

Lincoln University Digital Thesis

Copyright Statement

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

This thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- you will use the copy only for the purposes of research or private study
- you will recognise the author's right to be identified as the author of the thesis and due acknowledgement will be made to the author where appropriate
- you will obtain the author's permission before publishing any material from the thesis.

RETHINKING THE SCIENCE-POLICY RELATIONSHIP

Boundary Organisations and the Motueka Integrated Catchment Management Programme

A thesis

submitted in partial fulfilment

of the requirements for the Degree of

Master of Applied Science

at

Lincoln University

by

Joseph Harrison

Lincoln University

2013

Abstract of a thesis submitted in partial fulfilment of the
requirements for the Degree of Master of Applied Science

Rethinking the Science-Policy Relationship

Boundary Organisations and the Motueka Integrated Catchment Management Programme

by

Joseph Harrison

A crucial challenge for environmental management is the translation of scientific knowledge into productive useful policy and on-ground action. Considering how the domains of science and policy operate in isolation, bridging the science-policy divide is no simple task. An emerging and interesting framework for bridging the gap between science and policy is the use of boundary organisations. This research examines how boundary organisations might bridge this gap through improving communication and collaboration between researchers, policymakers, stakeholders, iwi and members of the public. The Motueka Integrated Catchment Management (ICM) programme was used to analyse how the programme managed the science-policy interface within a catchment management setting. It was concluded that while the Motueka ICM programme did effectively operate as a boundary organisation and produce numerous positive environmental, social and scientific outcomes, it only had limited success in bridging the science-policy divide at a local scale. The programme's inability to produce a higher volume of policy outcomes has highlighted issues within both the concepts of ICM and boundary organisations.

Keywords: boundary organisations, integrated catchment management, science-policy interface, water, resource, environment, Motueka, Tasman.

Acknowledgements

Firstly I would like to thank the many people who took time out of their busy schedule to talk to me about their experiences within the Motueka ICM programme. Their insights and opinions are the essence of my thesis. Specifically I would like to give thanks to Andrew Fenemor, Margaret Kilvington and Ben Knight for providing extra information and insight.

I would also like to thank my friends and family for their unwavering support. Thank you all for putting up with my strange thesis mood swings and keeping me going with words of encouragement and home cooking, I simply could not have completed this research without it.

Katy Sinton's copy-editing skills were a key component of this thesis. Her guidance and assistance made the writing aspect of this thesis far more enjoyable than I had expected, thank you Katy. Inclusive Education also deserves a special thank you, their generous support during my time at Lincoln University has played a crucial role in helping me fulfil my academic potential.

Finally I would like to thank my supervisors Dr Ronlyn Duncan and Dr Hamish Rennie for their expertise and support over the last 12 months. Dr Ronlyn Duncan unswerving guidance and encouragement over the last year has been a cornerstone of my research effort, I simply could not have asked for a better main supervisor.

Table of Contents

Abstract.....	iii
Acknowledgements.....	iv
Table of Contents	v
List of Figures	ix
Chapter 1 Introduction	1
Chapter 2 Theoretical framework	3
2.1 The science and policy interface.....	3
2.1.1 Why do we trust science?.....	3
2.1.2 Critiques of the ethos of science	4
2.1.3 The linear model	6
2.1.4 Problems with the linear model.....	6
2.2 Boundary work and boundary organisations	9
2.2.1 Boundary organisations.....	10
2.2.2 Boundary objects.....	14
2.2.3 Summary	15
Chapter 3 Literature review	16
3.1 Water issues in New Zealand.....	16
3.2 Water management and the Resource Management Act, 1991	18
3.2.1 Unfulfilled promises	20
3.3 Integrated Catchment Management (ICM)	22
3.3.1 Theory	22
3.3.2 Application.....	22
3.3.3 History.....	23

3.3.4	A new approach	24
3.3.5	Problems with ICM.....	24
3.4	Integrated Catchment Management in New Zealand.....	25
3.4.1	The RMA and the Treaty of Waitangi	26
3.4.2	Government and scientific institutions.....	27
3.4.3	Community engagement	28
3.5	Motueka Integrated Catchment Managementprogramme.....	28
3.5.1	Background	29
3.5.2	Strategy	30
3.5.3	Programme outputs	31
3.6	Past research and the road ahead.....	32
Chapter 4 Research methodology		33
4.1	Research aims and objectives	33
4.2	Research approach	33
4.2.1	Case study	34
4.2.2	Shifting the research approach.....	35
4.2.3	Author's perspective.....	36
4.3	Evaluative framework.....	37
4.3.1	Evaluative criteria	37
4.4	Research informants.....	39
4.5	Data collection methods.....	40
4.6	Data analysis	41
4.7	Ethics	45
4.8	Summary	45

Chapter 5 Results	46
5.1 Convening	46
5.1.1 Workshops and meetings	46
5.1.2 Annual General Meetings (AGM)	48
5.1.3 Working groups.....	49
5.2 Translating	52
5.2.1 Translating between researchers	52
5.2.2 Translating between ICM Programme, stakeholders, iwi and local communities	53
5.2.3 Translating between science and policy.....	55
5.3 Mediation	55
5.3.1 Mediation workshop	56
5.3.2 Social learning platforms	56
5.3.3 Watershed Talk	58
5.3.4 Informal mediators	59
5.4 Collaboration.....	60
5.4.1 Programme management.....	60
5.4.2 Project level collaboration.....	62
5.4.3 Poor collaboration and limited policy outputs	66
5.5 Boundary objects	67
5.5.1 Travelling River	67
5.5.2 Computer modelling	70
5.5.3 Websites and multimedia	71
5.6 Summary	73
Chapter 6 Discussion	74

6.1	Convening	74
6.2	Translating	77
6.2.1	Translation between researchers	77
6.2.2	Translation between researchers, stakeholders, iwi and members of the public.....	78
6.2.3	Translation between researchers and policymakers	79
6.3	Mediation	82
6.3.1	Mediation events and processes	82
6.3.2	Finding and building unofficial mediators	82
6.3.3	Staying neutral	83
6.4	Collaboration.....	84
6.4.1	Collaboration at programme management level	84
6.4.2	Collaboration at project level.....	87
6.5	Boundary objects within the ICM programme	89
6.5.1	Travelling River exhibition.....	90
6.5.2	Computer models	91
6.5.3	Websites and multimedia.....	93
6.6	Summary	95
	Chapter 7 Conclusions.....	96
7.1	How did the Motueka ICM programme negotiate the interface between science and policy?....	96
7.2	Compared with the theory, how effectively did the ICM programme operate as a boundary organisation in practice?	101
7.3	Research limitations and future research	104
	References	105
	Appendix.....	114

List of Figures

Figure 3.5.1	Map of Motueka catchment	30
Figure 4.3.1	Relationship between boundary organisations and knowledge attributes.....	38
Figure 4.6.0	Balancing knowledge attributes	44
Figure 4.6.1	Evaluative framework.....	45
Figure 5.1.2	Photo of Mick Park addressing ICM AGM field trip at Puketawai.....	49
Figure 5.3.2	How social learning can be used in ICM.....	58
Figure 5.4.1	Overview of how catchment issues connect through social learning.....	62
Figure 5.4.2	Diagram of actors, groups, institutions involved with Motueka ICM programme.....	63
Figure 5.5.1	Photo of local men at Travelling River exhibition at Tapawera.....	69
Figure 5.5.2	Photo of opening night for Travelling River exhibition.....	70

Chapter 1

Introduction

Through the development of modern environmental science, it appears that we are now able to understand the planet we live in, with much greater precision than was previously possible. Today scientists explain everything from how our glaciers and rivers operate to why our climate is getting warmer. While this information is of great importance to our planet and humankind, expectations for its use by policymakers are often not met. Authors (Cash et al., 2006; Guston, 1999) argue that the challenges for environmental managers and planners go beyond collecting sound scientific data to finding ways of producing knowledge that can move across the science-policy interface. They argue that in order to produce this kind of knowledge which can move between both science and policy, both sides of the interface need to rethink and reshape their professional roles.

As a means to bridge the gap between science and policy, a range of authors have sought new ideas to bring the different worlds of science and policy together in order to address our environmental and social issues. A conceptual framework that has developed from the field of science and technology studies is that of boundary organisations. These organisations come in many shapes and forms and operate within the spaces that exist between the fields of science and policy. In theory, boundary organisations provide the institutional capacity for communication and knowledge-sharing between knowledge providers (e.g. scientists, communities) and knowledge users (e.g. natural resource managers, policymakers)(Guston, 2001).

One environmental management framework which seeks to redefine the traditional science-policy interface, much like boundary organisations do is that of integrated catchment management (ICM). Unlike other top down approaches to natural resource management, ICM seeks to bring together the disciplines of science and policy alongside different social groups (e.g. farmers, iwi and fishermen) in order to collaborate and address catchment issues from a catchment-wide holistic perspective.

Although New Zealand has been keen to sell its '100% Pure' marketing campaign to the international tourism market, in recent years it has come under increasing pressure to admit its natural resources are anything but 100% pure. One set of issues which continues to

receive regular media coverage is that of New Zealand's freshwater resources. New Zealand's economy is driven by its primary industry sector (agriculture, fisheries and forestry). In the past decade, the agriculture and forestry sectors have come under increasing pressure due to the negative effects they are inflicting on New Zealand's water resources. These negative effects (reduced water quality and increased demand for water) are resulting in increased conflict over the country's water resources as different water user's fight over who has the right to access this resource and who is responsible for polluting it.

This conflict has placed extra stress on New Zealand's resource management framework and highlights numerous flaws within it. In order to address these water issues, authors such as Bowden (1999) have suggested moving to a more integrated catchment-based approach to water management. New Zealand's current environmental policy framework is erected around the Resource Management Act, 1991 (RMA) which aims to promote the sustainable management of the country's resources through the integrated management of land, water and air. In theory, catchment-focused approaches such as ICM sit well within the country's environmental policy capability. However, in practice ICM faces many challenges at a programme implementation level within the RMA framework.

This study examines the science-policy interface within a catchment setting by analysing the Motueka ICM programme alongside boundary organisation theory. Through the lens of boundary organisation theory this study focuses on answering the following two questions:

- How did the ICM programme negotiate the interface between science and policy?
- Compared with the theory, how effectively did the ICM programme operate as a boundary organisation in practice?

To answer these two questions, a wide range of literature covering the Motueka ICM programme, water management, boundary organisations and the science-policy interface was examined and is set out in Chapter 2. Subsequently, the literature on boundary organisations was used to produce a set of criteria for assessing the Motueka ICM programme. These criteria were applied to data collected through interviews (with members of the ICM programme), reports, articles, books and videos, to evaluate how the ICM programme compared to boundary organisation theory in order to answer the two research questions listed above.

Chapter 2

Theoretical framework

2.1 The science and policy interface

Environmental science and policy both play critically important roles within our societies today. The relationship between the two has changed greatly in the last 60 years and will be explored in this chapter. As well as discussing this relationship, this chapter highlights the issues of concern at the interface between the realms of science and policy and finally how they relate to the theory of boundary organisations.

Science has become a key tool for policymakers because it is able to offer an understanding of the human and natural systems which policymakers seek to manage. Environmental science's role within policymaking increased during the 1970s in the United States as a response to the growing public concern over environmental and public health issues (Jasanoff, 1987). The United States government attempted to address these issues through writing the country's first major piece of environmental legislation, the National Environmental Policy Act (NEPA) in 1969. This period also saw the United States establish its first natural resource management authority, the Environmental Protection Agency (EPA), in 1970. While the role of science in policymaking is primarily to provide answers to policymakers' questions, science also plays a rhetorical role within the policy framework as it lends credibility to decisions and invokes notions of authority. This is seen as necessary to gain public support and establish a sense of trust in decisions which may in fact be highly uncertain (Collingridge & Reeve, 1986).

2.1.1 Why do we trust science?

Science has for many decades been viewed by both society and science itself as an objective form of question asking and knowledge gathering free of outside influences such as fraud and corruption. Society's belief in scientists as seekers of 'truth' has been linked to a number of factors ranging from claims of apparently value-free scientific method to the peer-review

process, and to its creation of beneficial products e.g. penicillin, cell phones and the internet (Bocking, 2004; Merton, 1968).

In his book *Social Theory and Social Structure*, Robert Merton (1968) claims that science is the only pure discipline not influenced by the outside influences of politics, power and religion. Merton (1968) argues that these factors and others are kept at bay thanks to the 'ethos of science' which has helped keep science value-free and independent of political influence. The four institutional imperatives which Merton (1968) claims make up the ethos of science include:

1. *Universalism*: scientific claims are not based on politics, religion or personal qualities but rather pre-established impersonal unbiased criteria.
2. *Communism*: as scientists operate within one community their information is freely available.
3. *Disinterestedness*: scientific research focuses on the advancing of knowledge and not the bettering of the careers of the scientist. This is achieved by the rigorous policing of research ethics and methods.
4. *Organised scepticism*: scientific claims must be open to scrutiny from the scientific community, including the researchers themselves; judgement on claims should not be made until the facts are at hand.

2.1.2 Critiques of the ethos of science

Merton's (1968) views on science ran into some harsh critiques by other authors within the literature. In her study of chemical regulations in the United States, Jasanoff (1987) argues that Merton's (1968) claims lose their credibility once scientists leave the protected walls of their independent laboratories and institutions and begin working within the policy realm. Once inside the policy system in the United States, science has to work within the administrative process of policy which is based on the idea that 'truth' is established through adversarial processes rather than scientific research (Jasanoff, 1987). Rather than science being independent, as claimed by Merton (1968), Jasanoff claims that it is now so interconnected with policy that it is almost impossible to separate policy and science from each other. From Jasanoff's (1987) perspective claims about objectivity and resource to

ethos of science are rhetorical resources that are used by scientists and policymakers to justify policy decisions.

Another issue which also questions the concept of science as the seeker of truth is the role of uncertainty within policy-related science. Uncertainty has traditionally been seen as caused by a lack of scientific information on a particular issue. The standard approach for addressing uncertainty has been to undertake more research as a means to produce more information and reduce uncertainty (Sarewitz, 2004).

Sarewitz (2004) argues that while uncertainty is often blamed on a lack of scientific understanding, its real cause lies in scientific disunity and political conflict. Sarewitz (2004) claims that the issue of uncertainty is more dependent on factors such as political actors and research institutions than it is on a lack of scientific understanding. As the number of these factors increases, Sarewitz (2004) argues, so does the level of uncertainty surrounding an environmental issue.

Jasanoff (1987) and Sarewitz (2004) both claim that issues of uncertainty are regularly manipulated by decision makers and scientists, who are able to pick and choose data that best suits their own and interest groups' objectives. Uncertainty within science has grown in recent decades as environmental controversies have brought in a wider range of political, scientific and economic groups who wish to represent their own interest, e.g. oil, nuclear energy, and genetically modified foods. By highlighting the fact that scientific research is value-laden, uncertain and open to interpretation by other scientists, policymakers run the risk of reducing science's self-image and ending society's belief in scientists as seekers of truth (Jasanoff, 1987).

Although the work of Jasanoff (1987) and Sarewitz (2004) clearly makes the argument that science is not a value-free independent seeker of truth as claimed by the ethos of science, the science-policy relationship in operation today continues to be based on Merton's (1968) ethos of science.

2.1.3 The linear model

Up until the 1960s, the relationship between science and policy has been deemed to be fairly unproblematic and based on the premise that information freely flows between knowledge providers (scientists) to knowledge users (policymakers) (Cash et al., 2006; Jasanoff, 1987). Under this approach, scientific research is focused on addressing a particular policy issue as a means to influence and compel a political outcome. This new applied role for science was seen as a move away from scientists' more traditional role of simply creating knowledge regardless of its policy merit (Pielke, 2004).

This model of a flow of information between scientists and policymakers has been represented as a 'get the facts then act' approach to the science and policy relationship. This kind of framework was based around what has been termed as the linear model (Pielke, 2004). The linear model was very successful in the early stage of environmental policymaking due to its focus on applied scientific research.

Cash et al. (2006) use the term 'loading-dock' rather than linear model to explain how scientists and policy makers have traditionally interacted with each other. Under the loading-dock approach, scientists are seen to leave their research findings on a desk (loading dock) then walking away and beginning their next project without ever engaging in dialogue with people who might want to use their research (policymakers). The linear model also involves this kind of professional separation but is seen to be more institutionally entrenched and complex than the loading-dock approach and so tends to be more commonly used within the literature.

2.1.4 Problems with the linear model

While the linear model has been shown to be useful in addressing some environmental issues with clear solutions (e.g. poor air quality and point-source water pollution), it is seen by authors such as Pielke (2004) and Lövbrand (2007) as too simplistic to deal with highly politicised environmental issues. Pielke (2004) uses the example of climate change to show how the linear model approach fails to understand the complex geopolitical significance of

the debate and instead tries to cover up what are actually normative disputes with scientific language.

The linear model's failure to address many of today's environmental issues has been highlighted by a number of authors. Collingridge and Reeve (1986) argue that science often has very little impact on policy because it doesn't fit within the policy system, which is based on the principles of debate and compromise rather than research data.

This argument is also supported by Pielke (2004), who claims that one of the major drawbacks of the linear model is that it is based on the belief that policy should be formed simply on basis of scientific information alone. Commitment to the linear model would ignore all of the other non-scientific factors (actors and institutions) which are known to inform and shape policy.

By focusing on science alone within the policymaking process, the linear model places a great deal of responsibility on scientists who believe they have to provide answers to our policy issues. Kemmis (2002) argues that this idea is counterproductive to the policy process and simply bad science.

Collingridge and Reeve (1986) argue that the assumptions that uncertainties can be reduced by gathering large volumes of data and that science can answer all questions undermine the science-policy relationship. They argue that the assumption that more research equals better policy outcomes has led science away from helping policy, and has instead created confusion and misunderstanding by filling the science debate with so-called 'experts' and their thick technical reports which create more questions than answers.

Sarewitz (2004) agrees, and claims that by undertaking large volumes of scientific research, we in fact make environmental controversies worse, as this large amount of data simply provides political and scientific actors and groups with more information to push their agendas and create more uncertainty. Sarewitz (2004) argues that rather than focusing on technical issues surrounding scientific data, we should focus on the political, cultural and institutional contexts in which the data is used.

Another concern of the linear model is that it assumes science is value-free and politically neutral (Lövbrand, 2007). The linear model's assumption that science is value-free and independent can be partly attributed to Merton's (1967) 'ethos of science' which claims that science should not be influenced by outside forces such as politics. Rather than highlighting the values which inevitably exist between science and policy, the linear model has instead worked to obscure them from view and hide them behind fake boundaries of apparent credibility and authority.

Jasanoff (1987) highlights these issues and makes it clear that within the realm of policy-related science, the worlds of policy and science are actually inextricably interwoven and value-laden. Jasanoff (1987) argues that this mixing of the two disciplines is resulting in contested science governed not by scientific ethics but by lawyers and corporations operating within a regulatory framework, which is harming science by reducing its authority and integrity.

Pielke (2004) illustrates the issues arising from the use of the linear model and its inability to address the interwoven value-laden boundaries between science and policy by examining the climate change debate. As the issue of climate change is laden with values and uncertainty and has far-reaching economic and political effects, interest groups, policymakers and scientists within the debate now pick and choose which science they want to use to better their political position. This is done through the process of labelling scientific research which suits their political goals as 'sound science' while labelling anything which disagrees with their political stand as 'junk science' (Pielke, 2004).

