Hodgson, Fearnside, Heller, & Malikides, 2005; Royal Forest and Bird Protection Society of New Zealand, 2017). In this way

Student R11 used *cultural advocacy* to recall additional information when communicating such strong views and an abhorrence towards the use of 1080 as they viewed this poster image because it threatened their *Nature Ephemeral* cultural values.

The final example of a student using the strategy of remembering more details within the communication mechanism *cultural advocacy* to express their *Nature Benign* views was from Student U17. When commenting about the 1080 poster image, they did not describe any information that was on the poster at all, instead they posed the question, "*Should I bring a dog on the hike. I need to get a dog*." This seems to display their use of *cultural advocacy* to communicate their thoughts about the information on the 1080 poster. While the sign contains a clear statement about the risk to dogs from 1080, Student U17 did not directly refer to this. Instead they wrote their thoughts about them owning a dog in the future.

Moreover, in a further response Student U17 again recalled more information and stated that they were "*not usually worried. They don't poison where I am. I live in Manurewa*." This latter comment displayed their disinterest about the use of 1080, because they were not personally affected by its use. This display of an individualistic rationality is consistent with a *Nature Benign* Cultural Type and a view that people need to look after themselves. By focussing on their own needs, rather than describing the information within the questionnaire image and writing about issues that might affect them personally, Student U17 has demonstrated the use of *cultural advocacy* to communicate their views.

The responses displayed in Figure 7.4 demonstrate how these nine students used the communication mechanism *cultural advocacy* and the strategies of being open-minded, persisting in their beliefs and selectively choosing evidence and remembering more details. Using this communication mechanism assisted these students to make meaning of the images, regardless of their Cultural Types.

7.8 Summary

This chapter has presented information to demonstrate how the student participants in this project used cultural cognition mechanisms, initially proposed by Kahan (2012), to communicate their views of risk about the issue of biodiversity rescue, regardless of their Cultural Type.

The first two communication mechanisms were adopted directly from Kahan's (2012) ideas and were named *narrative framing* and *cultural credibility*. The communication mechanism *narrative framing* demonstrated that individuals attempt to make meaning of risk information by

fitting it into pre-existing narratives. An example given was Student R05 who displayed a *Nature Tolerant* Cultural Type and used this communication mechanism in their response by writing about remembering that their father had been bitten by a stoat that had been caught in a trap.

Cultural credibility was the second communication mechanism presented that was adopted from Kahan (2012). This analysis demonstrated how participants tend to believe that an expert is credible if they shared similar cultural values with the individual. An example of a student using this communication strategy in their response, was Student R09 with a *Nature Tolerant* view, who wrote about some information provided by DOC. This information related to the distribution of 1080 over New Zealand forests by helicopter, which they believed was credible. In the discussion of this mechanism no examples of the Cultural Type *Nature Ephemeral* were found.

The third communication mechanism discussed was named *cultural advocacy*. This mechanism was adapted by the researcher from Kahan's (2012) ideas about three communication mechanisms that he named *identity affirmation, biased assimilation* and *cultural availability*. The researcher adapted these ideas of Kahan's because his three mechanisms enabled a dismissive component to be investigated within his participants' responses, which the researcher did not find within her collected data. However, aspects of Kahan's three mechanisms were combined to form the nuanced *cultural advocacy* communication mechanism strategies used in this project to analyse students' responses.

An example of displaying open-mindedness, one of the strategies within *cultural advocacy*, was demonstrated in Student U03's response to the helicopter image when they wrote about not using too much 1080 in forests. Student U09 displayed a persistence of beliefs and selectively choosing evidence, which was a second strategy identified within the communication mechanism *cultural advocacy*. They communicated their *Nature Ephemeral* views about the image of a dead deer and demonstrated how their risk beliefs persisted throughout this project by describing being unable to sleep because of the upsetting image. The final strategy discussed within the communication mechanism *cultural advocacy* was remembering more details when presented with a questionnaire image. Student U07 was an example presented. They used this mechanism to communicate their *Nature Tolerant* ideas of secondary poisoning and described the accumulation of 1080 in fish and the dangers of drinking stream water within forests.

Chapter 8 follows. In this final chapter the research questions are answered. Additionally, a discussion of the significant findings of this project and its implications for education are provided.

Chapter Eight
DISCUSSION AND IMPLICATIONS FOR EDUCATION

8.1 Introduction

This chapter will answer the research questions and discuss the significant findings of this research. These questions are presented as an encompassing question, which underpinned the research focus, and four sub-questions which identified individual aspects within the project.

These questions were:

> What are New Zealand secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy?
>
> - How could these students' responses be qualitatively analysed?
> - What is the range of views expressed about a biodiversity strategy?
> - How consistent are students' views of risk across a range of contexts?
> - What mechanisms do students employ to communicate their views and allow meaning-making when justifying their positions about a biodiversity rescue?

The focus of this study was an examination of the risks associated with the use of 1080 (sodium fluoroacetate) as a method to rescue the unique biodiversity in New Zealand's forests. Data were gathered from Year 12 biology students in two schools within New Zealand using a questionnaire booklet containing five images that required open-ended responses as well as individual interviews. While analysing the data it became apparent to the researcher that a new framework was needed to unpick the complexity of these students' views about risk. The analysis framework that was developed expanded on the grid/group typology proposed by Douglas (1978), the ideas of Schwarz and Thompson (1990) and the Myths of Nature characteristics identified by Steg and Sievers (2000). This new framework was displayed in Figure 4.10 (p. 75).

Within this chapter, Section 8.2 discusses the capacity of this framework to analyse the data gathered from the students. It also expounds the significant outcomes of this research and provides answers for the first research sub-question, *How could these students' responses be qualitatively analysed?* Section 8.3 identifies the range of risk views revealed during analysis of the data using the framework and therefore answers the second research sub-question, *What is the range of views expressed about a biodiversity rescue strategy?* Section 8.4 describes the consistency of students' risk views when they responded to images within the questionnaire.

This section therefore answers the third research sub-question, *How consistent are students' views of risk across a range of contexts?* The final research sub-question posed within this research was, *What mechanisms do students employ to communicate their views and allow meaning-making when justifying their positions about a biodiversity rescue*? The mechanisms adapted from the work of Kahan (2012) and used in this study to investigate the ways that the students communicated their risk views are discussed in Section 8.5 and provide answers for the final sub-question. Section 8.6 describes a potential holistic approach for future risk research and identifies further directions this research might take. Section 8.7 debates the educational implications of this research and Section 8.8 presents a concluding statement.

The capacity of the framework to analyse data will now be discussed.

8.2 The capacity of the analysis framework

The most significant outcome of this project was the development of the Risk Analysis Framework (Figure 4.10). This new framework enabled a **qualitative** analysis of these students' perceptions of risk when discussing a biodiversity rescue strategy. The analysed data answers the first research sub-question and provides a major contribution to the risk research field. Also noteworthy is that this new analysis framework has the potential to be used in other risk contexts.

Mary Douglas's (1978) concepts formed the skeletal structure for this analysis framework, however to the researcher's knowledge, she did not carry out any empirical study to support her ideas.

Furthermore, few empirical studies have been carried out by other researchers, apart from Dake and Thompson who investigated 220 British households and their ways of "making ends meet" (p. 417, 1999) and Steg and Sievers who investigated 413 participants' views about the environmental risks associated with the use of cars in the Netherlands (2000).

Moreover, the findings within this research are different from other New Zealand research about risk, which has been largely quantitative. For example, the quantitative research by Gulliver and Fanslow (2016) who investigated the personal risks involved in cases of family violence; Seville and Metcalfe (2005) who produced models to develop a hazard risk assessment of roads for Land Transport New Zealand; and Kaiser, Balfour, Holden, Litchfield, Gerstenberger…Gledhill (2017), who researched the damage resulting from a 2016 earthquake in Kaikōura in the South Island of New Zealand and produced an overview of the event to derive insights into the evolution of the ruptures in the Earth caused by the earthquake.

The Risk Analysis Framework (Figure 4.10) has particular strengths. One significant strength of the analysis framework was that it allowed a "common consciousness" (Durkheim, 1984, p. 38), or shared ideas and beliefs, that unified each of the four individual Cultural Types, to be revealed. These shared beliefs or *common consciousness* were revealed via the indicative words that were identified from within the student responses. These indicative words were established by the researcher as identifiers of the attributes of each of the four Cultural Types (see Appendix 7) based on the common cultural characteristics developed by combining the ideas of Douglas (1978), Steg and Sievers (2000), Schwarz and Thompson (1990) and Thompson et al. (1990). As an example, in the Cultural Type *Nature Benign* an identifying word was "venison" when referring to the image of a deer, whereas in the Cultural Type *Nature Ephemeral* the word "victim" was an example of an identifying word used to describe the same image. Further examples of these indicative words are displayed in Appendix 4 (Nature Benign), Appendix 5 (Nature Ephemeral) and Appendix 6 (Nature Tolerant). Importantly, the identification of the indicative words used by the students enabled consistency of analysis within each of the Cultural Types within this new framework.

Moreover, during analysis of the qualitative data, a common language used by each Cultural Type was revealed. For example, the analysis of the responses from the students with a *Nature Tolerant* Cultural Type revealed that *our/we/us* formed part of their common language, and *them/they/I* were examples of the common language used by the students with a *Nature Benign* Cultural Type. In a similar fashion, emotional language was used by the students with a *Nature Ephemeral* Cultural Type such as *horrific/cruel/gruesome,* to describe the images viewed by this group.

This use of a common language within each Cultural Type supports Douglas's (2003b) Cultural Theory ideas. Although her ideas were theoretical, she believed that "a culture is a system of persons holding one another mutually accountable … through a collectively constructed censor" (p.31). This quote supports the proposal that within any Cultural Type, individuals instinctively code the danger of any risk and find a level of accountability at which they are comfortable or can live with being held accountable, that matches the level that they want to hold others accountable. As one example, when describing the image of the 1080 sign in the questionnaire, Student R207 wrote:

> *The introduction of poison 1080 in NZ and all of the risks it opposes to the community in the efforts to reduce threat to native plants by possums. Due to the low numbers of natural predators and lots of vegetation the poison has been introduced to limit the threat to native plants opposed*

> *by possums. Hence this poison will solve the pest outbreak. However, produce some issues of its own.*

Demonstrating a *Nature Tolerant* Cultural Type, Student R207's response reveals that they agree with the spreading of 1080 in New Zealand forests to rescue the natural biodiversity. Hence, they have coded the risk as acceptable. This is then followed by a justification of their view. They explain that the country has few natural predators to keep the possums in check, while acknowledging that the issue is not risk-free. This justification demonstrates that they believe the risks involved in the use of 1080 to control pests is acceptable and matches the level that they want to hold others in society accountable as well.

Douglas opined further that people in a community develop "a consensus on the kinds of solidarity that will help them to cope collectively with their environment" (p. 30). Consequently, the members of each Cultural Type use a common language to demonstrate how strongly they feel themselves, that all members understand, and by which are held jointly accountable. This research provides empirical data to demonstrate this use of a common language (see Appendix 4,5,6 and 7), supports Douglas's theoretical ideas and it is argued, displays the rigour of the Risk Analysis Framework.

Therefore, in answering the first research sub-question: *How could these students' responses be qualitatively analysed?,* it appears that the development of the Risk Analysis Framework used in this research, did allow the data to be analysed qualitatively. Furthermore, it revealed a *common consciousness* and the use of a common language within each of the Cultural Types.

The framework also revealed a range of responses within the collected data, which will now be discussed.

8.3 A range of responses revealed

Douglas (2003c) asserted that the inclusion of all four of the Cultural Types in any investigation was important because each of these types contained "cherished values" (p. 1357), that were important to their individual members. The Risk Analysis Framework used within this research contained four equally important and individual Cultural Types, each comprising five corresponding characteristics. Each of the four Cultural Types was also supported with descriptive rationalities. Therefore, the framework mechanism was able to qualitatively analyse the **range** of perceptions of risk collected from the student participants by having these five common characteristics, separated into individual attributes for each Cultural Type. A summary

of the common characteristics and individual attributes for each of the four Cultural Types is presented in Table 8.1.

Table 8.1
A summary of the common characteristics and individual attributes for each of the four Cultural Types

Common characteristics	**Individual attributes of the four cultural types**			
	Nature Tolerant	*Nature Capricious*	*Nature Ephemera*	*Nature Benign*
View of nature	Robust but vulnerable	Random system	Precarious and fragile	Robust and stable
View of Earth's resources	Scarce but controllable	Uncontrollable chaos	Depleting	Abundant and controllable
People's needs	Uncontrollable	Uncontrollable	Controllable	Controllable
Risk perception	Controllability and responsibility	Just cope	Equality of outcomes for all	Exploitability
Risk management strategy	Use planning and regulation	Attribute luck	Risk averse	Use trial and error

Furthermore, Douglas elaborated on the importance of having all four Cultural Types in any study, by emphasising that "[b]y anchoring cultures to the organizations that they justify, this assumption protects the interpretation from the interpreter's own bias" (2003c, p. 1355). Here Douglas was arguing that each of the Cultural Types acknowledged a particular way of living within a society and therefore all four must be treated equally by researchers in order to maintain objectivity during the data analysis. Significantly, the analysis carried out in this research was able to demonstrate that all four Cultural Types were present.

What is noteworthy about this research is that while Douglas (1999, 2003c) generally described identifying features of each Cultural Type, she did not develop a specific list of common characteristics for each. However, Douglas's idea about including each Cultural Type equally, was considered carefully by the researcher. Consequently, a similar number of ***common characteristics*** for each Cultural Type, within the new analysis framework was developed by the researcher, to achieve this equality.

These common characteristics that were developed for each Cultural Type were: a View of nature; a View of Earth's resources; an opinion about People's needs; a Perception of environmental risk; and the Risk management strategy adopted, as displayed in Table 8.1. These common characteristics are an integral part of the Risk Analysis Framework. Therefore, the

researcher's framework differed from the model developed by Steg and Sievers (2000) who used differing numbers of characteristics for each type in their analysis tool (see Figure 4.4 p. 68).

Furthermore, the new Risk Analysis Framework embedded the *polythetic* concepts of Douglas (1978), allowing for the identification of some, but not necessarily all, of the characteristics within each Cultural Type in the students' responses. As a result, the framework aided the analysis so that students could be identified as belonging to one of the four Cultural Types. It allowed for the differences between these four groups to be exposed which concurred with Rayner's (1992) ideas. He argued that a grid/group typology could indicate differences between societal groups and would be a useful tool for investigating a diversity of risk ideas within any society.

Moreover, when identifying the four Cultural Types, the differences between these findings and the research of both Wynne (1992) and Kolstø (2001) were revealed. They believed that within a society a binary of ideas developed where scientists' views differed from lay-people within a society. However, the findings of this study showed that there are four different Cultural Types within any society (*Nature Tolerant*, *Nature Benign*, *Nature Ephemeral* and *Nature Capricious*), where each Cultural Type is characterised by each group's distinctive ideas and values.

As well as having these strengths, the framework was also able to test several assertions made by Douglas (1978, 2003c), such as the distribution of the Cultural Types within any group. Douglas (2003c) opined that the two Cultural Types, *Nature Tolerant* and *Nature Benign*, will always be the most commonly represented within any society and that they were both "allies and rivals at the same time" (p. 1358). Douglas (2003c) believed that the *Nature Tolerant* Cultural Type were needed in a society because of their hierarchical beliefs, since they were the people who were responsible for the maintenance of a society, as they respected times and places. She argued further that *Nature Benign* individualists were the entrepreneurially-inclined members of society, who came up with the new ideas and competed for esteem and income. The other two Cultural Types, she asserted, would always be in the minority and were defined by their dissent from the majority. A strength of the new Risk Analysis Framework was that it was able to provide empirical, qualitative data to support these ideas asserted by Douglas.