Bocking (2004) argues that policymakers and their interest groups not only pick and choose their science but also commission their own scientific research. While these research groups or think tanks originally operated within their own organisations, they have in recent years started to fund university-based research, which has traditionally been seen as the home of 'pure science' (Bocking, 2004; Fischer, 2000). Lambright (2008) also highlights these attacks on science's independence and credibility through showing how policymakers within the Bush administration 2000-08 were caught actively editing scientific reports regarding climate change as a means to suit their political motives. Fischer (2000) also shows how politics affects environmental science by showing how the Reagan administration happily sided with

industry-funded scientists in regard to environmental standards. As a result, the EPA found its regulatory powers watered down and limited to industry-favoured assessment tools such as cost-benefit analysis.

As a response to the growth of political influence within science, some scientists have stepped outside of their laboratories and joined political parties or organisations which support their views of science (Pielke, 2007). Collingridge and Reeve (1986) claim that these new roles which scientists are playing bring into question the term 'scientist'. They argue that many of the scientists involved in today's policy debates should be referred to as 'advocates' rather than 'scientists'. Collingridge and Reeve (1986) argue that these so-called scientists have no interest in answering policy questions, as ultimately their loyalties lie not with the ethic of science but rather with their employers or personal inclination.

If the arguments above are correct and our current science and policy relationship is potentially doing more harm than good, the question needs to be asked - how can we better manage the relationship between scientists and policymakers? This next section will explore the literature on boundary work and boundary organisations to see how these concepts can provide a different way of connecting scientists with policymakers.

2.2 Boundary work and boundary organisations

The term 'boundary work' was first used by Gieryn (1983, p. 782) to explain how scientists discursively seek to preserve and protect the cognitive authority of science. Boundary work aimed to highlight the political manoeuvres occurring within science as it fought with outside influences of religion, power and government (non-science) (Gieryn, 1983). Much of the early debate on the threats to science's independence came from scientists themselves, who believed there was a need to protect the autonomy and authority of their profession.

As a means to examine the science and policy relationship, Jasanoff (1987) draws on the work of Gieryn (1983) in order to explore the different conceptualisations of the science-policy interface surrounding the use of formaldehyde in the United States.

Guston (1999) has also applied the concepts of Gieryn's (1983) boundary work and Jasanoff (1987). Notwithstanding the rhetoric identified by Jasanoff (1987) that separates science and policy and which operationalises the linear model, Guston (1999) argues that the worlds of science and policy should work side by side and could even be merged together through breaking down the boundaries of science and policy. In order for the theory of boundary work to be successful, Guston (1999) claims there is a need to acknowledge that science is not void of values and neither is politics void of rationality.

2.2.1 Boundary organisations

Managing complex environmental issues riven with uncertainty is no simple task. Hence, notions that a simple exchange of scientific information and its uptake into policy as envisioned by the linear science policy model are reductionist and optimistic. Guston (1999) advocates boundary organisations as a more productive means of managing the nexus between science and policy and states that boundary organisations operate by providing institutional space in which multiple levels of communication can be established, collaboration fostered and relationships built.

Boundary organisations are conceived as being able to address science-policy relations by building a bridge between the two domains of science and policy (Guston, 2001). Through establishing this connection, it is claimed that both sides of the boundary win; policymakers get the information they need to address complicated issues, while scientists get the information they require to undertake practical and relevant research (Cash et al., 2002). Cash et al. (2006) argue that out of this new science-policy relationship the coproduction of knowledge is able to occur between these two domains.

Duncan (2011) claims that the coproduction of science and policy is in stark contrast to the current linear model of knowledge production between science and policy. Emerging from the field of Science and Technology Studies, coproduction focuses on the creation of knowledge through collaborative means (Duncan, 2011). Coproduction aims to open up the decision-making processes to include a broader range of perspectives from both experts and non-experts and the disclosure of values from both sides (Cash et al., 2006). Boundary organisations have been identified as a possible method for facilitating coproduction due to

their ability to manage the boundaries and relationships between knowledge providers and knowledge users (Cash et al., 2006).

Although they do not use the term 'boundary organisation', Star and Griesemer's (1989) article on the role of boundary objects within Berkeley's Museum of Zoology is widely referred to within the literature as being one of the cornerstone concepts of boundary organisations. Star and Griesemer's (1989) article illustrates how boundary objects can be used to bring different actors (professional scientists and amateur specimen collectors) together in order to collaborate, share information and achieve multiple and divergent outcomes. The boundary objects concept has since evolved as an independent concept which works alongside boundary organisation theory to help promote collaboration and share information (Cash, 2001; Guston, 1999).

Although boundary organisations are normally mentioned as operating across the science and policy divide, this is not the only setting in which they can operate. In their study of Australian farmers and scientists, Carr and Wilkinson (2005) found that boundary organisations can also be used as an effective framework for bringing scientists and farmers together to collaborate. This example shows that boundary organisations are more than just bridges between science and policy, they can also be applied to a range of situations which involve working with people from different social groups who are surrounded by their own 'boundaries' (e.g. researchers, communities, businesses, government). "Boundary organizations are thus characterised as not only helping to bridge science and policy but also linking science and policy across different levels" (Cash, 2001, p. 432).

Within the literature on boundary organisations, the terms 'policy' or 'decision makers' are commonly used to describe the world of politics. These terms are used throughout the literature to label the different actors operating within a regulatory framework who have the ability to write policies and plans. For example, Cash's (2001) research on water management uses the term 'decision makers' to refer to different natural resource management authorities at local, state and federal levels involved in water management. This term can also be applied to the global setting through international organisations such as the European Union or North East Atlantic Fisheries Commissions (Cash et al., 2003).

How they operate

Boundary organisations have been defined in numerous shapes and forms since Guston (1999) first coined the phrase in 1999. For example they have been characterised as

A space, in which groups can retain their own cultural perspectives while coming to appreciate those of others (Carr & Wilkinson, 2005, p. 256).

Boundary organisations, as formal institutions or informal institutional collectives, can serve to translate ideas, vocabularies, practices and worldviews across knowledge and institutional boundaries that ordinarily serve to isolate science and policy (Duncan, 2011, p. 160).

As mentioned above by Duncan (2011), boundary organisations can exist in either formal or informal settings; they can be a research body, government department or simply one person acting alone as a boundary operator. While the physical format of a boundary organisation is fluid, Guston (1999) has articulated three distinguishing features that boundary organisations should embody:

- They (boundary organisations) provide a space that legitimizes the creation and use of boundary objects
- They involve the participation of both principles and agents, as well as specialized (or professionalized) mediators; and
- They exist on the frontier of two relatively distinct social worlds with definite lines of responsibility and accountability to each. (Guston, 1999, p. 93)

Cash et al. (2006) builds on Guston's (1999) boundary organisation provisions and argues that if boundary organisations are to be truly beneficial to managing the science-policy relationship, and produce productive policy outcomes and on the ground action, they need to produce knowledge that is *salient*, *credible* and *legitimate*. Cash et al. (2006) claim that these knowledge attributes can be produced through using boundary organisation functions of *convening*, *translation*, *collaboration* and *mediation*. These four institutional functions of boundary organisations are seen by Cash et al. (2006) as the key gears which drive a boundary organisation that is capable of producing salient, credible and legitimate knowledge. Cash et al.'s (2006) four institutional functions aim to bring different parties across the science-policy divide together to collaborate through using mediation and face to

face interactions based on a shared non-technical common language. It is these aspects of boundary organisations which are the focus of this thesis.

Application in different contexts

The concept of boundary organisations has been applied in a number of contexts over the last 13 years. For example, in her study of organic farming regulations in the United States, Ingram (2007) illustrated how a boundary organisation, in the form of the National Organic Standards Board (NOSB), was used in an attempt to promote collaboration and information sharing between scientists and organic farmers. The NOSB was used as it sat at the boundary of regulatory science and organic farming across multiple scales. The board was made up of a collaborative team which included farmers, environmentalists, scientists and industry representatives. Ingram (2007) found that while boundary organisations provided a useful framework for bringing together different social groups, they often struggle to address institutional and historical issues.

Cash et al. (2006) focused their use of boundary organisations on a much broader international setting and applied the theory to study different weather-forecasting systems in the Pacific and southern Africa (Pacific ENSO Application Centre and Southern African Drought Monitoring Centre). This study showed that if boundary organisations fulfil their functions of convening, translating, mediation and collaboration, they can effectively form connections between information providers and information users which can result in positive outcomes for both. As well as highlighting the positive aspects of information translation, Cash et al. (2006) also show how a lack of focus on these four functions can limit the production of salient, credible and legitimate knowledge, which results in a lack in on the ground action.

While the theory of boundary organisations has been applied to a number of different settings, much of its use within the literature has been focused on environmental issues. Since Cash et al. (2001) used the theory to study the science-policy relationship surrounding the High Plains Aquifer in the United States, numerous other authors have used the concept to examine other environmental issues, such as farmer and scientist relationships (Carr &

Wilkinson, 2005), water management (Duncan, 2011; Wallington et al., 2010) and climate change (Miller, 2001).

2.2.2 Boundary objects

Boundary objects play a key role within boundary organisations and have been referred to by Star and Griesemer (1989) as a means by which people from distinct social worlds with different world views are able to communicate and cooperate. Fujimura (1992) claims that boundary objects can help to reduce conflict and misunderstandings by fostering interactions and translating one group's interests into the interests of other groups.

In a more practical sense, boundary objects have been referred to as objects that are all around us, e.g. maps and models (Duncan, 2011). Bechky (2003) gives the example of engineering drawings as boundary objects since the drawings provide a means for communities, builders and designers to convene and discuss a project. Another quite different style of boundary object is used by Emad and Roth (2009), who use national education policy as means to communicate between the different boundaries involved in marine education. Star and Griesemer (1989, p. 393) claim that the physical form of boundary objects is not important as they can be "abstract or concrete". Rather than having a physical presence; boundary objects need to be abstract, institutionally or conceptually strong, yet be flexible enough to be used over multiple sites by different actors (Star & Griesemer, 1989). Although boundary objects are crucial to implementing information sharing and collaboration, they are dependent on the trust and consent of actors on both sides of the boundary (Guston, 2001). Concerns of trust and consent for the use of boundary objects are also interlinked with the knowledge attributes of salience, credibility and legitimacy found in boundary organisations (Cash et al., 2006). Unless the different parties involved in the particular issue(s) view the boundary object (and boundary organisation) as practical, transparent and credible, it is unlikely that the project will meet its objectives of collaboration and coproduction.

For example, Cash (2001) highlights how computer models have become an important tool within the boundary object toolbox. Given their ability to convert technical information into maps and graphics which can be understood by laypeople, models provide a unique setting

for different groups to come together and collaborate. Although models can no doubt be very useful within the boundary object context, they should not be seen as a magic boundary object bullet. Siebenhüner and Barth (2005) argue that while some computer models are effective at managing uncertainty, informing stakeholders and improving participation many are not. They also claim that such models also have very little impact on participant reflection and belief systems. In order for models to be effective, Siebenhüner and Barth (2005) argue their users/creators must manage their level of complexity (simple vs. high-tech), geographic scale, non-expert input (using a facilitator) and the role of uncertainty within the model. While these factors do not create a perfect model, they do help to build a far more effective one.

2.2.3 Summary

In this chapter we have seen how the current linear science-policy model is unable to successfully manage the complex science-policy interface which surrounds today's environmental issues. Boundary organisations have been proposed as a possible means to better manage this interface through focusing on communication, collaboration and coproduction. Unlike the linear model, which attempts to separate the disciplines of science and policy, boundary organisations aim to manage these disciplines together in order to produce salient, credible and legitimate knowledge. This next chapter provides information on the topics of catchment management, environmental policy and the Motueka ICM programme in order to provide a context for the later application of boundary organisation theory.

Chapter 3

Literature review

This chapter lays the foundation for the case study aspect of this research by exploring water management topics within New Zealand and overseas. This chapter will begin by identifying the different water issues affecting New Zealand before offering a brief summary of the country's water management framework. It will then move on to explore the concept of Integrated Catchment Management (ICM) and its application in New Zealand before finishing with an overview of the Motueka ICM programme. Through examining the Motueka ICM programme and other topics, the chapter seeks to highlight and connect the concepts (science-policy interface, boundary organisations) mentioned in the theoretical framework chapter to what is happening from a New Zealand water management perspective.

3.1 Water issues in New Zealand

New Zealand's remote location and geography provide for a climate of contrasts. Areas like the West Coast of the South Island regularly receive up to 10000 mm of rainfall per year, while only 150 km away on the east coast of the South Island rainfall drops dramatically to 500-750 mm annually (NIWA, 2003). New Zealand's freshwater supply is not limited to simply surface water. Underground aquifers are located throughout New Zealand's landscape. These large bodies of freshwater provide cities such as Christchurch with some of the cleanest drinking water in the world (*Greater Christchurch Urban Development Strategy* 2009). While these figures and facts may give the impression New Zealand is a freshwater paradise, the literature on the country's water resources paints a different picture.

From a national perspective, New Zealand's lowland rivers continue to have their water quality reduced. *NIWA's Water Quality Trends at National River Water Quality Network sites for 1989-2007* report shows that the majority of New Zealand lowland rivers are suffering from increased levels of nitrate and phosphorus, and reduced visual clarity (NIWA, 2010). These findings are also supported by water quality research concluded at a regional level by Environment Canterbury (Stevenson, 2010) in the South Island and Environment Waikato

(Vant, 2008) in the North Island. The research undertaken by NIWA (2010), Stevenson (2010) and Vant (2008) shows that the issue of water quality is ultimately interconnected with catchment scale land-use processes. As intensive farming methods have spread throughout Canterbury and Waikato over the last 20 years, there has been a commensurate drop in water quality in these regions.

This decline in water quality in New Zealand's water bodies is resulting in serious harm to the country's aquatic ecosystems. Outbreaks of algae blooms are becoming more common in New Zealand rivers, as a result of declining water quality (Quinn, 2009). Research undertaken by Joy (2009) on land-cover trends in freshwater fish communities shows that New Zealand's freshwater ecosystems are suffering a decline in biodiversity as a result of intensive agriculture development. Joy's (2009) research findings show a significant decline in fish biodiversity in rivers located in catchments where the majority of the land cover is farming pasture. As New Zealand is a nation of farmers, fishermen and swimmers who rely on freshwater for their income, food, recreation and traditional beliefs (Maori), this decline in water quality is also impacting on the country's social-cultural values.

New Zealand agricultural practices have changed in recent decades as wool and sheep prices have fallen dramatically on the global market (Jay & Morad, 2006). As a response many New Zealand farmers have moved to more water-intensive forms of farming such as dairy farming in order to increase profits and remain financially viable. Today dairy farming plays a significant role within New Zealand's economy generating more than 26% of the country's export goods and contributing to 2.8% of the country's gross domestic product (Schilling et al., 2010). Although New Zealand is home to plentiful volumes of freshwater considering its small population, this recent transition to more water-intensive farming methods is placing great pressure on many of the nation's rivers and aquifers. Due to this high demand for water, a significant number of New Zealand's freshwater resources (rivers and aquifers) have been listed by the regional councils which manage them as being fully or even over-allocated (McGregor & Gully, 2007).

The limited amount of available water in many parts of New Zealand has resulted in conflict between different water uses (hydro-generation, irrigation, stock water and recreational users) (Memon, 1997). This conflict over water access and use regularly involves parties

taking their resource consent cases to the Environment Court in order to legally claim their rights to access and use water. This conflict over water resources has also spilled into the media with many of the country's news outlets blaming industries such as forestry and farming for the country's water crisis with article headings such as 'dirty dairying' (Proffitt, 2010).

3.2 Water management and the Resource Management Act, 1991

New Zealand's environmental and water policy underwent drastic changes in 1991 with the introduction of the Resource Management Act, 1991 (RMA). The RMA replaced numerous other environment-related acts and statutes which often overlapped each other and were generally seen as being outdated (Burton & Cocklin, 1996). Up until the RMA was established, New Zealand's freshwater resources had generally been managed under the Water and Soil Conservation Act 1967 (WSCA). Critiques of the WSCA are a mixed bag of good and bad reviews. Authors such as Poole (1983) and Rodda (1976) hold the WSCA in high regard for its focus on high quality catchment science, while other authors such as Memon (1997) saw the act as a weak water management framework which failed to manage freshwater resources in a sustainable manner.

The RMA soon caught the interest of numerous authors who saw the act as ground-breaking and of international significance (Buhrs & Bartlett, 1993; Burton & Cocklin, 1996; Memon, 1997). With its focus on the sustainable management of natural and physical resources, the introduction of the RMA was seen by authors such as Memon (1993) as a breath of fresh air for New Zealand's water policy. Unlike the WSCA which provided a very weak policy framework with little to no consideration of environmental and social values, the RMA provided an integrated and holistic approach to resource management, with a strong focus on policy and planning documents (Memon, 1993; Scott, 1993).

The RMA resulted in a number of changes to New Zealand's water policy, such as the establishment of regional freshwater policy statements and resource management plans. These plans and policy documents provide councils with a strategic and holistic overview of resource issues within a single region (Memon, 1997). Under the RMA these natural resources (land, air, water) were managed at a project level through the effects-based

resource consent assessment system (Memon, 1997). These new approaches to environmental management under the RMA were based on a new decentralised framework which moved decision-making power from central government to regional and district councils (Memon, 1997).

The RMA not only affected how New Zealand managed its natural resources but also who could take part in the management process. Under the RMA public, stakeholder and iwi involvement in resource management (water) decision-making was increased as a means to give a louder voice to these members of society.

This increased public involvement was primarily achieved through the development of district and regional plans, policy statements and the resource consent assessment system (Burton & Cocklin, 1996). These plans, policies and consents involved a public consultation aspect which gave members of the public the ability to voice their opinions over environmental management issues within their region (Burton & Cocklin, 1996). This apparent democratisation of the decision-making process under the RMA has played a major role in regard to water management issues in New Zealand, as it has given communities the ability to express their views on water-related issues and notified developments.

Another important social issue the RMA attempted to address was how to include Maori values and the Treaty of Waitangi (ToW) within New Zealand's environmental policy. Water is seen as very special within Maori culture and is regarded with the utmost respect. It is seen as being interconnected with the land and is a key aspect of Maori culture (Williams, 2006).

Although the 1840 ToW gave the Maori tribes of New Zealand the rights to the country's land with its forests, rivers and flora and fauna (how much of an ownership/management role the ToW gave Maori is still debated today), they were mostly left out of any environmental management processes until 1991 (Williams, 2006). The RMA tried to increase Maori involvement in the management of New Zealand's natural resources in a number of ways (Memon, 1997). This included incorporating Maori terms such as Kaitiakitanga (guardianship of environment) within the statute itself. By including such terms

within the RMA, the authors of the Act were seen as incorporating Maori principles and values within New Zealand environmental law (Burton & Cocklin, 1996).

Another key issue in regard to Maori rights was including section 8 within the RMA which required all government authorities implementing the Act to “take into account the principles of the treaty of Waitangi” (Lennox et al., 2011).

3.2.1 Unfulfilled promises

While the RMA helped to address many of the issues not covered by the WSCA, its implementation over the last 20 years has not been without its own problems in regard to water management. Authors such as Lennox et al. (2011) and Memon (1997) argue that while the RMA laid a positive foundation for addressing New Zealand’s water quality and quantity issues, it has failed to make any real progress on these issues.

Bowden (1999) argues that this lack of action to take a proactive approach to water management can be partly blamed on the restructuring that occurred within government following the introduction of the RMA. The transfer of power from central government to regional and district councils combined with new policy, planning and resource consent requirements, left many regional councils overwhelmed and underfunded (Ericksen, 2003). With their time and resources taken up writing plans and processing consents, councils simply did not have the ability to undertake alternative water management methods such as integrated catchment management even though the RMA clearly states that resources should be managed in an integrated manner (Bowden, 1999).