Within this project's data set, it was revealed that the *Nature Tolerant* and *Nature Benign* Cultural Types were the most common. This major finding is consistent with Douglas's (2003c) ideas. These data were displayed in Table 5.1 and are summarised in Table 8.2.

Table 8.2
Total number of student responses to the five images within the Cultural Types

	The four Cultural Types			
	Nature Tolerant (Hierarchical Rationality)	*Nature Benign* (Individualistic Rationality)	*Nature Ephemeral* (Egalitarian Rationality)	*Nature Capricious* (Fatalistic Rationality)
Number of responses to the five images	28	23	16	4

Table 8.2 shows that a total of 28 students displayed some *Nature Tolerant,* or hierarchist characteristics and a total of 23 displayed some *Nature Benign*, or individualistic characteristics. These two Cultural Types were the most common responses within the data set and aligns with Douglas's assertion. Also, as shown in Table 8.2 fewer participants displayed some *Nature Ephemeral*, or egalitarian, characteristics and the *Nature Capricious*, or fatalistic, characteristics were the least common.

As shown in Table 8.2, within the entire data set, four students gave responses that were identified as *Nature Capricious*. These students' responses were identified as belonging to this group as they had written, for example "Not sure" (Student U18). Douglas (2003c) reasoned that inclusion of the *Nature Capricious* participants in any research gave a space for those who want to respond with "don't know" (p. 1369).

Further potential evidence of this *Nature Capricious* Cultural Type, could be the 13 rural and 13 urban students who signed and returned the permission slips but then decided not to participate in the research, as displayed in Table 8.3.

Table 8.3
The possible identification of Nature Capricious participants within this research

Criteria within the two schools	**Rural School**	**Urban School**
Total possible student numbers	47	74
Number of students who returned their consent forms	31	35
Number of students who decided not to participate after returning their consent forms and were not included in the research data ***(possibly the Nature Capricious Cultural Type)***	**13**	**13**
Total participants in this research from whom data were analysed	18	22

The implication is that these 26 students' (13 rural, 13 urban) non-participation is representative of the *Nature Capricious* Cultural Type. If this were the case, then as a group, their non-

participation becomes a significant number of the total possible participants from both schools. The researcher asserts that by choosing not to participate, no one can ever be sure about these students' views, but they potentially "affect the polls by their silence" (Douglas, 2003c, p. 1369).

Therefore, in answering the research sub-question: *What is the range of views expressed about a biodiversity rescue*?, it appears that the range of views expressed by these students was able to be qualitatively analysed by the development of an equal number of common characteristics for the four Cultural Types. Furthermore, the analysis revealed the polythetic concepts of Douglas (1978). Moreover, this research provided empirical evidence to confirm Douglas's theoretical assertions (2003c). These assertions were that the *Nature Tolerant* and *Nature Benign* Cultural Types would be more common than the other types and that the Cultural Type *Nature Capricious* was displayed in responses such as "Don't know" (2003c, p. 1357).

8.4 The consistency of students' views

The Risk Analysis Framework used in this project also allowed an examination of Rayner's (1992) assertions where he proposed the *mobility* and *stability* hypotheses about how individuals perceive risk within a society and answers the question about the **consistency** of the students' views across a range of contexts within this study.

Rayner (1992) believed that when an individual discussed risk within a specific context, a particular cultural bias was displayed, and he argued that this cultural bias could change depending on the context, naming this idea the "*mobility hypothesis*" (p.107, italics in original). Data analysis showed examples of this hypothesis. An example was from Student R14 (see Figure 6.5, p. 138), who displayed *Nature Tolerant* attributes when they responded to the images of the helicopter, possum and stoat. However, Student R14 displayed *Nature Ephemeral* attributes when they responded to the 1080 poster image and *Nature Benign* attributes to the dead deer image. This revealed that Student R14 demonstrated different Cultural Types that changed depending on the image, indicating a plasticity in their Cultural Type.

Rayner (1992) also opined that Douglas advocated a "*stability hypothesis*" (p. 107, italics in original) believing that when an individual developed a cultural bias, they retained that view and did not change. Data analysis showed examples of this hypothesis as well. A student who demonstrated this stability hypothesis was Student R12 where all their responses to all five questionnaire images were identified within the *Nature Tolerant* Cultural Type (see Figure 6.2, p. 126). As one example, Student R12's response to just the possum image was:

> *Scary. Because possums aren't friendly and are scary. They are pests - damage nature. A pest being targeted by 1080. Because possums carry TB which can be passed onto the biggest industry-dairy farming.*

Student R12's response is of particular significance because, not only were all this student's responses found within the one Cultural Type, three of the five possible *Nature Tolerant* attributes were displayed within this single response about the possum. These different attributes are colour-coded in the response above and are explained in depth in Chapter 6 (see Figure 6.1, p. 124 and Figure 6.2, p. 126 for the analysis).

Therefore, in answering the research sub-question: *How consistent are students' views of risk across a range of contexts?* it appears that the findings of this research were able to uncover that both the mobility and stability hypotheses proposed by Rayner (1992) were used. For the students who demonstrated the *mobility hypothesis*, the context or image viewed appeared to be key, as their beliefs were not so strong that they expressed just one Cultural Type. However, the consistency of beliefs within one Cultural Type appeared to be the important factor for the students demonstrating the *stability hypothesis.* Therefore, it seems that both hypotheses were demonstrated within the students' views within this research, which is counter to both Rayner's and Douglas's ideas (Rayner, 1992).

The findings to answer the final question about identifying the mechanisms employed by the student participants within this study to communicate their views will now be discussed.

8.5 Communication mechanisms identified

The data within this study showed that **regardless** of their Cultural Type, the student participants used **common** mechanisms to communicate their risk views. Each Cultural Type communicated their views using these common mechanisms to support their own cultural bias. These communication mechanisms were developed by Kahan et al. (2011) and Kahan (2012) in their Cultural Cognition Theory. They quantitatively analysed data about people's views of risk, and then graphed these views onto a two-dimensional continuum (see Figure 2.5, p. 35). As part of their Cultural Cognition Theory, Kahan et al. and Kahan also described five communication mechanisms. They asserted that these mechanisms explained ways that individuals communicated their views of risk and connected an individual's perception of risk to their cultural bias. Kahan et al. and Kahan identified these five Cultural Cognition Mechanisms as: *narrative framing*, *cultural credibility*, *identity affirmation*, *biased assimilation* and *cultural availability*.

In this study, the researcher used two of the mechanisms directly from the ideas of Kahan et al. (2011) and Kahan (2012). These two mechanisms were *narrative framing* (where individuals assimilate information, fitting it to pre-existing narratives, to invest the information with meaning) and *cultural credibility* (where individuals tend to believe an expert is credible if they share similar cultural values with the individual directly). The researcher then adapted three of the communication mechanisms (*identity affirmation, biased assimilation and cultural availability)*. This adaptation occurred because each of these three mechanisms contained negative components, which facilitated placement within Kahan et al. and Kahan's Likert scale that they used to quantitatively analyse data. As the researcher used a qualitative analysis approach, the negative component was omitted because a fine-grained analysis was sought rather than a gradation on a scale. Therefore, within this qualitative research, only the positive aspects of these three communication mechanisms were used and were combined into one. This expanded and further developed mechanism was named *cultural advocacy*.