This restructuring under the RMA also saw councils move to a resource management framework which focused on effects-based or downstream issues. Lennox et al. (2011) argues that this new effects-based system was too narrowly focused and soft on resource users and polluters as it was based on managing (downstream) effects rather than taking a more proactive regulatory approach to the activities themselves.

Another factor which limited the ability of regional and local councils to manage their water resources was a lack of guidance by central government who had failed (up until 2011) to produce a national water policy outlining the country’s freshwater standards (Memon,

1997). Without a national water policy, the country's regional councils were left to write their own water policies and plans which were often weak and did little to protect water resources let alone improve them as is emphasised under the RMA (Memon, 1997). While the National Policy Statement (NPS) for Freshwater Management was released by central government in 2011, authors such as Mike Joy argue that the new policy was "20 years too little too late" (personal communication, 19 July, 2012).

The public consultation process as outlined under the RMA has also run into some issues. The technical nature of many of today's resource consent applications means that many Maori iwi (excluding large corporate-focused iwi) and members of the public lack the capacity to take part in the consent applications as they cannot afford to hire expert advice (Burton & Cocklin, 1996). This kind of process not only limits the public's ability to enter into the consent application process, it also risks tipping the decision-making framework in favour of the side with the largest chequebook and the largest pile of technical reports. Many iwi also feel that councils are not living up to their responsibilities under the RMA to work with Maori as treaty partners rather, Maori views are often labelled as 'stakeholders' and lumped together with other views which often trump theirs (Lennox et al., 2011)

While the RMA relationship to water management has been a difficult one given the many challenges and barriers outlined above, it does appear that the New Zealand water management framework under the RMA is beginning to learn from some of these issues and move (or at least appear to) towards a framework based on sustainability and integration. Evidence of this can be seen in the recent interest in water-related issues such as riparian plantings, establishment of NPS for freshwater, nutrient capping on farms and integrated community-driven water management frameworks such as the Canterbury Water Management Strategy. While many of the issues affecting how the RMA manages New Zealand freshwater resources have yet to be addressed, these new approaches show that there is at least an interest at an institutional level in improving the country's water management framework.

3.3 Integrated Catchment Management (ICM)

Since its creation in the 1960s, the concept of managing water at a catchment scale has been discussed by numerous authors under a number of titles (integrated catchment management, integrated water resource management or river basin management) (Fenemor, Phillips, et al., 2011). The nature of ICM has seen it defined and summarised in different ways over time. Authors such as Bowden (1999) have described ICM as both a research approach and an organising philosophy, while others like Calder (1999) see ICM as an effort to develop satisfactory solutions, not necessarily the optimal solutions, to environmental management problems.

3.3.1 Theory

The best method for understanding the ICM may in fact come from breaking the concept into three phases and examining it as a philosophy, process and product (Mitchell & Hollick, 1993). Rather than viewing ICM as simply a resource management process, Ashton (2000) argues ICM requires a new way of thinking about catchment issues and so it can be seen as a new philosophy of water management. This new way of thinking is very much a people-orientated management process which requires inputs from a wide range of actors who value and use the catchment in different ways (Ashton, 2000). In a physical sense, ICM produces strategies and plans which are used to achieve the sustainable management of natural resources while also promoting a sustainable society within the catchment. These 'sustainable' goals are achieved, Ashton (2000) claims, through joint partnerships between stakeholders, community and government.

3.3.2 Application

In New Zealand, ICM can be described as a process which involves building up a collective of scientists, resource managers, policymakers, stakeholders and community representatives. This interdisciplinary collective is then tasked with identifying, researching and addressing water- and land-related issues within a single catchment (Fenemor & Bowden, 2001). ICM recognises that the environment is a complex system of interacting natural and social factors occurring within the scope of a single catchment (Bowden, 1999). Rather than just focusing

on individual issues unconnected to catchment sites, ICM takes a systems approach to studying catchments. This system or ecosystem approach involves examining the relationships between different environmental features (e.g. water, land, sea) and social systems.

By linking the natural features of the catchment together with the social, economic and political issues, ICM provides a framework for addressing current and possibly future catchment issues (Fenemor & Bowden, 2001). Instead of taking a linear model project-based approach where the experts operate in isolation to address policy and management issues, ICM places the community and stakeholders within the management framework alongside researchers and policymakers. The role of communities and stakeholders' engagement is very important within the ICM process and should not be neglected as it can decide the success of the ICM programme (Fenemor, Phillips, et al., 2011). By including both natural and social aspects of the catchment under one management 'roof', ICM aims to improve not only the health of the catchment's ecosystem but also the health of the catchment community through increasing understanding, creating social networks and building resilience (Fenemor, Phillips, et al., 2011).

3.3.3 History

ICM first came to international attention at the 1977 United Nations water conference in Mar del Plata, Argentina (Petit & Baron, 2009). This international focus on the concept saw countries like Australia introduce their own ICM programmes throughout the 1980s (Mitchell & Hollick, 1993). Although ICM was in use throughout the world in the 1980s, the concept was not held in high regard and was ignored as water issues fell off the international agenda (Petit & Baron, 2009). According to Petit and Baron, (2009) ICM did not reappear on the international stage again until the Dublin (water and the environment) and Rio de Janeiro (environment and development) conferences of 1992. Since then, the concept of ICM has grown in popularity within the freshwater management sector. Much of this success can be attributed to the birth of the sustainable development movement and documents such as the Brundtland report - *Our Common Future* (Petit & Baron, 2009). This report, like much of the literature of this era (and today), placed great emphasis on the need for

integrated and catchment-based approaches for addressing environmental issues (Petit & Baron, 2009).

3.3.4 A new approach

In contrast to ICM, natural resources have been traditionally managed through a top-down agency-centred approach which focused on single issues without looking at the 'bigger picture' (Allen et al., 2011). This model has resulted in a 'paradigm lock' within the natural resource management which has seen science fail to produce real on the ground action in response to environmental issues (Fenemor, Phillips, et al., 2011). Authors such as Holling et al. (1998) and Lennox et al. (2011) argue that this top-down approach has shown to be unable to address many of today's complex environmental issues. Holling et al. (1998) argue that our current resource management frameworks simply cannot recognise the non-linear and multi-sectoral nature of today's environmental issues.

ICM has been identified by authors such as Allen et al. (2011) as a means to move water management away from the old top-down approach into a new era based on integration and collaboration. This is achieved through employing management and learning tools such as collaboration, indigenous knowledge, institutional learning and adaptive management (Fenemor, Phillips, et al., 2011). Fenemor and Bowden (2001) suggest that by using these tools ICM can be used to release the paradigm lock which, it is argued by these authors is currently preventing better management of our freshwater resources.

3.3.5 Problems with ICM

Although ICM has enjoyed increased popularity within the land and water management sector in the last two decades, it has also had to deal with its fair share of criticism which has primarily focused on its broad and complex nature, difficult implementation, ambiguous goals, long time frame and high costs (Edgar, 2004; Mitchell & Hollick, 1993; Petit & Baron, 2009). These complaints are in many cases justified, as a number of ICM programmes have failed or been abandoned due to these issues (Ashton, 2000; Mitchell & Hollick, 1993). For example, Ashton's (2000) study of ICM in South Africa found that in order for ICM to work strong statutory and institutional structures are needed in order to increase participation

and promote transparency. These kinds of criteria tend to limit ICM to countries with strong national and local environmental-focused institutions.

3.4 Integrated Catchment Management in New Zealand

Although integrated catchment management (ICM) has been in use throughout the world since the late 1970s, the concept is relatively new within New Zealand's environmental management sectors. The first major ICM project in New Zealand was undertaken in the Motueka catchment and it operated from 2000-2010. The introduction of ICM to New Zealand came at an important time for the country as it attempted to address important land and water issues such as declining water quality and conflict between water users (Memon et al., 2010).

Since the start of the Motueka ICM programme, a number of other community catchment management programmes have been established. These include a number of small-scale projects throughout Auckland City, Dunedin and Canterbury's Styx River (Meurk, 2004; Scott, 2007; Tyson et al., 2005). While some of these programmes do not use the 'ICM' label, they have been mentioned because they fit within the broad ICM concept.

In 2002 NZ Landcare Trust, a non-profit environmental organisation, undertook a nationwide project to increase ICM use in New Zealand. The aim of their project was to establish a national network of ICM practitioners and participants in order to build knowledge and share experiences about the practical application of ICM initiatives at a community level (Edgar, 2004). While the NZ Landcare Trust ICM project helped to spread the ideas and foundations of ICM to different catchments around New Zealand, these ICM building projects did not necessarily blossom into full-scale ICM programmes as seen in the Motueka catchment.

While the above ICM examples do show that this catchment style of management is in use in New Zealand, the small number of ICM programmes which have been launched shows that this style of management has yet to gain support within New Zealand's land and water management sectors.

From a broad perspective, both the principles of the RMA and ICM match up almost in sync. Both promote the sustainable management of natural resources through integrated land and water management systems, both have a strong focus on public and stakeholder involvement, and both are designed around the catchment scale (council boundaries encompass catchments) (Memon et al., 2010).

While the principles of both the RMA and ICM are easy to identify within the New Zealand context, making ICM work within the RMA framework at a programme and project scale has proven much more problematic. This next section seeks to explore this issue of compatibility between ICM and the RMA by highlighting the different institutional, political and social barriers which make implementing ICM within the RMA framework so challenging.

3.4.1 The RMA and the Treaty of Waitangi

The RMA, which should be helping to promote ICM, has in fact turned out to be as much of a hindrance as a help. For example due to the ambiguous nature of the term 'sustainable management' in the RMA, many regional councils have been left unsure how to manage their water resources in a way that fulfils the RMA principle of sustainable management (Memon et al., 2010). This lack of clarity on the issue has resulted in many regional councils opting for light-handed water management regulation, rather than upsetting the agriculture sectors in their districts with tighter water allocation and quality limits (Memon et al., 2010). Another negative RMA legacy is the 'first in first served' water allocation system. Under this process, New Zealand's water-related science has been greatly politicised through court hearings as developers and regional councils have argued over who should have access to water resources. This process has created a legacy of distrust around water resources in many parts of the country (Memon et al., 2010).

Another important national document which affects ICM in New Zealand is the Treaty of Waitangi (ToW). Under the Treaty of Waitangi all freshwater bodies in New Zealand are owned by Maori. Since a claim was lodged by Maori to claim ownership of freshwater in 2012 uncertainty surrounding who will own the country's freshwater has resulted in anxiety within New Zealand's water management sectors. Authors such as Memon et al. (2010)

claim that this kind of uncertainty around who owns the country's water only increases disagreements and prevents collaboration.

3.4.2 Government and scientific institutions

Under the RMA New Zealand's natural resources are managed by three levels of government authority: central government, regional councils and district/city councils. This institutional arrangement sees regional councils responsible for surface and groundwater while land use is managed by district/city councils. While this system works for simple narrow-focused issues, it does not lend itself well to issues such as non-point source water pollution which involve both land and water issues. This current institutional situation results in ICM programmes having to deal with both regional and district authorities. This matter becomes even more complicated when there is a poor relationship between local and regional councils, which is often the case (Memon et al., 2010).

A lack of guidance from central government on ICM is also limiting regional and district/city councils' ability to implement ICM at a local level. As New Zealand's resource management framework is primarily regulatory driven, the voluntary nature of ICM has left many councils around the country unsure how to incorporate both voluntary and regulatory approaches into their regional and district plans (Daly & Fenemor, 2007). Bowden (1999) argues that without strong support and guidance from central government, there is very little chance that ICM programmes around New Zealand will be able to emerge, let alone grow into productive management systems.

ICM is also limited due to how scientific institutions operate. For a number of decades now New Zealand's environmental scientists (working within councils, consultancies and research institutions) have been operating within the traditional linear conception of the science-policy relationship. This style of management generally operates in isolation with very little contact with other research disciplines or stakeholders and so does not work well with the concept of ICM (Memon et al., 2010). One of the challenges facing ICM implementation in New Zealand is overcoming this silo mentality within the country's scientific community (Memon et al., 2009). Bowden (1999) argues that this is no easy task as it requires scientists

to alter their world view and try new approaches which in the past have not been included within their roles as researchers (Bowden, 1999).

3.4.3 Community engagement

Many of these challenges for ICM implementation at a local level involve issues surrounding community participation. While some members of a community may be happy to get involved in ICM, it is often very difficult to include members of the community who feel they have been labelled as the 'bad guy', e.g. farmers and forestry companies (Daly & Fenemor, 2007). This issue is not helped by councils (operating under the RMA framework) who often focus on the environmental issues first and community involvement second (Memon et al., 2010). This current style of community engagement does not lend itself well to the principles of ICM which require strong relationships between communities, stakeholders and researchers from the beginning. This lack of focus on building social capital within catchment communities needs to be addressed if ICM leaders truly wish to get real buy-in from their local stakeholders and communities (Memon et al., 2010).

The arguments stated above clearly show that while the RMA and ICM share similar ideology and goals of sustainability they are at a programme level operating on fundamentally different strategies and frameworks. While this does not mean that it is impossible to operate ICM within the RMA, it does illustrate just how difficult it can be to operate ICM programmes within New Zealand's existing institutions and environmental policy system.

3.5 Motueka Integrated Catchment Management programme

The Motueka Integrated Catchment Management (ICM) programme was based around the Motueka river catchment, which is located at the very top of New Zealand's South Island. The programme operated for a 10-year period and involved research organisations, government departments, interest groups, local iwi and community groups. The Motueka ICM programme has been described by Bowden, Fenemor and Deans (2004), who were closely involved with the development and implementation of the programme, as 'experimental catchment research'.

The objectives of this research were:

to improve the understanding of – and social learning about – land, freshwater and near coastal environments in catchments with multiple interacting and potentially conflicting land uses (Bowden et al., 2004, p. 311).

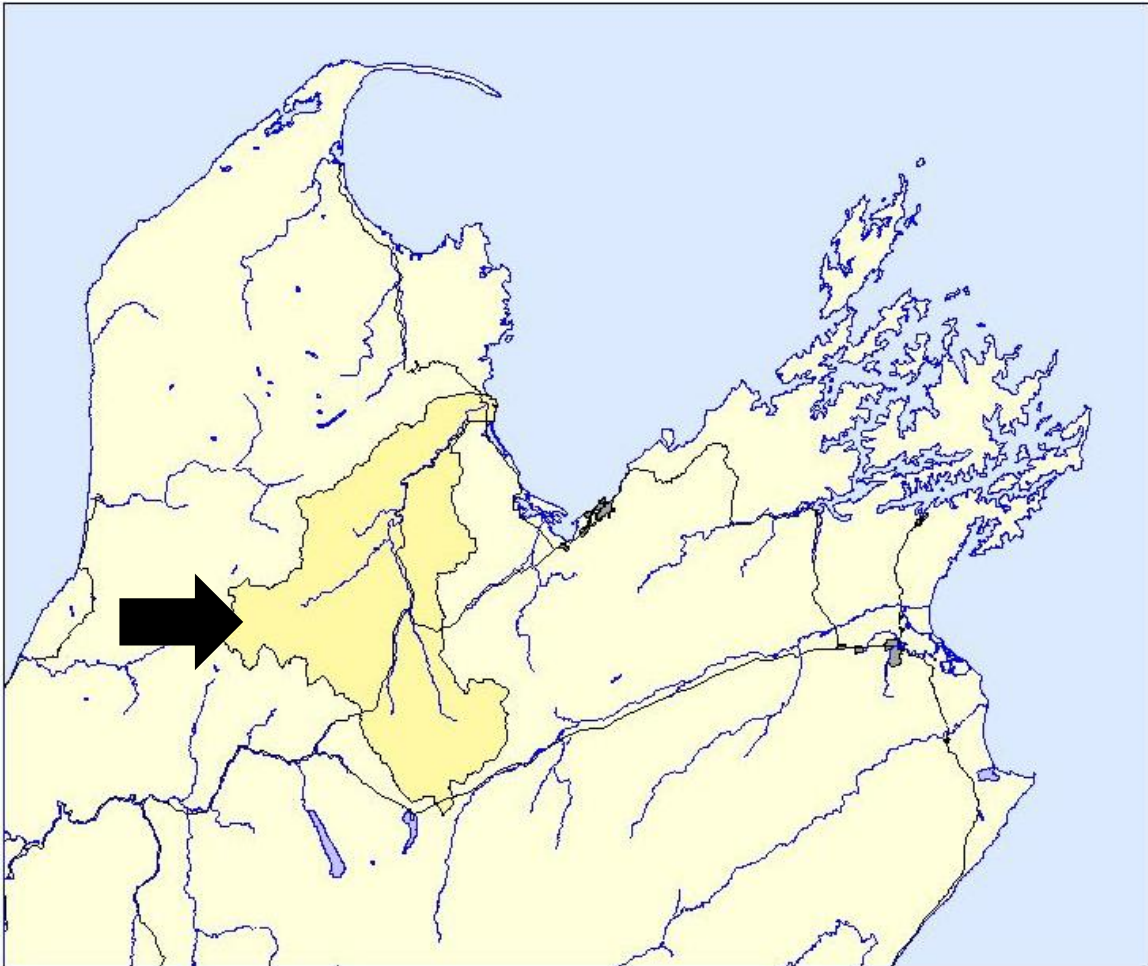


Figure 3.5.0 Map of Motueka catchment (Landcare, 2010a)

3.5.1 Background

The Motueka catchment was chosen for the ICM study by Landcare Research (a crown research institute) due to its diverse land and water use (forestry, farming and fisheries), broad range of environmental issues and the wide-ranging catchment characteristics that are available to study (e.g. rainfall, geology, land cover) (Phillips et al., 2010). This catchment also has a history of contentious catchment-based issues which provided a good context for the study. For example, in 1989 Fish and Game applied for a Water Conservation Order as a means to protect the aquatic ecosystem of the Motueka River (Bowden et al., 2004). This

resulted in intensive debate within the community as to how to weigh up the costs of economic development against the associated environmental impacts. Although the Water Conservation Order has since been replaced by a negotiated settlement, the community and stakeholders within the catchment have acknowledged the need for better catchment management strategies (Bowden et al., 2004).

The Motueka ICM programme officially began in July 2000, but its original conception can be traced back to workshops held between Landcare Research (Landcare) and local stakeholders in 1998 (Phillips et al., 2010). These workshops identified the need to manage the land, river and coastal environments of the Motueka area in a sustainable and holistic manner. Another major output of these workshops was the concept of a catchment-scale approach to water, land and coastal issues. This concept resulted in the creation of the 'ridge tops to the sea' perspective, which would go on to be the motto of the programme (Phillips et al., 2010).

An interregional part of the ICM programme was its focus on redefining the science-policy relationship through using new strategies which aimed to encourage collaboration and communication between researchers, policymakers and members of the public, iwi and stakeholders within the catchment. It is this aspect of the ICM programme this study is seeking to explore and analyse through the lens of boundary organisations.

3.5.2 Strategy

The research component of the ICM programme was organised into four science themes, land use, freshwater, coastal marine and human dimensions (Fenemor & Bowden, 2001). A major aspect of the programme was to integrate these different science themes within the Tasman District Council, local community and stakeholders, in order to build a truly interdisciplinary and holistic team. This kind of community, scientific and policy integration was to be achieved through processes and tools such as shared learning, adaptive management, workshops and modelling (Bowden et al., 2004). The programme leaders operated on the premise that if they could improve the community's ability to address environmental issues through these processes, they would also be improving the resilience of the ecosystem as well (Fenemor, Phillips, et al., 2011).

In order to build an interdisciplinary team, ICM programme partners Landcare and the Cawthron Institute (an independent research institute) worked with a wide range of agencies and government departments including: the National Institute of Water and Atmospheric Research (NIWA), Geological and Nuclear Sciences (GNS), former Forest Research Institute (SCION), Tasman District Council (TDC), local iwi, Fish and Game and the Community Reference Group (CRG) (Phillips et al., 2010). The Motueka ICM programme operated from 2000-2010 at a cost of \$18.5 million. This funding was managed by Landcare and supplied by the New Zealand Government (Smith et al., 2010).