The researcher asserts that the communication mechanisms used by these students support the Risk Analysis Framework developed by the researcher by revealing how each participant communicated their risk views within their Cultural Type. As an example, Student R05 wrote about remembering that their father had been bitten by a stoat that had been caught in a trap. Here, Student R05 displayed a *Nature Tolerant* Cultural Type and used the communication mechanism *narrative framing* in their response to make meaning of risk information by fitting it into pre-existing narratives. However, Student U02 who displayed a *Nature Ephemeral* Cultural Type also used the communication mechanism *narrative framing*, by recalling a television programme called "*CSI*" when they responded to the image of the deer. In their response, Student U02 focussed on the idea that they saw the deer as a "victim" as they had remembered the victim theme from the television programme. The third example of a student using this communication mechanism, was Student U04. Displaying a *Nature Benign* Cultural Type, they recalled seeing a helicopter when on holiday and they used this memory to assist them to make sense of the image of the helicopter in the questionnaire. All three students in the above examples (see Figure 7.3, p. 155) used the same mechanism, but in diverse ways, that aligned with each of their different Cultural Types, in order to communicate their individual ideas about risk.

Therefore, in answering the final sub-question: What mechanisms do students' employ to communicate their views and allow meaning-making when justifying their positions about a biodiversity rescue?, it appears that by using two mechanisms and expanding another mechanism first developed by Kahan et al. (2011) and Kahan (2012), the researcher was able to demonstrate

that **narrative framing, cultural credibility** and **cultural advocacy** were the mechanisms are used to communicate risk ideas. Additionally, regardless of their Cultural Type, the students used the same mechanisms to communicate their risk views.

The potential for combining the communication mechanisms described above and the Risk Analysis Framework to provide a possible future for risk research is now discussed.

8.6 Moving towards a more holistic analysis of risk perceptions

It is argued that the Risk Analysis Framework and the communication mechanisms both adapted and adopted from Kahan et al. (2011) and Kahan (2012), provide an improved understanding of the "collective consciousness" (Durkheim, 1984, p.38) of each of the four Cultural Types. This improved understanding can be gained because a more fine-grained analysis can be carried out than would be possible by using one tool alone or a quantitative approach. The researcher asserts that this combination provides a "holistic view" (Kasperson, 1992, p. 157) and allows an in-depth analysis of the personal experiences of the participants within the study. Additionally, this view explains "why people want what they want and why people perceive the world the way they do" (Thompson et al., 1990, p.2).

Moreover, Rayner proposed that future directions of risk research need to be more "interdisciplinary" (1992, p. 113). He argued that risk analysis will change in the future from being single sourced or a local risk - such as the risk of a chemical spill from a factory, to multi-sourced or a global risk - such as the risks associated with greenhouse gases accumulation worldwide, such as rising ocean levels and more extreme weather conditions. Therefore, he believed the future challenge for risk research will be the need to become more holistic in its approach, as displayed in Figure 8.1.

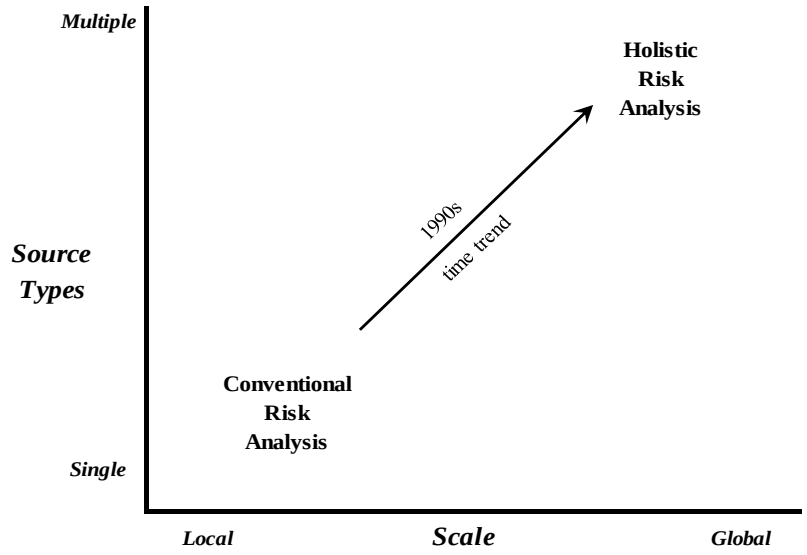

Figure 8.1. Diagram showing Rayner's view of the future directions of risk research (1992, p. 114).

In Chapter 2, a three-dimensional model of risk research developed by Taylor-Gooby and Zinn (2006) (Figure 2.2, p. 22), was discussed. In their three-dimensional model they mapped a mosaic of the differing perspectives of risk analysis that they believed portrayed the differing risk approaches. In comparison to their model, Rayner (1992), with his graphical representation, was suggesting a more outward looking, holistic approach to risk analysis. He believed that as more global risk issues arose in the future, instead of each perspective being separate when analysing risk, they will become more interdisciplinary. Moreover, he argued that this mixing of perspectives will grow in importance. Additionally, Rayner opined that in the future a more systematic approach to risk management regimes would be necessary because of the growing seriousness, and importance of social issues involving risk.

Consequently, as these emerging issues require more attention, so the importance of risk analysis will also grow. Rayner (1992) believed that each branch of social science analysis offered a plausible explanation for differing aspects of any risk issue. He also argued that they all shared the view that risk behaviour was a function of how human beings "perceive their place in the world and the things that threaten it" (p. 113). Rayner believed that this growing need may provide an opportunity to overcome "the vast gaps that presently exist between various social science paradigms for risk analysis" (p. 113) in order to successfully solve or at least mitigate these risk issues by using this holistic approach.

This growing urgency was also identified by Ravetz (1997). He argued that in previous times people believed that the Earth was an endless pit into which environmental wastes could be dumped. Ravetz opined, that there is an increasing feeling of uncertainty amongst people about

the capacity of science and technology to solve emerging issues and their associated risks in a rapidly changing world.

The researcher believes that the Risk Analysis Framework developed for this project has the potential to analyse risk situations that are both local and global in an "interdisciplinary" (1997, p.113) manner suggested by Rayner. However, it is acknowledged this research sought to examine the data collected from a small group of similar aged students' perceptions of risk when discussing a biodiversity rescue strategy. It is also acknowledged that further research needs to be carried out with different age groups within New Zealand. Additionally, further research needs to be undertaken using controversial contexts internationally, using both different contexts and age groups to test the robustness of the Risk Analysis Framework.

However, Douglas (1997, 2003c) did not agree with this more holistic view. She opined that the psychometric model of risk, on which Kahan's (2012) communication mechanisms are based, paid no attention to the personal experiences or personal lives of individuals within any society, believing that such models had limited capacity to describe how cultural processes worked. She further opined that this psychometric model aimed to depoliticize risk to impart a "halo of objectivity" (1997, p. 131) which she said was not possible because the development and maintenance of culture in a society was political. Also, Douglas argued that the psychometric model had a focus "solely on the intellectual and emotional aspect, without regard for the constraining economic and social environment" (2003c, p. 1355), and asserted that within any research the identification of both time and place were important.

Nevertheless, the researcher asserts that by using the communication mechanisms discussed in this project, and combining these with the new Risk Analysis Framework, a more detailed, holistic and nuanced analysis of participants' risk perceptions is possible. Moreover, only the '*communication mechanisms*' portion of Kahan et al. (2011) and Kahan's (2012) Cultural Cognition Theory was used in this analysis. The researcher argues that this combination allows for the complexity of the personal experiences of participants within this study to be recognised and included within this analysis.

The educational implications of this research will now be discussed.

8.7 Educational implications

Since science increasingly poses ethical and moral dilemmas, engaging with socio-scientific issues (SSIs) can enable students to gain an insight into how science is used, see the connections

of science to everyday life and so enhance their scientific literacy skills (Evagorou, Jimenez-Aleixandre & Osborne, 2012). However, Oulton, Day, Dillon and Grace (2004) opine that SSIs are different from the usual problems often presented in science classrooms since they can be complex issues that are often ill-structured and involve both ethical and moral aspects.