3.5.3 Programme outputs

Over the 10-year period of the study, the Motueka ICM programme undertook in-depth research projects for all of the four science themes throughout the catchment. These research projects provided new insights into a wide range of scientific topics ranging from groundwater modelling to collaboration building. Evidence of this research can be seen in the many peer-reviewed published articles by members of the ICM programme and the interest the programme received from a wide range of government, research and non-governmental bodies both within New Zealand and overseas.

Productive outputs from the ICM programme have not only been limited to published scientific papers and conferences. Smith et al. (2010) claims that the ICM programme improved social networks within the local community which helped to establish a shared understanding of environmental issues within the catchment. This view is also shared by authors such as Allen et al. (2011) who claimed that the collaborative nature of the ICM programme helped to instil trust and friendships both within the research teams and also with the local communities and stakeholders. These new relationships were then used to help key stakeholders improve their capacity for addressing environmental issues so they could take a more active role in managing the catchment (Allen et al., 2011).

Smith et al. (2010) claim that the ICM programme also played an active role in bridging the divide between scientists and policymakers. They claim that evidence of this relationship can

be seen through the number of management and policy changes that occurred at the regional Tasman District Council as a result of ICM programme.

3.6 Past research and the road ahead

Except for external ICM programme reviews by Smith et al. (2010) and Lawrence (2010), little has been written by authors who were not directly involved within the programme. This limited amount of information on the programme by external authors provides an excellent opportunity for this research to cover new ground and explore the ICM programme from a science-policy perspective. It is worth noting that this study is not a review of the overall ICM programme but rather an analysis of the programme through the lens of boundary organisations. This analysis will be focused around the following two research questions:

- How did the ICM programme negotiate the interface between science and policy?
- Compared with the theory, how effectively did ICM programme operate as a boundary organisation in practice?

Chapter 4

Research methodology

This chapter provides a description of how this research was undertaken and the rationale for why the specific procedures and methods were chosen. It describes what research methods were used to collect data, and how the data were analysed to answer the research questions.

4.1 Research aims and objectives

The aim of this research was to examine the relationship between science and policy in the freshwater management context, with a focus on the role of boundary organisations in facilitating communication and knowledge sharing across the science-policy interface. The Motueka Integrated Catchment Management programme is used as a case study as it appeared to embody the key characteristics of boundary organisations. To achieve this aim my research objectives have been to:

1. Develop a theoretical framework from the literature on boundary organisations
2. Establish a set of evaluative criteria for assessing the effectiveness (or not) of the ICM programme as a boundary organisation.
3. Apply these criteria to collected qualitative data to evaluate how effectively the ICM programme negotiated the science-policy interface
4. Assess the effectiveness of the ICM programme as a boundary organisation

4.2 Research approach

The descriptive, in-depth and multi-disciplinary nature of this research was best suited to a qualitative data collection approach. Interviews were chosen as the appropriate research method for this study due to their ability to provide rich data about peoples' experiences, perceptions, and world views (Strickert, 2011). As this research required analysing the ICM programme, these experiences, perceptions and world views of the people involved in the programme were vitally important.

As the programme finished in 2010, direct observation and participation could not be used for this study. Importantly interviews were not limited by the fact that the programme had finished; this was actually an advantage as it offered the advantage of hindsight. By allowing interviewees the ability to review the programme from a holistic and historical perspective, the interviews aimed to produce rich, diverse and focused data.

In order to gather information on the Motueka ICM programme a number of different information sources were used. These included official and detailed reports, published peer-reviewed articles, media features, information booklets and YouTube videos. These different information sources provided triangulation of information about the case study. A three-day visit to the Motueka catchment was also undertaken in April 2012 in order to gain a better understanding of the different physical, social and economic processes occurring within the catchment.

In total twelve interviews were undertaken with scientists, policymakers and members of the CRG. This number of interviews was seen as sufficient given that the programme involved an estimated 58 people and the time limitations placed on this research.

4.2.1 Case study

Given the goals and objectives of this research a single case study format was used to explore and examine the ICM programme from a science-policy perspective. As this research focuses on a single study (Motueka ICM programme) which occurred over a long time period (10 years) the case study method offered the best approach for undertaking an intensive analysis of the Motueka ICM programme.

Case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in a “real life” context (Simons, 2009, p. 21).

As this study is based around research questions which focus on the terminology of “how and why” (e.g. how did the programme negotiate...how effectively did the ICM programme...) rather than questions based on “how many” or “how much” (e.g. how

many scientists choose to...) it used an exploratory research strategy as outlined by Yin (2002).

Yin (2002) argues that the exploratory case study research provides a unique and useful strategy for examining an event, system or programme which involves complex social, cultural and political systems. Given the diverse range of actors, groups and institutions involved in the ICM programme the exploratory research strategy was seen as the best method for answering this study's research questions.

4.2.2 Shifting the research approach

The original research aim of this thesis was to study the role of Landcare within the ICM programme in order to see how it managed the science-policy relationship and how it compared to boundary organisation theory. However once data had been collected and analysis started it became clear that focusing on just Landcare's role alone in the ICM programme was limiting the scope of the study and its ability to investigate the science-policy interface. The Motueka ICM programme's integrated interdisciplinary approach meant that the programme partners (Tasman District Council, Landcare and Cawthron) often fulfilled a number of roles in different disciplines (research, management, facilitation) in partnership with other groups. An example of this kind of overlap can be seen at the ICM Community Reference Group meetings, which would often be organised and facilitated by a combination of staff (researchers, programme managers and planners) from Landcare, Cawthron and TDC. This often messy overlapping of roles and responsibilities within the ICM programme by different actors and groups meant that it was close to impossible to separate one group alone (e.g. Landcare) without taking into account the roles of other actors and groups.

Given the complexity of the ICM programme it was decided that this research would be better suited to focus on the programme as a whole unit rather than just on Landcare's role within the programme. By taking a step back and focusing the research from a wider perspective this research aimed to provide a much more accurate picture of how the programme managed the science-policy interface.

4.2.3 Author's perspective

Given that people's experiences will always shape their world view and opinions I see it as necessary to briefly outline both my personal and professional background in order to offer some insight into how I approached and undertook this research.

Like many New Zealanders who grew up in a rural setting I had a close relationship to freshwater from a young age. As a young boy I would enjoy my summer days swimming and fishing in the river below our property as water from our underground irrigation system irrigated our commercial fruit orchard.

Over the last 7 years I have held a number of professional positions which have seen me working with both land and water issues. While still an undergraduate student I investigated water quality issues relating to land use within the Lyttelton harbour for the Christchurch City Council. After graduating with my Bachelor Degree in Environmental Management in 2008 I took up a resource planner position with Timaru District Council. This role involved accessing a broad range of land-based developments through the resource consent framework. Over 2012 I have held a part-time position with Insight Project Management (Farming Consultancy). This agriculture development-focused role moved my professional experience outside of the local government sector and saw me work on numerous water-related projects throughout the Canterbury region.

I believe that these past experiences have provided me with a unique insight and on the ground experience into a range of topics which are covered in this study (e.g. RMA, science-policy interface, water resources and government institutions). Given my experience in local government and the consultancy sector, the concept of boundary organisations appealed to me as it offered a means to possibly address many of the issues I saw limiting more effective management of our natural resources.

4.3 Evaluative framework

This study involved using the literature on boundary organisations to establish a set of evaluative criteria that could be used to identify and evaluate the effectiveness (or otherwise) of the ICM programme as a boundary organisations. The criteria were sourced from the two most cited authors of boundary organisation theory, Guston (1999, 2001) and Cash (2001, 2006).

4.3.1 Evaluative criteria

According to Cash et al. (2006) boundary organisations need to undertake a number of ‘critical functions’ at an institutional level in order to successfully move knowledge across the science-policy interface. These functions include: convening, translating, mediation and collaboration.

According to Cash et al. (2006) these functions are essential for the creation of salient, credible and legitimate knowledge. Cash et al. (2006) argues that these knowledge attributes can only be produced and managed if a boundary organisation is fulfilling its critical institutional functions (see figure 4.3.1).

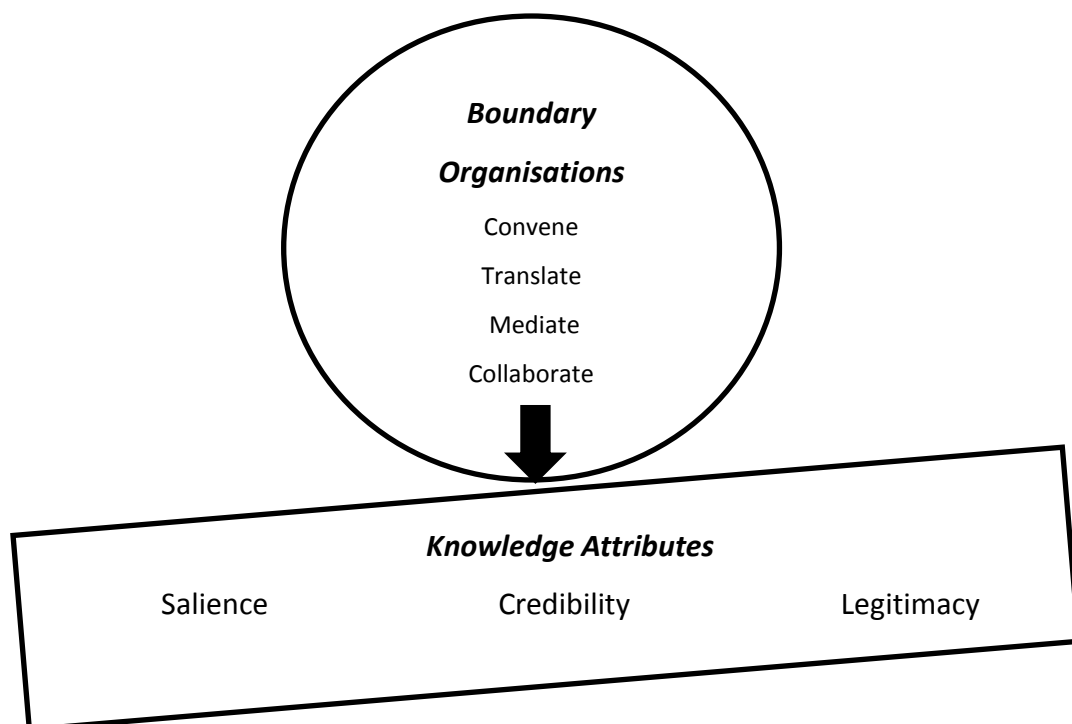


Figure 4.3.1: Relationship between boundary organisations and knowledge

This research examined how these institutional functions were carried out within the Motueka ICM programme in order to see how the programme operated from a science-policy perspective. These evaluative criteria were used to focus on the processes, tools and interactions (both physical and social) which occurred as a result of the ICM programme.

The evaluative criteria which were used for this study are listed below:

- **Convening:**
Stakeholders, iwi, research bodies, local authorities and community groups meet face to face (convene) regularly to debate and discuss relevant topics. Cash et al. (2006) state that convening plays a critical role within boundary organisations through helping to establish trust and build relationships. It also lays the foundation for the other criteria listed below.
- **Translating:**
Information is presented in a manner that it is understandable to both experts and laypersons. This can involve technical language (jargon) being converted into more basic laypersons' terms or a layperson's local knowledge and values being presented in an understandable format to an expert. Translating allows information to pass between actors on different sides of the science-policy boundary by promoting and using a common language (Cash et al., 2006).
- **Mediating:**
The boundary organisation provides a means by which all conflicting viewpoints are explored and addressed through a dispute resolution process. Environmental issues are often emotionally and politically charged and so a mediating process is required in order to resolve issues and hopefully prevent deadlock. This process will involve the creation of spaces for mediation to occur (Guston 1999).
- **Collaboration:**
Collaboration involves different disciplines and social groups working together to address a common issue. Collaboration provides a means to move experts out of isolation and include non-experts within a research framework. A key part of collaboration is the use of boundary objects. Star and Griesemer (1989) describe

'boundary objects' as a means by which people from distinct social worlds with different world views are able to communicate and cooperate even under conditions of a lack of consensus. Through using a range of technical, social and education methods, boundary objects seek to facilitate collaboration through focusing on collective independent tasks rather than on actors' own interests.

4.4 Research informants

The research population for this study was made up of people who were involved in some manner with the Motueka ICM programme. The focus on both boundary organisations and ICM draws this population down to scientists, community members and policymakers. Interviews were undertaken with members of the programme who had been involved for longer than two years. Involving those with extended experience took account of the long length (ten years) of the programme and ensured that interviewees experienced different stages of the programme. Interviewees were also required to fit into one of the three following categories: scientist (biophysical, social, natural resource managers), policy (planner) analyst and community group member.

Informants were accessed via Landcare's publicly available ICM database which contains the names of all the scientists (biophysical, social), natural resource managers and policy analysts who were involved in the Motueka ICM programme. Members of the Community Reference Group (CRG) were not listed on Landcare's database and so their details were supplied by Landcare after a formal request was submitted. The CRG was chosen due to its role within the programme as a representation of the wider Motueka community and local iwi. The snowball method was used identify key members of the ICM programme and CRG who may not have been listed on the Landcare database.

Once interviewees were identified they were contacted via email or telephone. This email/ telephone call included information outlining the research aims and how the data produced from the interview would be used. If the interviewee agreed to take part he/she would then be supplied with a consent form to sign which outlined their rights under the terms approved by Lincoln University's Human Ethics Committee.

4.5 Data collection methods

The questions used in the interviews were open-ended and presented in a semi-structured format. This format allowed the interviewee the ability to respond in depth, while also giving the discussion the flexibility it needed in order to discuss topics that were related but not listed as interview questions. Three sets of interview questions were created so that the primary research groups (scientists, policy makers and CRG members) all had questions which were tailored to their role within the Motueka ICM programme.

Interviews are an excellent method for gaining access to information about events, opinions and experiences (Dunn, 2000, p. 52).

Face to face interviews were the prime form of data collection for this study and were used for eight out of the twelve interviews (two of the in-person interviews were undertaken over Skype). These interviews were undertaken in the participant's place of work, home or a chosen neutral location. After gaining permission from the interviewee a digital voice recorder was used during all face to face interviews (including Skype interviews). The voice recorder was used to free up the researcher from note taking and to allow them to focus on the interview dialogue. Voice recorders have been shown to be very useful to researchers as they provide them the ability to re-listen to the interview at a later date (Gorman & Clayton, 2005). After interviews had been completed the voice recording was used to transcribe the interview into a text document for analysing.

Email interviews were used for participants who preferred to answer the interview questions in their own time. These participants were also located outside of the Christchurch area, which limited their ability to take part in face to face interviews. The email interviews used the same set of questions that were used in the in-person interviews. Email interviews are a relatively new form of data collection which has become quite common in academic research due to the popularity of email (Gaiser & Schreiner, 2009). Although this format of interviewing misses 'off-the cuff' and emotional responses found in in-person interviews, it makes up for this through other advantages. Since the interviewee has the ability to respond in their own time and in a comfortable environment they are able to produce data that is rich and detailed (Gaiser & Schreiner, 2009). Email interviews are also generally faster and cheaper to complete than in-person interviews as they do not require the researcher to

travel long distances in order to have face to face meetings, which is beneficial to researchers with limited time frames and budgets.

4.6 Data analysis

Analysis of the interview data and documents in light of the boundary organisation criteria was undertaken using the evaluation research method. Evaluation research has been described by White (2006, p. 166) as “a means to investigate the scope, reach and interactions associated with an intervention” and “a means to gauge competency and performance”. The evaluation research method was used for this research due to its focus on the assessment of particular programmes. Therefore, it provides the evaluative means to undertake an assessment of the performance of the ICM programme.

Analysing qualitative data can be a difficult task as there is no one right way or process to follow in order to get the results as there is with the quantitative approach (Paulsen & Dailey, 2002). In order to get the best possible results from the interview data this study underwent the following process:

Firstly the study collected and organised data according to the three different interview groups (researchers, policy analysts and CRG members). Patterns within the data which related to the criteria of boundary organisations were then identified according to which interview groups that data came from. This process was then repeated as recommended by Paulsen and Dailey (2002) in order to pick up any issues which may have been missed during the first search. Once the patterns between the data and criteria were identified the next step involved bringing these patterns together in order to build a solid collection of evidence which corresponded with the different criteria. These bodies of evidence were then applied to the criteria in order to analyse the role of the ICM programme and how it compared to the theory of boundary organisations. In order to connect the data with boundary organisation theory, quotations were used within the text to provide a personal insight and connection with the interviewee.

A critical aspect of the analysis process involved assessing how the Motueka ICM programme managed the knowledge attributes of salience, credibility and legitimacy. In order for a

boundary organisation to foster positive relationships and collaboration it must be viewed by actors on both sides of the science-policy divide as being able to produce salient, credible and legitimate information (Cash et al., 2006). If a boundary organisation is unable to produce these knowledge attributes it will likely not succeed in gaining trust and support from the different actors involved in the issue (Cash et al., 2006).

- **Salience:**
The salience of knowledge refers to the relevance of information for an actor's decision choices that affect a given stakeholder (Cash et al., 2002). Salience can be seen through a programme's/project's ability to focus on issues relevant to a wide range of actors within a 'real world' context. These research issues are presented in a manner which highlights the benefits of the research to all those involved.
- **Credibility:**
Knowledge is produced via appropriate research methods which are seen as transparent and credible to both researchers and other actors. As well as being credible, research needs to be presented in laymen's terms so as to be understandable to all interested groups.
- **Legitimacy:**
Actors both within and outside of the system view the processes as unbiased and meeting standards of political and procedural fairness (Cash et al., 2002). Legitimacy is achieved through providing a high level of accountability to all actors.

The production of knowledge attributes is complicated by the fact the three factors of salience, credibility and legitimacy are all interconnected and rely on an even balance between each other. For example if a project is seen as having a high level of salience (lots of community buy-in) it may as a result suffer from a lower standard of legitimacy (stakeholders view the project as being hijacked by the community). In order to manage this complicated relationship it is vital that all three attributes are produced and managed together rather than as individuals in isolation.

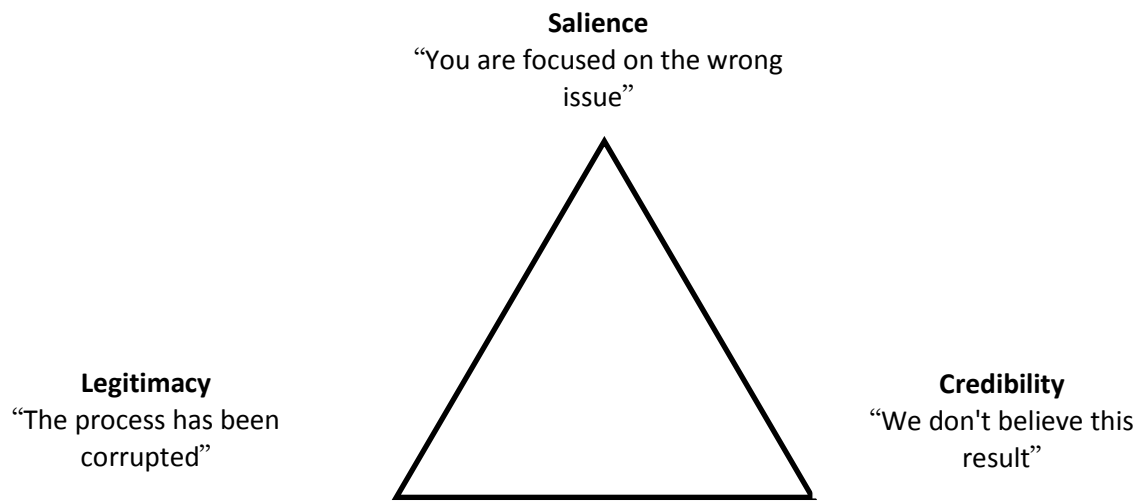


Figure 4.6.0: Balancing knowledge attributes

Knowledge Attributes

	Saliency	Credibility	Legitimacy
Boundary organisation evaluative criteria	Convene	Different actors, groups and institutions meet regularly to discuss relevant issues	Convening processes are open, transparent and easy to understand All actors, groups and institutions are involved. Convening process are seen as unbiased and fair
	Translate	Translating processes are built around issues within a timely real world context	High quality information is presented in layman's terms via credible methods Translating processes are seen as accountable to all actors involved.
	Mediate	Mediation focuses on a wide range of local catchment related issues	Mediators maintain healthy relationships with a wide range of actors, groups and institutions Mediation processes are seen as neutral and fair. They include all the actors, groups and institutions involved in the issue
	Collaborate	Collaborative projects are based around issues which interest researchers, policy makers, stakeholders, iwi and the public	Research involves inputs from the actors and groups involved (e.g. public). Processes and events are used to foster collaboration and build relationships Research outputs are seen as trustworthy and accurate by all those involved in its production

Figure 4.6.1 Evaluative framework

4.7 Ethics

This research was approved by the Human Ethics Committee of Lincoln University. The rights of all interviewees were respected throughout the entire research process. Interviewees were free to withdraw from the research up until 31 June 2012. The privacy of all interviewees has been protected through the use of pseudonyms instead of names within the interview transcripts and thesis. All private information regarding this research was considered as confidential and privileged. Access has been limited to only the researcher and supervisors.

4.8 Summary

This study aims to fulfil its research objectives through using evaluative criteria from the literature on boundary organisations and applying these criteria to data collected on the Motueka ICM programme. Data was collected through a number of sources and based around a single case study format. The evaluative criteria set out in this chapter have been used to undertake an evaluation in order to understand how the ICM programme compared with boundary organisation theory as well as how it managed the science and policy interface.

Chapter 5

Results

This chapter aims to outline the different pieces of evidence which were collected through analysing the research data alongside the evaluative criteria outlined in the methods chapter (4). Through establishing connections between the research data and the evaluative criteria (convening, translating, mediating and collaborating) this chapter seeks to highlight the different aspects of the Motueka ICM programme which align with boundary organisation theory.

5.1 Convening

Stakeholders, research bodies, local authorities and community groups meet face to face (convene) regularly to debate and discuss relevant topics.

5.1.1 Workshops and meetings

Articles published by authors who worked within the Motueka ICM programme (Allen et al., 2011; Bowden et al., 2004; Kilvington, Atkinson, et al., 2011) indicate that workshops and meetings were active throughout the life of the ICM programme, especially during the early years. Interviews with members of the ICM programme showed that workshops and meetings brought members of the catchment communities, iwi and stakeholders into regular contact with the ICM programme partners and researchers:

So you had Forest and Bird sitting next to the agricultural industry and farming representatives and council, and it was quite nice to see that there was a real spread of interest and perspectives brought together in that room, in those workshops (Research Scientists IC06).

Lawrence's (2010) review of the ICM programme found that the programme had a very high level of engagement with the different catchment communities and stakeholders. Lawrence (2010) claims that this high level of engagement was created thanks to techniques and processes such as: up front dialogue, facilitated conversations, and field days (workshops). Interviews with ICM programme members support Lawrence's (2010) findings and suggest

that these kinds of convening techniques and processes occurred regularly over the length of the ICM programme. They covered a wide range of topics and issues and allowed participants to get to know one another and build trust and confidence through regular interactions and dialogue.

Interviews and articles by ICM researchers (Allen et al., 2011; Fenemor, Phillips, et al., 2011; Kilvington, Atkinson, et al., 2011) show that meetings and workshops were held in a number of locations both informal (e.g. a woolshed) and formal (e.g. TDC building) and were sometimes based around a shared meal or social drink. One research scientist (IC09) who was interviewed noted how these kinds of social occasions provided the different groups and stakeholders interested in the ICM programme with opportunities to meet, interact and build relationships with a wide range of people:

I guess trust, healthy relationships with each other, if you like – and they were developed through social things. We had a few beers and you'd go and have food and stuff. The lesson is you can't throw a bunch of people in a room and just say collaborate (Research Scientists IC09).

Interview data showed that many of the workshops which were undertaken within the ICM programme were facilitated by an independent facilitator, social researcher or research scientists. Interview data suggest that these official and unofficial facilitators played key roles in making the convening process work effectively:

Andrew Fenemor and some of the social researchers, so Maggie Atkinson, Will Allen, those guys I think were quite heavily involved in setting up the workshops, and those surveys ... they were certainly well organised and I was quite impressed with the range of people that they had in the room (Research Scientists IC06).

One of the key meetings to occur regularly within the ICM programme was the Annual General Meeting (AGM).

5.1.2 Annual General Meetings (AGM)



Figure 5.1.2: Mick Park addressing ICM AGM field trip at Puketawai.

Photo by Andrew Fenemor

The Motueka ICM programme held an AGM once a year for a period of three days, usually in October. The AGMs were made up of a number of sessions covering different topics and issues involving the Motueka catchment. The aim of the AGM was to review the ICM programme's research progress and to build social networks amongst the people who attended (Kilvington, Atkinson, et al., 2011). One of the ICM programme managers noted how the AGM played a key convening role within the ICM programme:

We had annual meetings where we all got together and chewed the fat...a lot of that created a sense of momentum, connectedness and collective focus (ICM Programme Manager IC02).

The AGMs' ability to bring a wide range of experts and laypeople together to discuss catchment issues and build new relationships was also highlighted by members of the catchment communities, for example:

This chap came out to the final one [AGM] we had, Gene somebody [Dr Gene Likens], heck of a nice bloke, and I sat at the table with him at teatime and we yarned away for ages. And you know, quite prepared to just talk to Joe Bloggs and didn't go away with a whole lot of science (CRG member IC12).

5.1.3 Working groups

In order to create interactions between the communities, TDC, stakeholders, iwi and researchers involved in the ICM programme, a number of working groups were launched within the programme which aimed to bring these different groups together in order to establish a first point of contact and build collaboration. These included the Community Reference Group, Sediment Learning Group and the Technical Advisory Group.

Community Reference Group (CRG)

The CRG was established as a means to make connections between the ICM programme and Motueka catchment residents. The group was made up of members who were appointed to their role within the CRG due to their interests and knowledge of the catchment (Allen et al., 2011). These members came from a number of different backgrounds (e.g. law, tourism, farming and medicine) and ethnic groups (Pakeha and Maori).

CRG meeting minutes and an article by ICM researcher (Allen et al., 2011) show that CRG meetings were held throughout the year (3-6 times per annum) from 2000-2009 to discuss different issues involving the catchment and the programme. These same sources also show that CRG meetings were usually well attended by CRG members and representatives from Landcare, TDC and Cawthron.

When asked about their involvement in the ICM programme CRG members replied that they saw it as a kind of moral responsibility to both the community and the environment to be involved:

Well if you want a community to go, you've got to put something into it. That's one of the reasons why I took it on with the ICM programme (CRG member IC12).

I think I came to the project with a real sense of concern about the environment. I mean I've always, for a long time, described myself as an environmentalist. My concerns were around the things that I saw in the catchment that were detrimental to it (CRG member IC10).

Interview data and CRG meeting minutes show that convening within the CRG occurred on a number of levels, the most basic being that it brought together different members of the catchment communities in order to discuss catchment issues and the ICM programme. On a more complex level it connected these community members with the people who were managing the ICM programme.

Evidence of an open flow of discussion between the CRG and ICM programme leaders and researchers was identified in the interview data. CRG members in general spoke of the ICM programme leaders and researchers in a positive light and claimed that they did a good job in letting them express their ideas and bringing them into the ICM process:

We could bring up a point [at CRG meetings], you know, what we thought, oh no we didn't agree with them or yes we did agree, or what about this way, or that way, or something, and they [ICM programme leaders, researchers] were very, very supportive of it (CRG member IC12).

Sediment Learning Group (SLG)

The SLG aimed to bring together a wider range of actors and groups (i.e. researchers, TDC, iwi, stakeholders and members of the public) to focus on sediment management issues (Kilvington, Atkinson, et al., 2011). Sediment was chosen because it represented a catchment issue which the group could take action together upon collectively through a hands-on approach (Allen, 2006).

According to ICM researcher Allen (2006) the SLG had its first meeting in May 2005 and went on to have a total of three meetings and one outdoor workshop over the next year. The first two meetings were used to focus on a group discussion which outlined the goals of the group. For their third gathering the SLG took part in a workshop at the Motueka River in order to get a better understanding of the sediment issues in the catchment through taking part in activities such as electric fishing (Allen, 2006).

Articles published by authors (Allen, 2006; Allen et al., 2011) suggest that convening occurred within the SLG primarily in the form of workshops and meetings which were attended by a wide range of actors and groups. The adaptive management 'learning by doing' approaches used in the SLG meetings and workshops would have provided an ideal setting for convening to occur between the different attending actors and groups. Lawrence's (2010) review of the ICM programme also supports this notion that the SLG worked as a convening process as she lists the SLG as a technique/process which was used to foster connections and engagement between researchers, TDC, local iwi, and stakeholders.

Technical Advisory Group (TAG)

Compared to other groups within the ICM programme which were involved in convening processes, the programme's different research disciplines engaged in very few specialised research-focused convening events. This was primarily due to the fact that no such interdisciplinary get-together events existed within the programme. The TAG was a proposed group which aimed to possibly address this issue by bringing technical specialists (e.g. modellers, scientists, engineers) together to work on issues much like the CRG did but from a more technical perspective. While the TAG had support from the ICM programme managers it never gained enough momentum to become operational and was soon abandoned:

I was keen on setting up a technical advisory group but that never really got off the ground (ICM Programmer Manager IC02).

The same programme manager attributed TAG's inability to get off the ground on factors such as lack of time and resources to hold activities such as meetings. Another barrier to its implementation was a possible lack of interest in interdisciplinary convening events by the technical specialists involved in the ICM programme. The TAG's failure to get operational was to set the tone for research-focused convening events within the ICM programme as no other event or process managed to successfully bring researchers together regularly.

5.2 Translating

Information is presented in a manner that it is understandable to both experts and laypersons. This can involve technical language (jargon) being converted into more basic layperson's terms or a layperson's local knowledge and values being presented in an understandable format to an expert.

5.2.1 Translating between researchers

Although the ICM programme brought people together for face to face contact early on (1998 was first ICM meeting), interviews with ICM researchers showed that this contact did not necessarily result in instant productive communication processes between the different research disciplines; rather it took a considerable period of time:

It took probably two years of relationship-building with individuals to be really comfortable with each other to kind of get through [those interdisciplinary communication issues] (Research Scientist IC09).

One researcher noted that translating between the different research disciplines during the early years of the programme was being prevented due to the false assumption that everyone understood everyone else's research and technical jargon:

We used to have these AGMs, or these meetings, sort of research planning meetings, and there'd be a big table, and people would be talking past each other, because they didn't really get what the other people were saying, largely because they were talking from their own set of jargon (Research Scientist IC09).

The same researcher also stated that once he had become aware of these assumptions and how they affected their ability to work in an interdisciplinary manner they began to translate their information better:

We were having this conversation, we were geomorphologists and these guys were trout researchers, basically what it boiled down to is well, we thought they knew about all this stuff, and they thought we knew all about this stuff, and when you actually worked it all out, that we both didn't know, our science, our disciplines didn't know about the thing that we were really kind of keen on (Research Scientist IC09).

Interviews with the ICM programme's social researchers suggest that translation processes improved over the programme's lifespan as the different researchers learnt how to better present and translate their knowledge. Biophysical researchers highlighted the role of social researchers, interdisciplinary projects and learning platforms (e.g. CRG, workshops, AGMs) in helping them improve their communication skills:

Interviewing one of the geomorphologists, and saying well, what role did we play in the programme as social researchers, and he was going, well, when we came in we were a bunch of basically biophysical guys that sat around in meetings and told people how it was because we were the experts, and he says, ten years on, we never have meetings any more, we have conversations, and when a new person joins the group, like from the council, we all listen to them, and he said that's because of the way you've helped us model things and actually just start to feel we're making a contribution rather than telling people the answer (Social Researcher IC13).

5.2.2 Translating between ICM Programme, stakeholders, iwi and local communities

A strong focus on connecting local communities, iwi and stakeholders to the ICM research was highlighted by an ICM programme manager as being a key goal for the programme:

One of the objectives in my head was that by the end of the programme 80% of the people in the Motueka Catchment would be aware of the research going on in the ICM programme and I think we met that objective largely because of its life span (ICM Programme Manager IC02).

The ICM programme attempted to bring about this awareness of their research through a number of different methods (e.g. the Travelling River exhibition, computer models and workshops) to help translate technical scientific language into a format that could be understood by laypeople:

Predictive models showing effects of land use changes, maps and posters were especially good for sharing information with the public (Policy Analysts IC03).

One researcher within the ICM programme also highlighted these translating methods for their ability to not only educate the public but to also act as a feedback system which helped researchers to better understand their work from a public standpoint:

Basically Landcare would organise a workshop. They'd get a whole lot of people in the room, we'd present some of the basic science behind what we thought was happening in the system and then there'd be a question round of OK, has this answered the questions that you want answered in the community? And basically we drew a bit of a map of, OK, these are all the questions that you asked, and sometimes they were things that we hadn't addressed directly (Research Scientist IC06).

This illustrated the extent to which the exchange of knowledge moved in multiple directions.

Cultural Health Index

In order to open the ICM programme's research up to new forms of information based on community and Maori knowledge as opposed to more traditional scientific knowledge, the ICM programme created a Cultural Health Index (CHI).

The CHI was used to translate and incorporate the values and knowledge of local communities and iwi within the scientific research being undertaken in regard to river and stream health. The CHI was based around a range of cultural monitoring indicators (e.g. water clarity, pest plants and access to river) involving river and stream health from a community and Maori perspective. The CHI used a scoring system to rank the different indicators being assessed; these scores were then compiled to produce a cultural stream health measurement (CSHM) which ranked the overall health of a particular river or stream. Once CSHM scores had been completed they were then entered into a geographic information systems (GIS) mapping system to outline and identify the rivers and streams of interest.

Harmsworth et al.'s (2011) study of the CHI within the ICM programme found that the CHI was able to provide useful water quality and stream health data that often matched results found with more traditional scientific monitoring methods (e.g. Macroinvertebrate Community Index). Harmsworth et al. (2011) go on to claim that the CHI can play an important role within the resource management sector by promoting Maori values in a format which can be understood by non-Maori through tools such as GIS.

5.2.3 Translating between science and policy

Interviews with the TDC policy staff and researchers involved in the programme showed that the researchers met regularly with the TDC policy staff to discuss different ICM projects:

There was regular discussion between council staff and researchers during development of various aspects of the programme. Also in relation to data collection and model development for some specific projects (Policy Analysts IC03).

One policy planner noted how information was made freely available within the ICM programme and how different communication tools (e.g. models) were used to share this information between researchers, TDC and the public. When asked about their contact with TDC policy staff, one researcher highlighted the role of having interactions with policy staff as being crucial to understanding how they should translate their research in a useful and productive manner:

Having policy people involved with the programme meant I was able to step back and look at the range of issues that they have to think about, and it made me think about how I produce information that's going to be useful to those people (Research Scientist IC06).

The same researcher also noted how working with the TDC within the ICM programme increased their understanding of how their science worked within New Zealand's environmental policy framework:

I certainly learned a lot from other people from working in the programme, and it was good to be able to sit down with policy people and hear the broader range of issues that they deal with... I definitely think my policy appreciation grew with the time I spent in the programme (Research Scientist IC06).

5.3 Mediation

The boundary organisation provides a means by which all conflicting viewpoints are explored and addressed through a dispute resolution process.

The wide range of actors and issues involved in the programme meant that conflicting opinions were bound to collide throughout the ten-year life of the programme. Interviews

with the different members of the ICM programme and CRG meeting minutes show that while there was often heated discussion between different groups (researchers, CRG, TDC) these discussions were normally held in a civil productive manner. Evidence collected through analyses of these interviews and meeting minutes suggests that the negative discussions and outcomes were reduced and mitigated through a number of mediation processes such as workshops and social learning platforms.

5.3.1 Mediation workshop

Workshops focused on mediation were not found to be common within the ICM Programme but one did occur according to one of the programme's social researchers. The River and Gravel Workshop, which focused on gravel extraction issues, included a wide range of actors and groups, some of which had had very little contact with the ICM programme. The workshop was held as part of the ICM programme's 2006 AGM and used an independent facilitator to help address some of the conflicting issues and views surrounding gravel extraction within the catchment. Hence there was scope within the programme for mediation to occur.

5.3.2 Social learning platforms

Within the ICM programme a number of platforms were launched by the ICM programme's social researchers under the banner of 'social learning'. Social learning can loosely be defined as a set of social process ingredients which are used to solve complex environmental issues (Maarleveld & Dabgbégnon, 1999). It is primarily based around the processes of dialogue, information exchange, systems thinking, addressing conflict, debate and learning. Figure 5.3.2 shows how these social learning approaches fitted within the ICM programme.

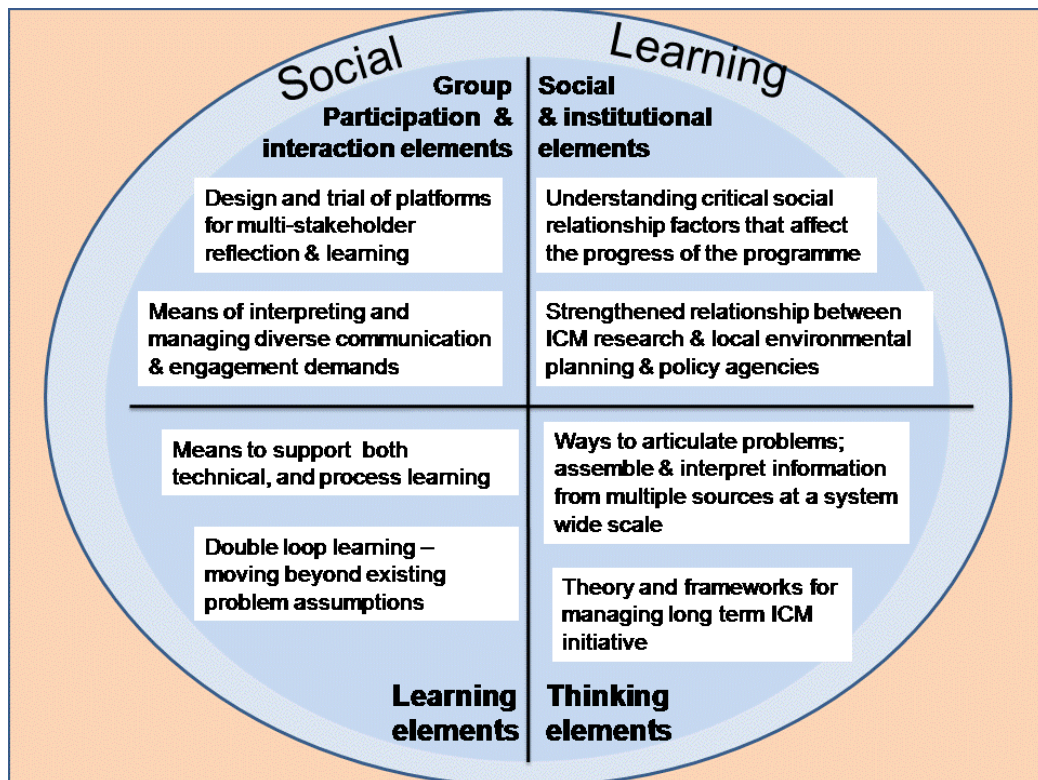


Figure 5.3.2: How social learning can be used within ICM. (Kilvington, 2010)

According to ICM researchers Kilvington et al. (2011) the aim of these social learning platforms was to shift the understanding of the people living in the catchment and develop their capacity to address complicated environmental issues. The social learning platforms implemented within the ICM programme came in a number of formats (online networking and face to face meetings) and ranged in length from one day events to multiyear long processes (Kilvington, Atkinson, et al., 2011). Social learning platforms undertaken within the ICM programme included AGMs, CRG, Confluens website, Mountains to the Sea, SLG and Watershed Talk.