Therefore, the educational implications of this research are potentially significant because students may be unaware of the sociocultural complexity impacting on risk issues. These implications are that post-normal science and an SSI approach are appropriate and necessary vehicles for teaching a new view of science that includes views about risk.

Stevenson et al. (2014) assert that it is important to teach this new view of science in the teenage years as adolescents represent a group whose worldviews are still forming and therefore, they may be more open to new views. The researcher proposes that the teaching of risk, which is an inherent component of post-normal science and an SSI approach, is essential as a vehicle to enhance the teaching of a new perspective of science which examines differing points of view, as discussed in Chapter 2 (p. 18). However, the researcher asserts that the teaching of risk is often overlooked when teaching about SSIs. It appears instead that the focus can often be on the pedagogical strategies needed to teach the content. While the researcher makes no claim to providing an exhaustive list, three examples of research having this pedagogical focus are the decision-making frameworks developed by Lee (2007) which was then further explored by Lee and Grace (2010) and the ethical thinking model developed by Saunders and Rennie (2013). In these three examples models were developed to scaffold students to make decisions about controversial issues. Lee investigated the views of 160 Hong Kong students, aged between 15-16 years within two secondary schools about the risks of smoking. In the second example, Lee and Grace investigated 31 secondary students in Hong Kong of similar age to Lee's (2007) study about whether bats were worthy of conservation. In the final example, four teachers within two New Zealand schools trialled an ethical enquiry model using students aged between 13-18 years. While the use of the different models, that scaffolded students' learning, were shown to enhance their decision-making skills, no reasons why the participants in each study came to these decisions, were explained to the students. That is, the reasons **why** people have different points of view about risk issues were not explained – this valuable cultural perspective that could enhance students' understanding about risk was omitted.

Moreover, Ekborg (2008) carried out a project to investigate students risk views and used the strategy of argumentation to assist decision-making. She used the socio-scientific issue of the risks involved in using genetically modified plants by gathering data from 64 students' in three

different Swedish secondary schools. Ekborg concluded by stating that within the views of the students "knowledge, values and risk assessment interact and it is not always possible to separate them" (p. 64). This statement demonstrates the complexity of teaching socio-scientific issues involving risk because of the interaction of ideas.

Potentially, the use of the new analysis framework developed for this research could assist in the teaching of these controversial issues, by unravelling of the complexity of risk ideas. This could be achieved as teachers could incorporate an explanation of the framework in an introduction to a risk issue within a classroom situation. An explanation would be possible because the researcher believes that framework (Figure 4.10, p. 75) has a simplicity of construction, while allowing for a complexity of analysis of risk, that Year 12 students (for example) could comprehend. Such an introduction would enhance an understanding of the roles that each Cultural Type plays within any society and in turn improve the development of meaningful discussions about risk within the classroom. This enhanced understanding could be encouraged by the students carrying out such activities as role-play, debates or on-line discussion groups about the risk issue, perhaps even between different schools, both within and between different countries.

The use of the Risk Analysis Framework, in an in-class discussion of an issue, may also contribute to students' learning. These discussions could facilitate their individual abilities to negotiate and compromise as they develop an awareness of the different Cultural Types.

Moreover, students could begin to recognise their own Cultural Type and the reasons why they have this bias and therefore, their personal position about a specific risk issue, within a community. It is of interest to note that the use of the Risk Analysis Framework during discussions of risk issues have been carried out by the researcher with Year 12 students, in her role as a full-time teacher. While none of this data were collected, or used in this project, her personal experience suggests that the learning and understanding of the students within her classes about risk issues, was enhanced by discussions that included the different Cultural Types found within society.

Furthermore, as another example of a potentially significant educational implication, as part of an investigation of a risk issue in a classroom setting, the students could examine the importance of, and participate in, an "extended peer community" (Funtowicz & Ravetz, 1992, p. 254). This could be carried out by inviting into the classroom a variety of people with differing points of view - from different Cultural Types - about a particular risk issue to discuss their ideas.

Potentially, if these situations were arranged, the knowledge of people with relevant scientific expertise could be presented along with knowledge from lay-people within the community who have a wealth of pertinent, local information (Stevenson et al., 2014). This may then enable the students to develop an in-depth appreciation of the complexity of an issue as well as the various opinions about the risks involved.

Additionally, the use of the communication mechanisms framework used within this study may assist both teachers and students to reveal the way individuals communicate their risk ideas. Within this study, the communication mechanisms were reduced from the original five mechanisms suggested by Kahan et al. (2011) and Kahan (2012) to three. The researcher asserts that this reduction in number of mechanisms could enhance the ease of comprehension and understanding by students. Importantly, it may also allow students to recognise the mechanisms that they personally use while discussing risk issues and therefore improve their self-awareness and oratory skills.

Moreover, the use of the new framework may assist in the development of students' empathy. This could occur as they learn about the diversity of points of view held by people about any of the numerous science-based risk issues that are affecting society today. Their appreciation of the range of views will enable students to become aware of the "common consciousness" that develops within each Cultural Type when discussing any risk issue (Durkheim, 1984, p. 38). Furthermore, this growing awareness could allow students to comprehend how each Cultural Type differs from the others, how each uses a common language to communicate their ideas and how these views are collectively constructed. Potentially, they may even be able to establish indicative words and phrases as their awareness grows, so assisting their understanding of the "common consciousness" within each Cultural Type (Durkheim, 1984, p.38).

8.8 Concluding statement

This project investigated secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy. A significant finding of this project was that the researcher was able to develop a new analysis framework which enabled data about risk perceptions to be analysed **qualitatively** and is one of the few empirical studies exploring perceptions of risk in this field. Douglas asserted that any analysis framework needed to "transcend the culture in which the risks are being debated" (2003b p. 31). The researcher contends that this new framework could have this potential and may be able to be used in different contexts that involve risk.

Moreover, this analysis was able to confirm the **range of views** expressed by the identification of four Cultural Types within a society. The researcher asserts that this confirmation occurred because the original grid-group typology ideas proposed by Douglas (1978) have been developed and expanded in this study. In this development, each of these four Cultural Types shared five common characteristics expressed as individual attributes within each type. Within this analysis it was also shown that most of the participants displayed either *Nature Benign* or *Nature Tolerant* Cultural Types, as Douglas (2003c) suggested occurred within any society.

In addition, the Risk Analysis Framework uncovered the **consistency of views** held and the idea that the strength of beliefs was important. Some participants had a plasticity of views, while others held constant views, thus supporting both of Rayner's (1992) hypotheses about the stability or mobility of risk ideas within society.

Another significant finding of this project was that three different mechanisms were used by the participants to communicate their risk views and these mechanisms were common across all four Cultural Types.

The greatest worth of this research however, was that the Risk Analysis Framework enabled both the identification of indicative words and the use of a common language by the participants within each Cultural Type. This was of most significance because it revealed a *common consciousness* (Durkheim, 1984) within each of these Cultural Types. Furthermore, combining the framework and the communication mechanisms provided a **qualitative, holistic** and fine-grained analysis of these New Zealand secondary students' perceptions of environmental risk when responding to the issue of a biodiversity rescue strategy. This qualitative, holistic and fine-grained analysis was enabled by weaving different pieces of data together to create a bricolage (Denzin & Lincoln, 2005) of participants' views to reveal the four Cultural Types and supported Douglas and Isherwood's views when they opined:

> "Cultural analysis sees the whole tapestry as a whole, the picture and the weaving process" (Douglas and Isherwood, 1996, p. 42).

Appendices

Appendix 1: Questionnaire Booklet

My pseudonym is: _____

Look at this photograph of a NZ scene. What do you first think of?