Although the term ‘mediation’ was not used within the different social learning platforms, it was in many ways built into the social learning platforms which placed emphasis on topics such as dealing with barriers to learning and managing conflict. As one social researcher stated, mediation is very much a key aspect of social learning:

Building blocks of mediation are effectively building blocks of social learning (Social Researcher IC11).

5.3.3 Watershed Talk

One example of this social learning approach was the Watershed Talk project. According to Kilvington et al. (2011) Watershed Talk was an action-based research project which aimed to gain a better understanding of how multi-stakeholder dialogue and social learning can be used to address complex environmental issues. A study of the Watershed Talk project which was undertaken by members of the ICM programme (Atkinson et al., 2009) suggests that the project had a number of positive outcomes for the participants who took part, and some of these positive impacts can be linked back to the theme of mediation.

The initiative was broken into 4 stages: engagement, conversation, evaluation and feedback. The engagement stage involved identifying the right people to take part in the project. This was achieved through using interviews, meetings and the snowball technique. The project managed to involve a wide range of participants which included scientists, artists, tangata whenua, farmers, residents and council staff.

Interviews undertaken by Atkinson et al. (2009) indicate that interactions between these actors resulted in previously held views and opinions being shifted during the process as people found that their pre-existing ideas did not match up with the people they met face to face:

I had never met scientists before – my expected stereotypes didn't fit!
(Watershed Talk member) (Atkinson et al., 2009, p. 24).

The conversation stage of the project Kilvington and Atkinson et al. (2011) state was based around discussions about the catchment and employed a number of take-home tasks for the participants to fulfil in their own time. Workshops and shared meals were used as a stage to facilitate these discussions between the participants taking part in the project (Kilvington, Atkinson, et al., 2011). Interviews undertaken by Atkinson et al. (2009) with members of the Watershed Talk project highlighted the role of the shared meal in dealing with the group's internal issues.

Creating a neutral forum, or a space within a formal space, which can act like pushing a refresh button ... like you can't be killing someone if you are busy sharing food with them (Watershed Talk member) (Atkinson et al., 2009, p. 34).

Some of the project's workshops were held down by the river or in another natural setting. The project leader called this process 'camping out'. The camping out process was mentioned by members of the Watershed Talk group as being helpful in developing their own trust and opening up their views to new perspectives:

... learning that you do have a viewpoint, people will accept that, and it is valuable (Watershed Talk member) (Atkinson et al., 2009, p. 27).

...looking at different viewpoints worked well (Watershed Talk member) (Atkinson et al., 2009, p. 28).

Watershed Talk's ability to open up participants' views and opinions to include new information and new perspectives was highlighted numerous times within Atkinson et al.'s (2009) study.

...I'm slightly more confident in approaching people and I notice I am more open minded towards what they know, and I think I know (Watershed Talk member) (Atkinson et al., 2009, p. 23)

The final evaluation and feedback stages of the programme gave both the participants and project leaders the opportunity to explain their views on the project. The participants did this through post-back interviews while the project leaders used a final meeting (social event) to present their findings (Kilvington, Atkinson, et al., 2011).

5.3.4 Informal mediators

The role of mediator was never officially labelled within the ICM programme; this made identifying members of the programme who fulfilled a mediator role officially or unofficially rather difficult.

While some data points to the ICM programme's social researchers as fulfilling some form of a mediator role within their social learning platforms, the social researchers themselves maintain that their role as mediators was very limited.

Within the programme people fulfilled different roles at different times....I would have never said I was a mediator (Social Researcher IC11).

Although this social researcher claimed they did not deserve the mediator label they did outline areas and topics which they were involved in which did connect to mediation.

A formal mediator will always want to know what's gone on in the past, want to know who's on whose side and what are the things that are immovable and what are the things that there is space to move. Being aware of conflict and being aware of history and relationships was actually quite an important part of our role (Social Researcher IC11).

While the term 'mediator' was never used in the programme the role of 'facilitator' was. Over the course of the programme a single professional facilitator was used to address a number of conflicting issues (e.g. the River and Gravel workshop). Interview data and CRG meeting minutes showed that a number of people within the ICM programme fulfilled unofficial facilitator roles; this included the ICM programme manager, social researchers and a number of biophysical scientists.

Les [Basher] was really good with one on one discussions...Break [Bowden] and his establishment of the programme in the first instance did a great job in addressing big divisions between institutions...Roger Young could often quietly come in and suggest something which would give people a way out (Social Researcher IC11).

That statement shows that although there were no formal mediators assigned to the programme mediation did occur and spaces were created for it to happen.

5.4 Collaboration

Collaboration involves different disciplines and social groups working together to address a common issue. Collaboration provides a means to move experts out of isolation and include non-experts within a research framework. A key part of collaboration is the use of boundary objects.

5.4.1 Programme management

Collaboration is visible at the management level of the programme in the form of the three partner agencies which managed its implementation, namely Landcare Research, Cawthron Institute and the Tasman District Council. While the roles and involvement within the

programme differed between the three partner organisations, the fact that the programme was overseen by a partnership of research agencies and a regional authority suggests a strong focus on collaboration from a programme management perspective.

The programme’s focus on collaboration can be seen below through the two ICM diagrams figures 5.4.1 and 5.4.2 which outline the different research groups, issues, interest groups and other institutions involved in the programme.

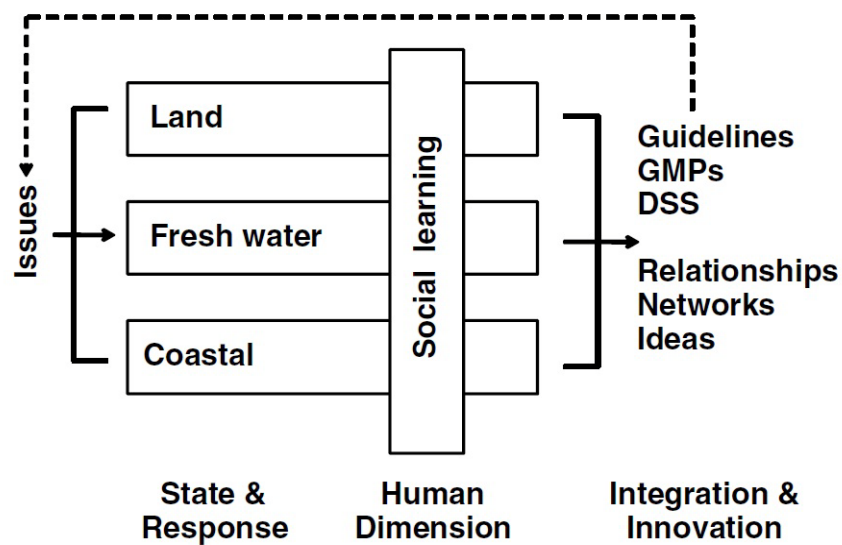


Figure 5.4.1: Overview of how catchment issues were connected through social learning. GMP: Good Management Practices, DSS: Decision Support Systems (Allen et al., 2011, p. 528).

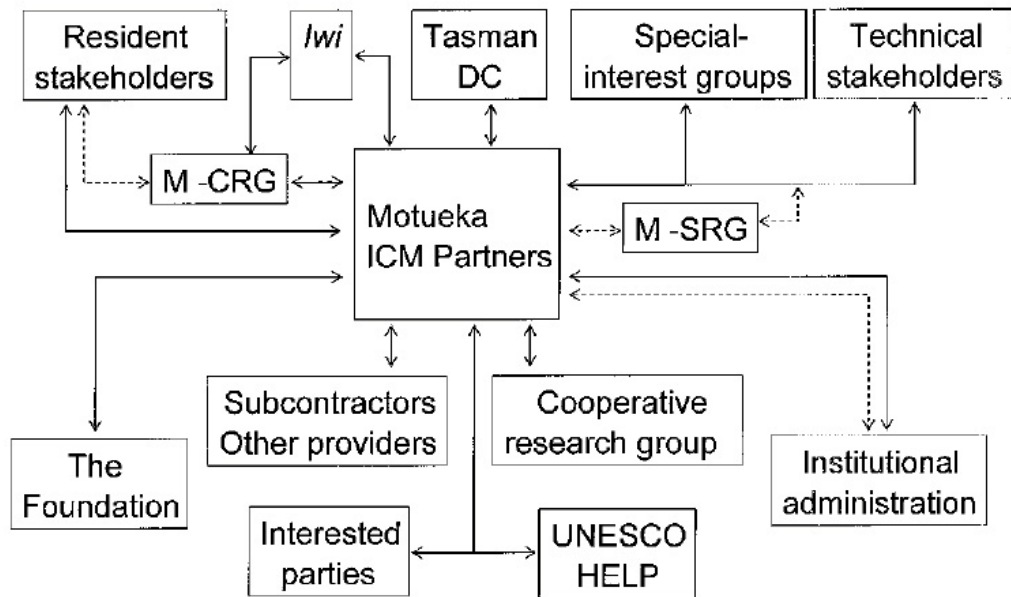


Figure 5.4.2: Diagram outlining the many actors, groups, institutions involved in the Motueka ICM programme(Bowden et al., 2004, p. 320).

As can be seen in these diagrams, collaboration was an important aspect of the ICM programme from a programme management perspective.

5.4.2 Project level collaboration

Collaboration within the ICM programme can be seen most clearly at the project level. Data collected through interviews, published articles by ICM researchers and other documents suggest that collaboration (at least from a broad perspective) was a key factor within the ICM programme. The proposed collaborative/integrated nature of the ICM programme was highlighted by one of the researchers as being one of the key reasons why he joined the programme:

I was keen from the outset to be involved in a programme that explicitly tried to 'integrate' across the boundaries and demarcations (between scientific disciplines and between science and policy and resource management) that are an impediment to good land and water management (Research Scientist IC07).

The same researcher then went on to state that from his own perspective the ICM programme had done a decent job bringing different research disciplines together within a collaborative framework:

My expectations of working with people from diverse organisations and other [types of] scientists including social scientists was certainly met (Research Scientist IC07).

The collaborative nature of much of the ICM's projects was also highlighted by another researcher who claimed that collaboration within the ICM programme was common due to the multidisciplinary projects they were working on:

Those catchment models [I was working on] were put into river transport models so I needed to talk to river transport modellers, so I gained a bit of knowledge across quite a broad range of disciplines by just being involved with the programme (Research Scientist IC06).

CRG meeting minutes and interviews with members of the CRG suggest that collaboration between the ICM programmes and between members of the public, iwi and stakeholders was very active. Members of the CRG had active involvement in many of the programme's projects in numerous ways (e.g. expressing community views on projects in meetings, setting up Travelling River exhibition). One CRG member stated how he actively took part in field work with the ICM research field work.

Yeah [I was involved in the research], Fish and Game, also with electric fishing [fieldwork]. (CRG member IC12)

While this kind of CRG involvement in the research was not the norm, it does highlight the kinds of science-community focused collaboration which did occur.

One project which has received a lot of attention in regard to the role of collaboration was the Sherry River water quality project.

Collaborative project - Sherry River

This project was based around improving the water quality within the Sherry River, which sits within the wider Motueka catchment. The project involved a wide range of actors which included local farmers, ICM programme leaders, researchers, Landcare Trust and the TDC. This project has been highlighted by both the ICM programme (Fenemor, Young, et al., 2011)

and the Landcare Trust (Stuart, 2010) due to its ability to cause fast behavioural change within the Sherry River farming community.

A study of the Sherry River project by ICM researchers (Fenemor, Young, et al., 2011) showed that the project was able to significantly improve water quality in the river (*E. coli* levels dropped by 50%) due to new farming and conservation methods (e.g. bridges were over the river for stock, native riparian zones were planted). Within their study Fenemor et al. (2011) placed great emphasis on the role of collaboration within the Sherry River farming community in making the project work. They outlined a number of processes which assisted in making collaboration work, these included: providing practical information, building positive relationships, offering personal and economic support, establishing clear goals and leadership, and the need to celebrate success.

A report published on the Sherry River project by Landcare Trust (Stuart, 2010) also highlighted the importance of collaboration and how it was used to address environmental issues within the Sherry catchment. The Landcare Trust's report (Stuart, 2010) provides some quotes by farmers involved in the Sherry River project to support this view:

Our community has seen measurable results from the efforts of the local catchment group and I think that inspires us to keep working at it

Our community working together in our own catchment with councils and science support will achieve far more positive outcomes.

The Sherry River's successful collaborative approach has also been highlighted outside of the ICM programme. Lawrence's (2010) review of the ICM programme (which includes a survey of different agencies, groups and actors) stated that the Sherry River was one of the programme's notable successes. While Lawrence's (2010) report does provide an outside perspective of the Sherry River project it should be noted that only one farmer responded to the survey.

Workshops and meetings

Interviews with the different members of the programme and CRG meeting minutes showed the workshops and meetings involving researchers, TDC, iwi, members of the public and

stakeholders were a common occurrence within the programme. This view is also supported by a number of the articles published by authors involved in the programme (Fenemor, Phillips, et al., 2011; Kilvington, Allen, et al., 2011; Kilvington, Atkinson, et al., 2011). These workshops and meetings would have likely provided a space for different disciplines and groups to come together, build relationships and foster collaboration. Interviews with members of the CRG suggest that these workshops and meetings did provide a space for people to learn about the ICM research as well as ask questions:

I mean I didn't understand everything [at the workshops and meetings], probably quite a bit of it I didn't understand, but I had a general sense of it. I now know who to ask what I want to know, so that's good (CRG member IC10).

Constructing social networks

Building collaborative teams which include both experts and laypeople around environmental issues is far from a simple task. Throughout the interviews numerous members of the ICM programme highlighted the role of ICM programme leaders and researchers in helping to bring different actors and groups together in order to build social networks and promote collaboration:

I don't think in the programme we were playing the glue that necessarily links everyone. I think Andrew [Fenemor] did that, I think Chris [Philips] did that very well, Chris and Les [Basher] actually in the first two years did a lot of that role. I'm sure they had ice creams at the local shop (Social Researcher IC13).

This data shows that ICM programme leaders and researchers built relationships with many of the key groups and actors involved in the programme. This provided them with a wide-ranging network which connected them with everyone from farmers to iwi, researchers and TDC staff. One individual who was mentioned a number of times for his ability to make social connections and keep the programme moving forward was the ICM programme manager Andrew Fenemor:

I think the ICM programme was extremely lucky to have Andrew Fenemor running that work. He was extremely organised at pulling everyone together and separating the tasks into manageable units with useful outcomes (Research Scientist IC06).

5.4.3 Poor collaboration and limited policy outputs

While a number of examples of positive collaboration were identified within the interview process there were also some examples where collaboration was limited or seen as poor. For example, a member of the technical research science team noted that he/she preferred to focus on his/her own work rather than get involved in collaborative discussions and processes:

I didn't really have enough time to pay a huge amount of attention to that [collaboration processes], I didn't engage in all the email discussions and such, you can spend all your day on the sort of thing (Research Scientists IC08).

Research done by one of the ICM programme's researchers (Kilvington, 2010) showed how the ICM programme's collaboration focus was limited due to a number of issues. Kilvington (2010) argues that while the ICM programme claimed it was taking a collaborative management approach during its early stages (2000) it was in fact operating in the very client-research (linear) model it was trying to avoid. Kilvington's (2010) study also found that while large quantities of information and engagement were occurring within the ICM programme, this was not necessarily resulting in outputs such as collaborative research.

Another collaboration issue which was highlighted within the ICM programme was the role TDC played within the programme. On paper the TDC was one of the ICM programme partners and provided key services and inputs into the ICM programme in the form of facilities, policy advice and scientific research etc. Although the TDC had the label of programme partner, some members of the programme who were interviewed felt that TDC could have played a more active role within the collaborative framework of the ICM programme. One member of the programme stated that the TDC failed to incorporate many of the programme outcomes within its normal operations and future policies:

I mean the council are hopeless on consultation, for example, we have an on-going issue around that. So they haven't read anything out of the ICM around consultation! And yet consultation and inclusion of people from all walks of life and so on that had something to do with the catchment was a major message, well I thought (CRG member IC10).

This view that the TDC failed to make productive use of the ICM programme research through creating new approaches and policies was also highlighted in other data sources. Although Smith et al.'s (2010) and Lawrence's (2010) reviews of the ICM programme list a large number of successful ICM research outcomes, they only list three examples of how these outcomes were successfully turned into policy by the TDC. These policy outcomes include: new water quality limits for swimming and stock; establishing new gravel extraction limits in the upper Motueka catchment; tightening septic tank and sewage discharge standards. Interviews with other members of the ICM programme were only able to identify one other TDC policy outcome not listed by Smith et al. (2010) and Lawrence (2010), this was: improving provisions for animal crossings and culverts. While these policy outcomes produced by the TDC clearly show that the ICM was able in some capacity to cross the science-policy interface, the relatively small number of policy outcomes at a regional scale raises questions as to how successful the programme was at turning science into policy.

5.5 Boundary objects

Through using a range of technical, social and education methods, boundary objects seek to facilitate collaboration through focusing on collective independent tasks rather than on actors' own interests.

5.5.1 Travelling River

The Travelling River exhibition was a combined art-science project which was developed in partnership between ICM programme researchers and local artists during the Mountains to Sea initiative (2002-04). The aim of the project was to build understanding about the environmental issues going on in the Motueka catchment by encouraging the local people who live within the catchment to think and talk about how they and their families interact with the catchment.



Figure 5.5.1: Local men visit the Travelling River Exhibition at Tapawera 2006.

Photo by Landcare Research

Atkinson et al. (2004), who took part in the project, claims that this discussion was created by encouraging the local communities to visit the exhibition and to submit photos and stories about their lives within the catchment to the project. Another aim of the project was to learn more about the collaboration-building process between people with different world views (Atkinson et al., 2004).

The exhibition was made up of artistic works, scientific research and photos and stories from the local communities in the catchment. Evidence of the community, science and artistic input into the project can be seen in the Travelling River book (Fenemor et al., 2004) which was published by the ICM programme to provide a printed version of the project. The book contains many stories and photos which were submitted to the project by members of the public, artists and scientists.

Twenty-four display panels were used to exhibit the 240 different pieces of the exhibition, which were all based around the hydrological 'mountains to the sea' theme. Travelling River

was a highly mobile exhibition, which allowed it to be moved to a number of locations within the Nelson area. The exhibition was shown in a number of different sites which included everything from art galleries to scout halls. In total over 2500 people visited the exhibition during its tour around the Nelson area (Atkinson et al., 2004). The high numbers of people who visited the exhibition plus the positive feedback it received from some CRG members suggest that the Travelling River fulfilled its objectives:

It really [Travelling River] got a lot of people involved to realise what it was and what was happening and how different ones [people in the catchment] got their relaxation, their sport, or even a lot of their income from the river (CRG member IC12).



Figure 5.5.2: Opening night for the Travelling River exhibition.

Photo by Landcare Research

The Travelling River book (Fenemor et al., 2004) and Atkinson et al.'s (2004) article both suggest that an interdisciplinary approach was used to create the exhibition. The project team was made up of a collection of local artists, environmental scientists and social researchers. Interviews and an online video documentary (Landcare, 2011) show that ICM researchers played a number of roles within the project which included: supplying the

scientific research from the ICM programme, curating the exhibition, moving and setting up the exhibition in different locations and engaging with local communities.

The project's combination of art and science gained interest from a number of overseas academics, and this interest resulted in members of the project team being invited to both the University of Washington and the Dartington College of Arts to discuss Travelling River (Landcare, 2011).

This was a travelling river which travelled a very long way (Maggie Atkinson)(Landcare, 2011).

5.5.2 Computer modelling

Modelling was used in many of the projects undertaken during the ICM programme (e.g. tracing *E. coli* levels in Sherry River, land-use impacts on shellfish and sediment flows in the Motueka River). Computer models were utilised for these kinds of projects as they provided a means to identify and illustrate how current social, environmental and economic issues occurring within the Motueka catchment and harbour might change over time.

Models were highlighted throughout the interview process for their ability to present complicated science in a format which was useful and productive to laypeople with limited science knowledge. Interviews with TDC policy staff suggest that some of the models produced within the ICM programme provided information which was useful for developing policy:

Better information will assist in helping to make more robust decisions. In this respect the ICM was very useful for policy (Policy Analyst IC03).

Some of the projects used in the ICM programme activity included stakeholders as part of the modelling design process. One example of this is the Motueka Action-Based Model (ABM). The Motueka ABM was developed as a means to show how different land-use changes could affect the economic, environmental, social and cultural makeup of the Motueka catchment (Montes de Oca Munguia et al., 2009). Given the diverse range of issues the ABM was attempting to quantify and explore, it was necessary for the model's builders to work with a wide range of disciplines in order to get the necessary data. Public and stakeholder involvement for this ABM was generally limited to local iwi with no other non-

Maori public groups involved in the project. Engagement between the ABM and local iwi was based around a number of workshops and meetings which aimed to identify means to include cultural values within the model and also how the model could be used by Maori for their own policy and planning purposes (Allen et al., 2011).

The Integrated Dynamic Environmental Assessment System (IDEAS) model was another example of how stakeholder input was included within a highly technical model. IDEAS involved bringing together different models and research data created during the ICM programme to create a model that incorporated all the different processes occurring within the catchment within one holistic model. Allen et al. (2011) states that the IDEAS model was both interdisciplinary and stakeholder driven as it includes inputs from a number of research disciplines as well as local knowledge from catchment communities and the local iwi.

5.5.3 Websites and multimedia

The Motueka ICM programme occurred at a time when the internet was starting to become common in many of New Zealand's homes. The internet was used in a number of ways throughout the life of the ICM programme (e.g. websites, online discussion groups and online videos). Some of the programme's researchers claimed that this aspect of the ICM programme was in fact the most innovative, as web tools like this had not been used in this context before in New Zealand:

I think all the so-called communication, knowledge management, media stuff was at the time innovative. It wasn't world-leading, because people were starting to use the web in different ways, but we certainly were the model (Research Scientists IC09).

The ICM programme's website <http://icm.landcareresearch.co.nz/> played a key role in providing a gateway to the different aspects of the programme. The website provides the viewer with information on the aims of the programme, the staff involved, the different research projects and links to more detailed reports/articles. Making ICM information freely available through the website was mentioned by one of the ICM researchers as being one of the key aims of the ICM programme:

My world view was you can't bring about change if you keep everything [information] locked up. Our policy was if we had it, we'd put it out there (Research scientists IC09).

Confluens was a web tool used by the ICM programme which aimed to share information both between research disciplines and with the public. It was based around a message board format where scientists, members of the public or stakeholders could pose questions, share information or engage in discussions about issues involved in the programme (Allen et al., 2011). Confluens' ability to operate as an effective tool for connecting people, sharing information and creating understanding through online dialogue was highlighted during an interview with one of the ICM programme managers:

We had this online discussion group called 'Confluens' and we ended up with about 70 people linked into that, the greatest success of that I think was when we had some specific defined discussion going on...We would end up with some quite vigorous dialogue about the questions related to the project and that carried on for about 50 weeks which was quite invigorating (ICM Programme Manager IC02).

According to Allen et al.'s (2011) article, getting Confluens up and running was no easy task; when it was first introduced early in the ICM programme it attracted little interest from the people involved in the programme and was initially abandoned. It was reintroduced a few years later and thanks to a more active facilitation role by the website's manager and coordinator was able to attract a sustainable amount of visitors who either commented on discussions or simply watched (Allen et al., 2011).

Over a period of one year Roger Young from Cawthron led two weekly discussions about all the individual projects we are doing across the ICM prompted by some questions (ICM Programme Manager IC02).

Researchers who took part in debates on Confluens noted that they did so because the debates were based around their field of study and so they wanted to contribute to the dialogue. One researcher noted how emails between themselves and the website manager and other ICM researchers were productive processes for getting their input up on the Confluens website.

I was involved in Confluens discussions. I was not prompted to be involved - but joined in discussions within my area of expertise and/or of interest to me. I did

not do this through the website directly, but through group emails that arrived in my inbox (Research Scientist IC09).

Another internet tool used by the ICM programme was the YouTube video website. Near the end of the ICM programme in 2010 Landcare produced six short (6-14 min) documentary videos <http://www.youtube.com/playlist?list=PLA6BF5D889308B522> which covered different aspects of the ICM programme : *Motueka Mountains to Sea: Integrated Science, Motueka ICM Building Iwi, Hapu and Whanaunvolvemen, Motueka ICM Innovative Engagement: Watershed Talk & Travelling River, Motueka ICM Managing Water, Motueka ICM Integration In Action - The Sherry River, Motueka ICM Models for envisaging the future*). These videos interviewed key members of the programme and provided a basic overview of the different projects and themes which made up the programme's goals. As of 26 November 2012 these YouTube videos had collectively been viewed a total of 1498 times.

5.6 Summary

This chapter has shown that there were many aspects of the ICM programme which fulfilled the evaluative criteria of convening, translating, mediating and collaboration. While certain issues (e.g. lack of convening between researchers) were highlighted within this chapter, these issues do not appear from a broad perspective to be limiting the ICM programme's ability to operate as a boundary organisation. The discussion chapter will now take these results and analyse them more thoroughly alongside the literature on boundary organisations and the science-policy interface in order to lay the foundation for answering the research questions in the conclusion chapter.

Chapter 6

Discussion

The aim of this research is to examine the relationship between science and policy in the freshwater management context, with a focus on the role of boundary organisations in facilitating communication and knowledge sharing across the science-policy interface. The two research questions that have guided this research are:

- How did the ICM programme negotiate the interface between science and policy?
- Compared with the theory, how effectively did the ICM programme operate as a boundary organisation in practice?

In this chapter I analyse the results of my fieldwork with the theoretical framework (chapter 2) and the evaluative criteria (chapter 4) in order to assess the extent to which the four institution functions of convening, translating, mediation and collaborating contributed to the production of salient, credible and legitimate knowledge.

6.1 Convening

Over the lifespan of the ICM programme, convening between researchers, community members, the TDC and stakeholders occurred in a number of formats and locations. One of the most important assembling processes was the Community Reference Group (CRG) meetings. CRG meetings involved a wide range of participants which included ICM programme managers, researchers, TDC staff and members of the community. These meetings provided an opportunity for researchers and policymakers to leave the confines of their offices and interact with each other as well as with members of the public. As CRG meetings occurred every 2-4 months from 2000-2010 they also provided a location for interactions to occur over a long time frame. Cash et al. (2006) claim that such forms of contact which occur early in the programme are critical to establishing trust and mutual respect later on. Interview data shows that this did occur within the CRG meetings as many positive relationships were built based on interactions through CRG meetings.

Another working group which I identified was the Sediment Learning Group (SLG) which fulfilled similar assembling and organisational roles to the CRG and brought together ICM researchers, TDC, stakeholders, iwi and community members but over a shorter time period (2005-2006). Another important convening forum was the Annual General Meetings (AGMs) which were held annually over three days and involved a wide range of research groups, government agencies, stakeholders, iwi and community members. Much like the CRG meetings but on a much larger scale, these meetings provided a setting for people from different disciplines and backgrounds (experts and laypeople) to meet face to face and interact. Public and stakeholder involvement in many of these get-together events was likely to have been helped by the unique locations used for many of the workshops and meetings (e.g. down by the river, farmers' kitchens and woolsheds). These relaxed environments provided congenial spaces for outdoor people (e.g. farmers, fishermen) to interact with researchers and TDC staff.

While convening processes which connected members of the public and stakeholders with the ICM programme occurred every few months, convening processes between the different research disciplines within the programme were relatively rare. Research undertaken by Kilvington (2010) shows that researchers often had to attend CRG meetings to get in touch with other researchers in the programme. Unlike members of the public who had the CRG and SLG to engage with, researchers did not have their own specialised workgroup which operated to bring different researchers together. This appears to have limited their ability to regularly meet with other researchers outside of their research field. This suggests that convening between researchers may not have been as common as first thought.

The fact that researchers, TDC policy staff, stakeholders and members of the public met face to face suggests that the linear or loading-dock model of information transfer (e.g. experts operating in isolation) (Cash et al., 2006; Jasanoff, 1987) was not used within the ICM programme. From a convening perspective it would appear that the ICM programme was very much moving away from this one-way flow model and instead operated on the ICM-based model which Ashton (2000) claims is based on joint partnerships between stakeholders, community and government.

Interview data shows that certain ICM staff (programme managers and researchers) played key roles in making these convening processes work. These members of the ICM programme used their strong personal and professional connections to help bring the different groups and actors surrounding the ICM programme together. These findings suggest that without the involvement of these key researchers and programme managers it is likely that the programme would have struggled to bring the different actors, groups and institutions together to meet face to face.

The processes mentioned above generally fit within Cash et al.'s (2006) description of the boundary organisation function of convening. Cash et al. (2006) use the example of Pacific ENSO Applications Climate Centre (PEAC) to show how face to face interactions occurred through a process of regular meetings involving researchers, government agencies and stakeholders. These meetings, Cash et al. (2006) claim, were crucial given that the different researchers, groups and agencies involved with forecasting issues were not just providing input to PEAC (the boundary organisation), they were in fact inside PEAC and so part of the boundary organisation itself.

A similar situation can also be seen within the Motueka ICM programme where stakeholders and outside groups were included within projects and events within the programme (e.g. CRG, SLG and AGM) as opposed to being treated as outside actors.

Including these groups inside the ICM programme also helped to give the programme legitimacy, credibility and salience in the eyes of the catchment's stakeholders and communities. The development of these knowledge attributes was likely to have been achieved through the programme's focus on bringing local people and stakeholders into the research framework through meetings and workshops. These processes and events (CRG, SLG and AGMs) gave local people and stakeholders the ability to highlight issues they saw as important, as well as seeing how the programme operated at a micro and macro level. Assembling processes which brought together researchers, TDC and members of the public also helped to form a multidirectional form of accountability between these three groups.

Cash et al. (2006) claim that this kind of multifaceted accountability forces boundary organisations to address issues and concerns of actors on both sides of the science-policy

boundary, which in return results in increased levels of salience and legitimacy. If Cash et al.'s (2006) theory is applied to the ICM programme, it appears the ICM programme functioned well in terms of developing and delivering convening forums and as such, contributed to the production of salient, credible and legitimate knowledge.

While convening processes no doubt occurred between and within the different actors and groups involved in the ICM programme (researchers, TDC, stakeholders, iwi and members of the public) the amount and frequency of these face to face meetings varied greatly between the different groups. Members of the public and local iwi were generally the most active groups to take part in face to face get-togethers thanks to ICM initiatives like the CRG. Although events such as CRG meetings and AGMs provided an ideal location to connect these groups with the TDC and researchers, the ICM programme's community focus limited its ability to connect the programme's different research disciplines. The ICM programme did attempt to address this issue with the creation of the Technical Advisory Group (TAG), which aimed to bring together the programme's different researchers. However, the TAG never got off the ground due to a lack of buy-in and resources and so was abandoned. If the TAG had been successful it is likely that it would have provided the space which was needed to bring the ICM programme's researchers together much like the CRG did for members of the public and iwi.

6.2 Translating

Evidence collected shows that a number of processes of translating occurred between the primary actors, groups and institutions involved in the programme, this included researchers, TDC, stakeholders, iwi and members of the public. As translation processes differed between these different groups it was necessary to split those into three subgroups in order to see how these groups translated information.

6.2.1 Translation between researchers

Within the literature on boundary organisations, translating between different research disciplines has yet to be explored in detail as the literature's most prominent authors (Cash, 2001; Cash et al., 2006; Guston, 1999, 2001) tend to focus on translating between science

and policy. The need to better explain and translate technical information between *research disciplines* within the ICM programme was an important issue which was identified by this research.

One researcher stated that issues surrounding terminology and a lack of coherent understanding between researchers from different disciplines were preventing integration and collaboration within the first two years of the ICM programme. This lack of translation was primarily based around the use of technical language (jargon) and disciplinary assumptions. Many of the researchers at the beginning of the ICM programme seemed to operate on the assumption that given they were all experts (with PhDs and years of experience), they all understood each other's research disciplines and the associated technical jargon. It is clear from the findings that this assumption was incorrect and resulted in confusion and poor communication between researchers from different disciplines. Once it became apparent that such barriers were preventing the flow of information between researchers the programme worked to improve the translation processes between researchers.

It appears that the improvements in conversion of information can be attributed to the relationships between researchers improving over time and the realisation that they (the researchers) needed to improve their communication skills and not take what was known for granted. Improved translation between different researchers was also likely to have been helped by the ICM programme's social researchers. These social researchers played key roles in helping improve interdisciplinary communication within the programme. This was achieved through helping researchers realise their current communication methods were limiting interdisciplinary research while also providing them with new tools and techniques to improve their interdisciplinary communication.

6.2.2 Translation between researchers, stakeholders, iwi and members of the public

Throughout the ICM programme researchers used translating tools and processes such as computer models, workshops and art-science projects to present their research in a manner which could be understood by laypeople with little scientific knowledge. These interactive

processes were mentioned throughout the interview process for their ability to both educate and engage with members of the public and stakeholders.

Transferring clear understandable information between researchers, stakeholders and members of the public also travelled in the other direction with some translation processes occurring where local and cultural knowledge was turned into a scientific format, e.g. the Cultural Health Index. While these kinds of local/cultural knowledge conversion processes did occur within the ICM programme, they were not as common as the transformation processes which were expected to turn scientific information into layperson's language.

Cash et al. (2003) state that effective translation processes also include addressing past problematic experiences and presumptions between different groups and actors across the science and public interface. The need to address these issues in order to foster better communication and relationships is also highlighted by Carr and Wilkinson (2005), who claim that incorrect assumptions regarding the roles of farmers and scientists can prevent boundary organisations from being able to operate. Given that some members of the public who were involved in the ICM programme had never met a researcher before, there were naturally some preconceived presumptions about their jobs and personalities that needed to be overcome.

The ICM programme seems to have addressed these translating issues through groups and events such as CRG, SLG, Travelling River exhibition and AGMs. These groups and events allowed members of the public as well as researchers the opportunity to better understand the other side of the science-public interface through the creation of new relationships and experiences between members of the public and researchers.

6.2.3 Translation between researchers and policymakers

The translating of information between researchers and policy staff at the TDC occurred through a number of processes based around meetings and workshops. Researchers often used computer models and presentations at these meetings and workshops to help convert technical data into a format which could be understood and used by the TDC. The use of computer models to transfer information between researchers and policymakers is relatively

common within the boundary organisation literature. Models have been used in a number of boundary organisation contexts ranging from climate forecasts (Agrawala et al., 2001) to aquifer management (Cash, 2001):

We had local policy people from our Tasman District Council sitting in on the workshops, and they certainly kept the science on us, so they always questioned us on 'OK, well this is great that you're doing this bit of science, but how does it relate back to us helping make decisions for the community?' (Research Scientist IC06).

The exchanging of dialogue between researchers and policymakers also had positive effects for the researchers, who were able to get a better understanding of the policymaking process and how their research works within this system, which in return helped researchers to improve their own communication skills.

While translating methods such as computer modelling and meetings may appear to be new concepts for translating information, it is important to recognise that they existed for decades under the linear/loading-dock science-policy model. If these methods used in the ICM programme are to prove useful for moving away from the linear model (the very model which created them) and truly merge the boundaries of science and policy as proposed by Cash et al. (2006), then more attention needs to be applied to seeing how these methods can be used to produce salient, credible and legitimate knowledge, which I now focus on.

Methods such as computer models and indexes appear to have been able to maintain a high level of salience amongst the different groups and actors (e.g. TDC, stakeholders, iwi, and public) involved in the ICM programme for a number of reasons. Firstly these translating tools were designed so that they could be used quickly by multiple groups to address issues which were assumed to be important by the local iwi, public and stakeholders. The Integrated Dynamic Environmental Assessment System (IDEAS) model's ability to turn off and on farming best-practice scenarios was a compelling example of an effective tool which addressed issues from a local rural perspective.

Dialogue between researchers and policymakers over the use and reasons for research was crucial for the development of models which were seen as salient by the TDC. This

conversion process broke away from the linear model as it resulted in information travelling both ways between researchers and policymakers rather than just from science to policy:

We would basically ask the end-users what they wanted answered (Research Scientist IC06).

This dialogue process between researchers and policy staff at TDC gave researchers the ability to shape their conversion methods so that maximum policy and public impact was achieved, while also providing a space for non-experts to ask questions and better understand technical information.

Translating tools such as models and indexes were developed with input from a range of actors and groups (public, stakeholders and iwi) within the catchment. This in return helped to give them credibility as it allowed these actors and groups the ability to express their views and opinions about these tools while seeing how these tools operated. The fact that these conversion processes happened in open public settings and included a wide range of actors and groups also gave the process legitimacy as it aimed to include all aspects of the ICM programme. Therefore, it can be concluded that the ICM programme's translating methods and processes successfully transported salient, credible and legitimate knowledge between as well as within the different ICM groups (research, public, iwi, stakeholders and TDC).

Translating information between and within the different actors and groups within the ICM programme was overall successful but took a number of years to get going especially between the different research disciplines. The programme's use of models, indexes and multidirectional dialogue not only made the programme's research more understandable and useful, but also gave non-experts the ability to include their local knowledge within the programme's research. This in return gave the ICM programme the salience, credibility and legitimacy it required to translate information across the boundaries of science and policy.

6.3 Mediation

6.3.1 Mediation events and processes

While the ICM programme did not focus on mediation as a particular area of interest, it did use a number of processes and events which aimed to address issues linked to mediation (e.g. conflict resolution and building community resilience). Events and processes such as the River and Gravel workshop and the different social learning platforms provided a space for different actors and groups to discuss issues, overcome differences of opinion and explore new concepts and ways of thinking.

One social learning platform which has already been discussed was the Watershed Talk project. This project provided a unique environment for members of the public, researchers, TDC, and iwi to come together and learn how to manage conflict better and overcome barriers to learning. The project's commitment to social and environmental interactions through shared meals and field trips seem to have had a positive impact on the people who attended Watershed Talk. Research participants noted that these events worked as an emotional reset button and helped them better understand each other's points of view.

6.3.2 Finding and building unofficial mediators

Members of the ICM staff who were involved in mediation processes were generally able to maintain a high level of credibility and legitimacy due to a number of reasons. Credibility was no doubt aided by the fact that some of the ICM staff who were involved in the mediation processes had either worked professionally in the Motueka area before and/or had friends or family living or working in the area.