_____

_____

Why did you think that? (Justify your answer)

_____

_____

Look at this photograph of a NZ scene. What do you first think of?

_____
_____

Why did you think that? (Justify your answer)

_____
_____

Look at this photograph of a NZ scene. What do you first think of?

_____

_____

Why did you think that? (Justify your answer)

_____

_____

Look at this photograph of a NZ scene. What do you first think of?

_____
_____

Why did you think that? (Justify your answer)

_____
_____

Look at this image. What do you first think of?

_____

_____

Why did you think that? (Justify your answer)

_____

_____

Appendix 2: The five images used in the questionnaire booklet and their internet sources.

Image	**Internet source**
Helicopter	https://geog397.wiki.otago.ac.nz/images/0/00/1080Drop.jpg
Possum	https://movin2newzealand.files.wordpress.com/2014/09/creating_habitat_for_wildlife_such_as_the_brushtail_possum_8065737659.jpg
Deer	http://4.bp.blogspot.com/-VjG_RbrVFxc/Tf2GHBMnfEI/AAAAAAAAA20/Mvdr6-nCmu8/s1600/Dead+yearling+-+gasping.jpg
Stoat	http://cdn.zmescience.com/wp-content/uploads/2014/01/stoat-04.jpg
1080	https://therongolianstar.files.wordpress.com/2014/09/1080poisonwarning_gobeirne.png?w=640&h=451

Appendix 3: Indicative Semi-Structured Questions to Initiate Discussion about a Biodiversity Rescue

Interview with Students

You showed an interesting understanding of the science concepts in the activity. It is obvious from the responses you gave that the concepts of biodiversity are important to you. I can see by your answers that you have thought about the aspects shown in the images really well.

1. Can you tell me about your ideas now that you have completed this unit of work?

2. You made some interesting comments.
    a. Can you tell me more about what you were thinking when you wrote this response (*researcher points to each of the five risk resources, individually provided during the class activity*).

    b. What part of your life made you think like this?

Thank-you. I appreciate you participating in this research I am doing. That is the end of the interview questions I have for you. Is there anything you would like to ask me about? Remember, I will not be using your name in my research and if you change your mind, you need to let me know.

Appendix 4: Cultural Type: Nature Benign/ Individualistic Analysis

Cultural characteristics and attributes	**Participants**																						**Word Identifiers**
View of nature: Robust and stable	R18 H		U12 H			U21 H					R06 Deer		R15 H	R03 Deer	U06 H	U11 H		U05 H	U02 H	U16 H	U01 H	U19 H	U07 H	*Dead animal/Dead deer* *Place/Type of environment/* *Forest/forested landscape/* *Paddocks/'fur' trees/trees* *Annual doses of 1080*
View of Earth's resources: Abundant and controllable	R18 H	R08 H	U12 Stoat P			U21 H Stoat		R02 Stoat	U13 Stoat	R05 P	R06 H	U03 H P	R15 H P	R03 H	U06 H	U11 H	U04 H	U05 H	U02 H	U16 H	U01 H	U19 H	U07 H	*The ones they use/Way it is applied/1080 is scattered* *Method used/spread/aerial(ly) distribute/distributing/* *distributed/'drooping'/Dropping/* *dropped/drop* *Exterminate/Exterminating/* *Exterminated/can be killed/killed off/kill them/get killed/ reduce them*
People's needs: Controllable						U21 1080		R02 1080	U13 1080	R05 1080	R06 1080		R15 1080			U11 1080			U02 1080			U19 1080		*Written information/Information on sign/informs people/* *informed/informative* *Sign says/sign they use/ words say so/sign*
Perception of environmental risk: Exploitability and equal opportunity.	R18 P	R08 Deer P	U12 P	R14 Deer	U15 Stoat	U21 Stoat	U17 Deer P	R02 Stoat P		R05 P Deer	R06 Deer	U03 1080 P	R15 P Deer Stoat		U06 Deer Stoat	U11 Stoat		U05 Deer	U02 Stoat P		U01 Stoat P Deer H	U19 P		*Hunt/Hunter/Hunting/Hunted* *Shoot/Shooting* *Venison* *Pest(s)* *Prey* *I know*
Risk management strategy: Risk seeker. Use trial and error							U17 1080 P				R06 Deer										U01 1080	U19 Deer		*I'm not usually worried* *It wouldn't really harm you* *Little evidence to prove cause of death/ Unknown cause of death/No blood*

Appendix 5: Cultural Type: Nature Ephemeral/ Egalitarian Analysis

Cultural characteristics and attributes		**Participant Codes**															**Identifiers**
View of nature: Precarious and Fragile		U20 Deer	R02 H	R17 H Deer	R04 P		U10 Deer 1080	U14 H Deer	R14 1080	R11 1080	R16 Deer	R13 1080 H	U09 1080	U12 Deer		U18 1080	*No one's neck/twisted back/broke it back Un-natural/ Bruised* *Dangerous/danger/ Forest animals are all vulnerable* *1080 infected* *Not something good/ Not safe* *The risk of it being everywhere/ No waterways are avoided/ It doesn't show any streams that have been avoided/ animals and fish in the waterways aren't being avoided/ They are not avoiding it at all/ Falls into waterways*
View of Earth's resources: Depleting and Uncontrollable	U02 Deer		R02 Deer			U17 Stoat						R13 Deer					*Deers aren't pests* *Don't kill it/Should be avoiding it and still continuing to walk around* *Victim*
People's needs: Controllable																	
Perception of environmental risk: Equality of outcomes for present and future generations.			R02 Deer	R17 Deer 1080	R04 Stoat Deer			U14 Deer P		R11 1080 Deer P	R16 Deer	R13 Deer	U09 Deer	U12 Deer			*Not a peaceful type thing/Death is meant to be peaceful* *Pain/Painful/ Painfully/ Painful death/Drawn out deaths/Felt himself die* *Makes it happy* *Make sure dogs don't eat* *That's what possums do* *Other animals such as deer are dying/tragedy that deer are dying/ tragedy that a deer dies* *Forced* *It doesn't deserve it* *Innocent*
Risk management strategy: Risk averse. Use trial without error		U20 Deer 1080 H	R02 H	R17 Deer 1080		U17 H Stoat		U14 Stoat 1080	R14 1080	R11 Deer 1080 Stoat H		R13 P 1080 Stoat	U09 Deer 1080	U12 Deer	U22 1080	U18 1080	*Why you do this?* *Creates controversy/ wrong* *Sad Horrific/Disgusting/Upsetting/Horrible/Gruesome* *It doesn't look sick* *Poisonous/Bad poison/ Poisoned/Poisons/ deadly poison* *Should not be used/shouldn't be put down* *Cruel/cruelty/ Slow killer/Should not touch or eat* *Pesticide* *Cute*

Appendix 6: Cultural Type: Nature Tolerant/ Hierarchist Analysis

Cultural characteristics and attributes	Participant Codes																											Identifiers
View of nature: Robust but vulnerable	U08 Deer P			R07 1080 Deer P Stoat			U04 Stoat P	R10 P					U09 H			R09 Stoat P					R05 Stoat		R12 P					R16 P	*Forest is no longer sustainable/ Biodiversity* *Reduce the threat to native plants* *Negative effect on native species(wildlife)* *Negative impact on vegetation/Harmful to environment/Damage nature/ threat to the natural ecosystem* *Vulnerability for birds* *Extinction for native birds/ Cause extinction* *Protects our native lands (and animals)* *Positive impact on bird life*
View of Earth's resources: Scarce but controllable				R07 Stoat P	U16 P						U05 Stoat P			R14 Stoat			R08 1080	U21 P				U07 P	R12 Stoat P	U10 H		R18 Stoat			*Something needs to be done/needs to be controlled* *Aimed/Targeted/ Targets/Target* *DOC operations* *TBfree* *Government ordered it*
People's needs: Uncontrollable																												
Perception of environmental risk: Controllability and responsibility	U08 Stoat H 1080	R03 Stoat P 1080	U03 Stoat	R07 Deer Stoat H	U16 Stoat 1080 P Deer	U11 P	U04 1080 Stoat P	R10 Stoat 1080 H	R06 Stoat P	U06 P 1080	U05 Stoat P 1080	R01 Stoat P H 1080	U09 P Stoat	R14 Stoat H P	U13 P	R09 H 1080	R08 Stoat	U21 P	R17 Stoat	U15 P 1080 H	R05 H	U07 Stoat P 1080	R12 Stoat H P 1080	U10 Stoat P	U12 1080	R18 Stoat 1080	R04 H 1080	R16 1080 H Stoat P	*Pest control/pest population/ kills pests/reduce pests/pests in native forests/ pest to other animals in NZ/ pest in NZ/pest to the kiwis/pest for native life* *Parasite/Predator(s)/Prey(s/ing) on/Pray on/threat* *Responsible for death of birds/ native species eggs/ harm to our natives/kills native birds/eat native trees/destroying bird populations/ devour our birds/endangers native species survival* *Infected zones/land/areas/Infected by TB* *Infects cows with TB/TB which can be passed onto/Carry TB* *Hard to reach zones* *Effective/Efficient/Necessary/Required* *Reduction of one species* *Safety/Be careful* *Do not drink water* *Warns/warning(s)*
Risk management strategy: Risk accepter. Use planning and regulation	U08 H Deer		U03 Deer	R07 P 1080 Deer	U16 1080	U11 Deer	U04 Deer	R10 Deer 1080			U05 1080	R01 Deer			U13 H Deer	R09 Deer		U21 Deer	R17 P	U15 Deer		U07 Deer	R12 Deer			R18 Deer			*Best options* *Threat the possums pose* *Reduces the risk* *Collateral damage/ caught in the crossfire/ inevitable/ By-kill/poisoned by 1080/problem with wild animals eating the pellets* *Secondary poisoning/accidently poisoned/on accident/Intaking other food/accidental poisoning* *Wasn't the intention/Unintended target(s)/Not a target* *Resolve the issue/solve the pest outbreak* *New Zealander's brought possums over*

Appendix 7: Word identifiers used by participants for three Cultural Types

Image	**NATURE BENIGN / Individualistic**	**NATURE TOLERANT / Hierarchical**	**NATURE EPHEMERAL / Egalitarian**
Helicopter	Method used/spread/aerial(ly)/distribute/Distributed/ Distributing/'Drooping'/dropped/dropping/drop Place/Type of environment/ forest/forested landscape/ paddocks/ 'fur' trees/trees Annual doses of 1080 The ones they use/way it is applied	Effective/ Efficient/ Necessary/ Required/ Best options Targets/ targeted/ kills pests/ Pest control/ Reduce pests/ pests in native forests Infected zones/ land /areas/ Infected by TB/ Hard to reach zones Government ordered it Protects our native lands (and animals)	Unnatural/ Not safe Dangerous/Danger Pesticide/Poison(s)/ Poisonous/ Creates controversy The risk of it being everywhere/Falls into waterways
Deer	Hunt/Hunter/Hunting/Hunted Venison Prey Dead animal/Dead deer Little evidence to prove cause of death/ Unknown cause of death/no blood	Collateral damage/ caught in the crossfire/ inevitable/ By-kill/poisoned by 1080/ Problem with wild animals eating the pellets/ Forest is no longer sustainable Secondary poisoning/ accidently poisoned/ accidental poisoning/on accident/Intaking other food/ Unintended target(s)/ not a target/ wasn't the intention Reduction of one species	No one's neck/twisted back/Not a peaceful type thing/Death is meant to be peaceful/Slow killer/Horrible/Gruesome 1080infected/Disgusting/Upsetting/Victim/Innocent/Bruised/ Horrific/ Should be avoiding it and still continuing to walk around/Deers aren't pests/Why you do this?/Cruel/Cruelty Other animals such as deer are dying/tragedy that deer are dying/ tragedy that a deer dies Pain/ Painful/Painful death/Drawn out death/Felt himself die
Possum	Exterminate/ Exterminating/ Exterminated/can be killed/ Killed off/ Kill them/Get killed Shoot/Shooting Pest(s)	Negative impact on vegetation/Negative effect on native species(wildlife)/Harmful to environment/Biodiversity/Damage nature/Reduce the threat to native plants/ Predator(s)/ Parasite/ Prey(s/ing) on/Pray on/Responsible for death of birds/ native species eggs/ harm to our natives/Threat/Threat the possums pose/kills native birds/eat native trees/pest for native life/Pest control/ pest (to other animals) in NZ/destroying bird populations/ Resolve the issue/ solve the pest outbreak/ New Zealander's brought possums over/Infects cows with TB/TB which can be passed onto /carry TB/Something needs to be done/needs to be controlled/Aimed/TBfree//Targeted/Targets/Target	Not something good That's what possums do It doesn't deserve it Cute
Stoat	Pest Exterminate/exterminating /exterminated/killed off/kill them/get killed	Extinction for native birds / pest in NZ/Pest to the kiwis/ Predator(s)/preys on Targeted / Aimed Vulnerability for birds Positive impact on bird life	Don't kill it It doesn't look sick Makes it happy Cute
1080 sign	I know/ I'm not usually worried Written information/Information on sign/informs people/informed/informative sign says/sign they use/sign/words say so It wouldn't really harm you	Be careful/ Safety/ Do not drink water Required/ Necessary Kills pests/ Pest control/pest population/ reduce pests DOC operations/ Warns/Warning(s)/ Reduces the risk	Dangerous/ Not safe/ Drawn out deaths/ Pain/Forced No waterways are avoided/it doesn't show any streams that have been avoided/Animals and fish in the waterways aren't being avoided/They are not avoiding it at all Innocent/Should not be used/shouldn't be put down/ Make sure dogs don't eat/ Should not touch or eat/ Cruelty/ Cruel/Sad/ Poisonous/Bad poison/Poison(s)/ Deadly poison

Appendix 8: Participant Information Sheet

School of Curriculum and Pedagogy
Te Kura o te Marautanga me te Ako

THE UNIVERSITY OF AUCKLAND
FACULTY OF EDUCATION
Te Kura Akoranga o Tāmaki Makaurau
Incorporating the Auckland College of Education

Epsom Campus
Gate 3, 74 Epsom Avenue
Auckland, New Zealand
Telephone 64 9 623 8899
Facsimile 64 9 623 8898
www.education.auckland.ac.nz

The University of Auckland
Private Bag 92601, Symonds Street
Auckland 1150, New Zealand

PARTICIPANT INFORMATION SHEET

(Principal/Board of Trustees)

TITLE: Investigating secondary students' views about risk, nature and communication strategies when discussing a biodiversity rescue strategy.

RESEARCHERS: Kathryn Garthwaite, Associate Professor Bev France and Dr Sally Birdsall

Dear (Principal's name)

I am a student studying at the Faculty of Education at The University of Auckland for a doctorate. I am interested in finding out about the variety and development of Year 12 students' views of nature and risk when they discuss the socio-scientific issue of 1080 as a biodiversity rescue strategy in New Zealand. This research project aims to collect students' views about risk and nature associated with the use of 1080 and how the introduced class material has influenced students' responses to the relevant NCEA assessment task.

I am writing to ask for your permission to carry out this study at your school and I am inviting teachers and students at your school to participate in my research. Additionally, I am asking you to give information about my research to the biology teacher as I wish to have their assistance in the organisation and teaching of my programme. I am also asking permission from you to permit students in your school to take part in my research and to allow me to photocopy their unmarked NCEA assessment task.

I am seeking assistance from a Year 12 biology teacher to help me with my research. Their participation is voluntary and I request an undertaking from you that if the teacher does not wish to take part, their decision will not affect their employment status. Attached is an information sheet and consent form outlining what is involved. Could you please give the Year 12 Biology teacher these letters and if they agree to assist me, an envelope is attached for them to return the consent form to me.

I would like to carry out this research with the biology teacher and Year 12 students at a mutually convenient time in 2015. I am aware that Year 12 students are involved in NCEA assessments and time is valuable. However, their participation in my project will not disadvantage them in any way because

the data I will be gathering is part of their own research that is required for the Level 2 NCEA biology internal Achievement Standard: 91154 (Analyse the biological validity of information presented to the public, 3 credits). My teaching programme contains a variety of sources of information about the use of 1080 in New Zealand to control introduced pests. These resources form part of this standard.

The students' participation in my research is voluntary and they can withdraw their data at any time up to two weeks after data collection. I request an undertaking from you that if any students do not wish to take part, their decision will not affect their school grades or relationship with the school. I enclose copies of the information that will be given to students.

I am aware that many of the students will be sixteen years old and can consent to participating on their own behalf. However, at the time of data collection some of the students might not be sixteen years of age but because the project is of general interest, is not personally sensitive and does not involve any legal obligations, these students are capable of giving consent on their own behalf. I will provide an information sheet for all parents/caregivers.

The research design and teaching programme involves the Year 12 biology students being asked to comment about photos portraying nature and risk situations about the biodiversity rescue strategy. All students will take part in this teaching programme regardless of their decision to participate or not. This nature/risk activity will take 15- 20 minutes and could be carried out in the last part of a regular biology lesson.

The nature/risk activity will be followed at a later date by semi-structured interviews with 15 Year 12 students, where they will be asked individually to discuss their views about nature and risk as well as other questions about this socio-scientific issue. The researcher will select 15 students who have given full and detailed responses about the socio-scientific issue. These interviews will need to take place in a quiet room on the school premises and I request permission from you to do these interviews at your school. The interviews (audio-recorded) will take approximately 30 minutes and will take place outside of their class time. During the interview, a student can refuse to answer any questions or have the audio-tape stopped at any time. The audio-recording will be transcribed by a professional transcriber who has signed a confidentiality agreement. Each student's transcript will be returned to them for editing and students will have two weeks to respond. After that time, it will be assumed that the transcript is accurate.

The next step of my project will involve the students watching a powerpoint about the use of 1080 to control pest animal species in New Zealand. This will be followed by the students being given information from a variety of sources that provide differing views about the use of 1080. The students will be asked to make written comments on these resources. These activities will directly contribute to the Achievement Standard: 91154. I will require a photocopy of each student's work before marking and will cover the cost of this photocopying.

Confidentiality will be maintained by pseudonyms being allocated to all the students' data in publications. Details about the school and participants will be disguised. However, because the data collection involves a small number of students, confidentiality with respect to the students' identities cannot be guaranteed, as it is possible that someone in the school community may recognise a student's comments.

The data will be kept in a locked filing cabinet and password protected computer at the Faculty of Education of The University of Auckland for a period of six years, after which time the electronic data will be deleted and the written data shredded. The results of this project will be used in my doctoral thesis and may also be used to write journal articles and presented at conferences. I will provide you with a copy of the final research document.

I hope you will give permission for this research to take place in your school. If you have any queries, please contact me or my supervisors at the Faculty of Education, The University of Auckland.

Yours sincerely

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For any queries regarding ethical concerns you may contact the Chair, The University of Auckland Human Participants Ethics Committee, The University of Auckland, Office of the Vice Chancellor, Private Bag 92019, Auckland 1142. Tel (09) 373-7599 extn 83711.

Approved by The University of Auckland Human Participants Ethics Committee on 18/11/ 2014 for a period of three years. Reference Number 012754.

Appendix 9: Consent Form

School of Curriculum and Pedagogy
Te Kura o te Marautanga me te Ako

THE UNIVERSITY OF AUCKLAND
FACULTY OF EDUCATION
Te Kura Akoranga o Tāmaki Makaurau
Incorporating the Auckland College of Education

Epsom Campus
Gate 3, 74 Epsom Avenue
Auckland, New Zealand
Telephone 64 9 623 8899
Facsimile 64 9 623 8898
www.education.auckland.ac.nz

The University of Auckland
Private Bag 92601, Symonds Street
Auckland 1150, New Zealand

CONSENT FORM

(Principal/Board of Trustees)

THIS FORM WILL BE HELD FOR A PERIOD OF 6 YEARS

TITLE: Investigating secondary students' views about risk, nature and communication strategies when discussing a biodiversity rescue strategy

RESEARCHERS: Kathryn Garthwaite, Associate Professor Bev France and Dr Sally Birdsall

I have read the Principal/Board of Trustees' Participant Information Sheet and have understood the nature of the research and been given the opportunity to ask any questions and have them answered to my satisfaction.

I agree to allow the researcher access to the school to carry out this research project.

I agree to give the Year 12 biology teacher information about this project.

I agree that the Year 12 biology teacher can teach the programme provided by the researcher.

I agree that the researcher can collect the Year 12 students' unmarked NCEA assessment task.

I agree to provide a space for the researcher to carry out interviews with the students at my school.

I give an assurance that the teacher's decision to participate or not in this research will have no effect on their employment status in the school.

I give an assurance that a student's decision to participate or not in this research will have no effect on their relationship with the school or their grades.

I understand that:

- The teacher's and students' participation in the research is voluntary.
- As the Year 12 students are able to make their own decision about participation, they will consent on their own behalf.
- An information letter will be provided for the Year 12 students' parents/caregivers.
- Students can withdraw their data up to two weeks after data collection is completed.
- 15 Year 12 students will be invited to participate in 30 minute individual interviews at school out of their class time.
- The interviews will be audio-taped and transcribed by a professional transcriber.
- The students' identities will be protected through the use of a pseudonym and details about the school will be disguised.
- Because of the small number of students involved in this research, there is the possibility of someone in the community recognising a student's comments.
- Data will be securely stored for six years, after which it will be destroyed.
- Data will be used in the final research report as well as in journal articles and in conference presentations.
- I will receive a research report at the end of the project.

I therefore give my informed consent for the research project: **Investigating secondary students' views about risk, nature and communication strategies when discussing a biodiversity rescue strategy** to be carried out at my school.

Name: ……..

School: ……..……...

Signed: ……. Dated: …….

Approved by The University of Auckland Human Participants Ethics Committee on 18/11/2014 for a period of three years. Reference Number 012754

Appendix 10: The distribution of Cultural Types within all 40 students

Student code	**The distribution of Cultural Types displayed in the student responses to the five images**			
	Nature Tolerant	*Nature Benign*	*Nature Ephemeral*	*Nature Capricious*
U01	0	5	0	0
U02	0	4	1	0
U03	2	3	0	0
U04	4	1	0	0
U05	3	2	0	0
U06	2	3	0	0
U07	4	1	0	0
U08	5	0	0	0
U09	3	0	2	0
U10	3	0	2	0
U11	2	3	0	0
U12	1	3	1	0
U13	3	2	0	0
U14	0	0	5	0
U15	4	1	0	0
U16	4	1	0	0
U17	0	3	2	0
U18	0	0	1	4
U19	0	4	0	1
U20	0	0	3	2
U21	2	3	0	0
U22	0	0	1	4
R01	5	0	0	0
R02	0	3	2	0
R03	3	2	0	0
R04	2	0	3	0
R05	2	3	0	0
R06	2	3	0	0
R07	5	0	0	0
R08	2	3	0	0
R09	5	0	0	0
R10	5	0	0	0
R11	0	0	5	0
R12	5	0	0	0
R13	0	0	5	0
R14	3	1	1	0
R15	0	5	0	0
R16	4	0	1	0
R17	2	0	3	0
R18	3	2	0	0

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