I've known Andrew [Fenemor] since he was that big. First time I met him I think his mother and I collided round the river there with vehicles. (Laughs) Andrew was just a baby! (CRG member IC12).

These professional and personal connections meant that some ICM staff members already had a good idea of the different issues affecting the catchment and the different actors and groups which made up the catchment's social networks. This knowledge of the area and its

people was highly valued by the different actors and groups who lived and worked in the catchment and so helped to give these so-called mediators credibility.

These findings support Cash et al.'s (2006) claims that mediators operate most successfully when they come from professional backgrounds which are connected to the issues and geographic areas being discussed. This claim by Cash et al. (2006) regarding connections and experience in a geographic area raises an interesting point, as a number of the ICM staff who fulfilled mediation related roles had little or no experience working in the Motueka area.

ICM staff members who were involved in mediation processes but lacked connections with the catchment like their colleagues did, had to establish their credibility through other means. Events and processes such as AGMs, workshops and the different social learning platforms gave these ICM staff who lacked these connections to the area, a place to meet, talk and build relationships with the different people who lived and worked in the area. As one social researcher mentioned, these relationships were often formed through casual social interactions like hanging out and drinking tea after ICM meetings.

These interactions and the relationships they formed over time resulted in ICM staff being able to build credibility even though they were relatively new to the area. The establishment of this credibility for these ICM staff was made possible due to the long length of the ICM programme and the fact the programme managers and researchers were held in high regard within their field of research.

6.3.3 Staying neutral

The ICM programme managers and researchers involved in mediation processes were able to maintain a healthy level of legitimacy within their unofficial mediator roles thanks to the neutral standing of their employers. Government agencies (e.g. TDC, Department of Conservation) which operate in rural parts of New Zealand often receive unwarranted criticism from members of the public, stakeholders, interest groups and even other government agencies. These negative feelings often make mediation processes between these individuals, groups and government agencies difficult to implement.

The ICM programme was able to mitigate this issue by using researchers and programme managers who were employed by research institutes to manage mediation processes. As these researchers and programme managers did not work for government agencies (which charge rates and impose fines) they were seen by members of the public, stakeholders and other groups as having high levels of legitimacy and neutrality. This in return enabled individuals, stakeholders and other groups to take part in mediation processes which they may have otherwise avoided if these levels of legitimacy and neutrality had not been maintained. Guston (2001) states that a boundary organisation's ability to stay neutral and work with both sides of the boundary is extremely important as it shows that the boundary organisation is accountable to all sides and is not biased. The ICM programme's ability to remain unbiased can also be attributed to the collaborative design of the programme which is based around a local government and research partnership between Landcare, Cawthron and TDC.

Given the evidence which has been presented here it appears that the ICM programme was able to successfully manage issues surrounding mediation thanks to its focus on social learning, capacity building and its ability to remain unbiased. Although the programme lacked specialised mediators it was able to fulfil these roles with a number of different programme managers and researchers. While these members of the ICM programme lacked the training of professional mediators they were still able to produce positive outcomes thanks to either their history in the Motueka area and/or their willingness to engage with the people of the catchment.

6.4 Collaboration

6.4.1 Collaboration at programme management level

Given that collaboration is a key aspect of ICM theory and practice it is of little surprise that the Motueka ICM programme used a number of different collaborative processes throughout its life to bring together different actors, groups and institutions. These collaborative processes came in many shapes and forms and ranged from the programme's management structure to hands-on collaborative focused projects (e.g. Sherry River). Guston (1999) claims that boundary organisations aim to bring together actors and groups

from both sides of the science-policy divide in order to foster collaboration and build relationships. The connection between ICM and boundary organisations is highlighted by Carr and Wilkinson (2005) who claim that ICM committees provided useful examples of boundary organisations due to their ability to blur the lines between science and policy from an environmental perspective.

At the programme management level, collaboration could be seen through the management structure of the ICM programme which was driven by the three partner agencies Landcare, Cawthron and TDC. This partnership was unique as it included a Crown Research Institute (Landcare), an independent research institute (Cawthron) and a District/Regional Council (TDC).

While the ICM programme may have liked to present the image that its three-way management partnership was a classic example of collaboration, evidence collected by Smith et al. (2010), Lawrence (2010) and this study suggest that this partnership was in fact far from perfect. A number of the actors involved in the programme felt that TDC had not engaged and collaborated enough with the ICM programme. They felt that this lack of integration between the TDC and the programme resulted in a disconnect at the policy end of the ICM partnership. This lack of collaboration on TDC's part is seen by some CRG members and non-governmental group representatives as being the reason the ICM programme failed to produce more locally focused policy outcomes.

Both Smith et al. (2010) and Lawrence (2010) argue that this weak collaborative partnership could possibly have been improved through focusing on approaches such as embedding the ICM programme's research within the TDC through information officers or even placing ICM researchers within the TDC building. While these kinds of embedding science into policy institutes approaches may seem like a good idea for increasing science-driven policy outputs, it needs to be remembered that the policy development cycle is a deep-rooted institutional system that is unlikely to be changed due to the work of a few scientists or an information officer handing out reports.

Credibility within the realm of science is extremely important as without it the concept of trust is almost impossible to establish. Over last three decades a number of authors (Fischer,

2000; Jasanoff, 1987; Pielke, 2004; Sarewitz, 2004) have become increasingly concerned that science is losing this attribute of trust as different outside forces have attempted to interfere and manipulate environmental science to suit their own political and economic goals. One way the ICM programme was able to manage the issues of trust and credibility was through its collaborative management structure.

As the programme was managed by both research institutes and a local resource management agency it was able to represent itself as neither a strictly scientific experiment nor a council-driven initiative, but rather a community/stakeholder focused combination of the two. By representing the ICM programme in this light its managers were able to show the actors, groups and communities who make up the catchment that the programme was indeed salient, credible and legitimate.

Given the regulatory role of TDC it was not surprising that some members of the catchment communities had a negative view of the council. As the TDC was a partner of the ICM programme this undesirable view of the TDC could have reduced the credibility of the programme for some members of the public. This risk was mitigated by the fact that the TDC role was kept in balance by the other two programme partners Landcare and Cawthron, which were both research institutions as opposed to government bodies or agencies. This balance between research organisations and the regional authority was crucial in maintaining a high level of credibility in the public's eyes, as it showed that while the TDC was involved in the ICM programme it was not running the programme alone without oversight from its partner institutes.

The TDC involvement in the programme was not all negative in regard to the knowledge attributes. As the TDC is the most active government body in the Motueka catchment, it in many ways represents the government and democracy at a local level. Given that the TDC role is to ultimately serve the people of the Motueka area through supplying it with utilities and managing its resources, its involvement in the ICM programme was crucial in order to establish both salience and legitimacy in the eyes of the rate-paying public. As the TDC has been dealing with catchment related issues for decades it was able to share its knowledge with the ICM programme in order to focus their research on salient and relevant issues. Through having the TDC as a partner the ICM programme was able to harness the council's

knowledge and skills while also protecting its own credibility and legitimacy through keeping a safe distance from TDCs own political issues.

Cash (2001) argues that in order for boundary organisations to work across the boundaries of science and policy they need to be seen as accountable to both sides. The ICM programme appears to have managed this relationship through its management structure which remained accountable to its funders, the TDC and the people of the catchment. For example, the ICM programme's accountability to different actors both within and outside of the ICM programme can be seen on numerous levels and scales. From a financial perspective the programme was responsible to the Foundation for Research Science and Technology (FRST) who provided the funding for the programme. This accountability to FRST came in the form of the contract signed to produce certain research outcomes (reports, published articles) from the ICM programme in exchange for the millions of dollars FRST invested.

As the ICM programme was held within the Tasman district and in partnership with the TDC it was also accountable to the council. This accountability to the council was primarily linked to the programme producing research outputs which the council required to address catchment issues. The programme's strong community and stakeholder focus meant that many members of the public invested significant amounts of their own time into the programme. As a response to the strong community and stakeholder buy-in the programme received, it was held accountable for its actions by catchment stakeholders, iwi and community members.

6.4.2 Collaboration at project level

Collaboration within the ICM programme's different research projects was found to differ between the multiple groups (researchers, TDC, community members, stakeholders) involved in the programme. The most successful form of collaboration from a project level was the ICM programme's ability to bring stakeholders and community members into the research.

For members of the public and stakeholders collaboration came primarily in the form of the CRG meetings, workshops and AGMs. These meetings and workshops provided an

opportunity for members of the public and the CRG to contribute to the ICM programme by expressing their ideas and concerns regarding the programme with the managers, researchers and TDC staff. CRG input into the programme was based around verbal dialogue although there were some examples of members helping to set up the Travelling River exhibition and taking part in research fieldwork (e.g. electric fishing).

Connecting researchers and the public together in order to collaborate has been highlighted as a key function of boundary organisations (Cash et al., 2006; Duncan, 2011). According to Carr and Wilkinson (2005) the process of collaboration does seem to be more achievable as certain social groups (e.g. farmers) and researchers start to realise that their jobs and roles in society are becoming increasingly interconnected. This process of connecting scientists with other groups in society is explored in Carr and Wilkinson (2005), who conducted a study of how farmers and scientists in Australia interact. Their study found that while scientists and farmers have traditionally come from very different backgrounds which have created their own independent identities, their current professional roles are becoming increasingly overlapping as the barriers between the two spheres dissolve (with the help of boundary organisations). The data collected for this study supports Carr and Wilkinson's (2005) argument to the extent that it shows that farmers are often seeking the same outcomes as scientists but usually lack the skills, knowledge and support to achieve them. The Sherry River project provides a good example of showing how collaboration between farmers, community members and researchers can work to produce better outcomes for all the parties involved.

We saw that collaboration between the different research disciplines within the Motueka ICM programme at a project level occurred on a number of scales and ranged from exchanging dialogue to integrating different research disciplines together to focus on a collective research goal.

A number of collaborative research projects were undertaken within the ICM programme which successfully combined different research disciplines (e.g. the tracking of river plume contaminants into shellfish growing waters, IDEAS model). While many of the ICM researchers stated that they felt the programme had a strong collaborative focus, the limited number of truly interdisciplinary research projects identified suggests that the level of

collaboration within the different research disciplines may not have been as common or as in-depth as it first appeared. This apparent lack of collaboration within the programme's research disciplines is also highlighted by Kilvington (2010), who claims that while the programme built strong networks between researchers this did not necessarily result in interdisciplinary research outcomes.

One aspect of the ICM programme which is likely to have had a positive impact on the function of collaboration was the existence of strong social networks which interconnected with all the actors, groups and institutions involved in the programme. A number of members of the ICM programme (programme managers, researchers) were highlighted within the interview process for their ability to bring actors, groups and institutions together to form strong institutional and social networks. The roles these programme managers and researchers played closely match the roles fulfilled by country agents within Cash's (2001) study of the High Plains Aquifer. Cash (2001) claims that country agents played key roles within what Cash defines as a boundary organisation (the agriculture extension system) by effectively negotiating between scientists, farmers and decision makers in order to test new scenarios for managing land and freshwater.

Thanks to the ICM programme's collaborative management design and focus on integrating local knowledge alongside interdisciplinary research it was able, from a broad perspective, to fulfil the boundary organisation function of collaboration. Although the ICM programme can be called a collaborative research programme this does not mean that collaboration was achieved to its full potential within all the different features of the programme. The programme's interdisciplinary research projects and relationship with the TDC are two areas which could have benefited from a more focused cooperative approach.

6.5 Boundary objects within the ICM programme

Boundary objects play a key role within boundary organisations as they provide a means to bring people from distinct social worlds with different world views together in order for them to communicate and cooperate (Cash et al., 2006; Star & Griesemer, 1989).

Given that the ICM programme involved bringing together a range of actors, groups and institutions with different world views, the concept of boundary objects offers a useful

conceptual framework for understanding processes of facilitating cooperation and coherence.

While the ICM programme used a number of processes and tools to improve communication and collaboration, only a few of these fitted within the criteria of boundary objects. A key attribute of boundary objects is their ability to facilitate collaboration while also allowing those involved in the processes to maintain their own identities (Guston, 1999). The founders of the boundary object concept Star and Griesemer (1989) argue that emphasis should not be placed on the physical structure of boundary objects but their function, which does not depend on a physical presence but rather their ability to work within a number of different social worlds. This focus on connecting with different social groups as opposed to physical design can be seen through the diverse range of boundary objects identified below.

6.5.1 Travelling River exhibition

One boundary object which was identified early on within the ICM programme was the Travelling River exhibition. This exhibition was unique in many ways as it was a collaborative project which involved researchers, artists and members of the public who lived in the catchment. This collaboration came in the form of these different groups working together to create an exhibition which combined both the research aspect of the ICM programme and the values and history of the catchment from a local perspective.

Star and Griesemer (1989) state that boundary objects sit between the social worlds of science and non-science. The art-science focus of the Travelling River provided a setting for these different social groups to meet as it was neither a public nor science driven event but rather a combination of the two. By providing a neutral space (in the form of an art exhibition) where the public and researchers could meet and present their work, the exhibition was able to maintain the identities of the different groups (researchers, public) while also bringing about collaboration.

CRG members and researchers who were interviewed found the exhibition provided an excellent means to connect the catchment public with the ICM programme and inform them about the issues occurring in the catchment. The exhibition's ability to attract a high number

of visitors suggests that it fulfilled its goals of public engagement and building understanding around catchment issues. The exhibition was able to produce healthy levels of salience, credibility and legitimacy through the large number of visitors it attracted, its successful integration of local knowledge and the interest it received from overseas academic institutes.

6.5.2 Computer models

Like many environmental science-focused research programmes, the ICM programme relied on the use of computer models. Models have already been mentioned in this study in regard to their ability to translate technical information into layperson's terms. While they have been shown to be effective translating tools they can also be used as effective boundary objects (Cash, 2001; Cash et al., 2006).

Public, stakeholder and iwi involvement in the ICM programme's models differed depending on the model, with some models engaging in more consultation with these groups than others. One researcher who worked on some of the programme's models noted how important this public, iwi and stakeholder involvement was during the model design process. He claimed it helped to establish a sense of trust between the model and the people who lived and worked in the catchment. Cash et al. (2006) argues that this sort of trust is vital as without it models greatly reduce their ability to operate as effective boundary objects between different social groups.

A number of models were identified within the ICM programme which fitted within Star and Griesemer's (1989) concept of boundary objects. Both the Integrated Dynamic Environmental Assessment System (IDEAS) model and the Motueka Agent-Based Model (ABM) were designed in partnership with members of the public, stakeholders and other research disciplines.

The Motueka ABM coproduction focus and the opportunities it presented for both sides of the science-policy boundary (by researchers and Maori) highlights its capacity to operate as a boundary object between the ICM researchers and the local iwi. Although the Motueka ABM did operate as a boundary object between the researchers and iwi, its focus on Maori

knowledge and participation limited its ability to be used on a broader scale within the social makeup of the catchment.

In addition to the Motueka ABM was the IDEAS model, which was one of the ICM programme's most complex modelling projects. It aimed to bring together numerous kinds of data and smaller models created by the programme's different projects in order to build a highly technical holistic catchment model. Although the IDEAS model ran into issues integrating socio-economic and biophysical models due to issues of scale, it was overall considered to be a very effective model from a technical science perspective.

Even though the IDEAS model was very complex it was designed to be relatively easy to use so that it could be implemented by a number of different groups and stakeholders. The intention for the IDEAS model to be user friendly is a key attribute of boundary objects which aim to be simple enough to be used by actors and groups on both sides of the science and non-science boundary. The model's ability to test different land-use scenarios and best management practices through the use of visual graphics helped to give the model salience and credibility as it was seen as a very practical tool which could highlight effects from a farm to catchment scale.

Unlike the ABM which limited its collaborative focus to a single social group (Maori) the IDEAS model opened up the collaborative processes to a number of different groups and stakeholders from within the catchment. In order to include local and stakeholder knowledge within the model, IDEAS created its own social workstream which aimed to ensure the model was relevant to the people living and working within the catchment. The interdisciplinary coproduction design of the IDEAS model is very similar to the different models Cash (2001) describes as boundary objects in his study of the High Plains Aquifer. Cash (2001) claims that in order for models to meet the boundary object criteria they must include local knowledge and be seen as useful to multiple users (e.g. researchers, farmers).

Interactions between the model designers, researchers, stakeholders and members of the public through the social workstream ensured that the public and users of the model understood its inherent assumptions (Allen et al., 2011). According to Siebenhüner & Barth (2005) the scientific assumptions and the uncertainties found within models are very

delicate and so require careful management as they can easily undermine people's trust in a model. By discussing the assumptions found within the IDEAS model with members of the public and stakeholders the ICM programme was able to take a proactive approach to dealing with these issues. By explaining the model's limitations rather than hiding them and risking have them exposed negatively later on, this is likely to have helped the model maintain both its credibility and legitimacy.

6.5.3 Websites and multimedia

When the ICM programme started in 2000 the internet was not yet a common feature within many New Zealand homes especially within rural areas like the Motueka catchment. This made the ICM programme's use of the internet rather innovative from a New Zealand standpoint. According to one researcher interviewed it had yet to be used in this kind of catchment-scale research context. The ICM programme used the internet in a number of ways to engage with the members of the public and stakeholders as well as researchers working within the programme. At the most basic level the ICM programme's website provided a location where both experts and laypeople could access a wide range of information related to the ICM programme.

In order not to limit their research information to written reports and other text based documents the ICM programme also made six short documentary films which they shared on their website and on the YouTube video website. These videos used interviews with ICM programme managers, researchers, TDC staff, and stakeholders to explain the different aspects of the programme (e.g. modelling, integrated science). The basic non-technical nature of these videos makes them entertaining and easy viewing. This mode of communication is likely to have helped increase their popularity among social groups (e.g. youth, people from outside of Motueka) who had in the past shown little interest in the ICM programme. Given that the videos were released in 2011 when the ICM programme had finished they act as more of a summary of the programme than an engagement tool.

Although both the ICM programme website and its online videos worked as effective communication and educational tools, their design and use limited their ability to operate as boundary objects. Cash et al. (2002) claim that boundary objects provide a space where

different actors and groups can come together to work on a collaborative task. The ICM website and online videos clearly did not fulfil this task as neither of them provide a space (online or in person) for researchers, stakeholders and members of the public to meet and collaborate. This can be partly attributed to the design of these communication tools, which was based around a one-way flow of information from the ICM programme to the viewer.

One ICM internet project which did manage to operate as a successful boundary object was the Confluens website. Confluens was based around a message board or forum style website which gave members of the public, stakeholders and researchers the ability to post questions and answers regarding different ICM related issues. The website's open format provided a virtual space for the different actors and groups to exchange dialogue and share information from the comfort of their homes and offices. This gave participants the ability to maintain their identities while still taking part in a coproduction process. Confluens use was not limited to just connecting researchers with members of the public, it also provided a means to connect the different research disciplines within the ICM programme. Confluens' ability to fulfil different roles for multiple users within the ICM programme gave it legitimacy from experts and laypeople alike. Although Confluens had many of the attributes of a boundary object it was not without its own issues.

Confluens struggled to get off the ground during the early years of the ICM programme due to a lack of management guidance and interest from both the public and researchers. Another possible reason for its unsuccessful launch was that at this time (early 2000s) this kind of interactive internet dialogue was relatively new and untested and so may have appeared intimidating to users. Confluens' successful relaunch a few years later indicates that these kinds of boundary objects require a large amount of support and engagement from all levels in order to work. Given the popularity of social media websites such as Facebook and Twitter in the past few years it would be expected that web tools such as Confluens would be much easier to implement in today's social media connected society.

The different internet tools and process used by the ICM programme fulfilled a number of roles in regards to communication, education, collaboration and coproduction. The only internet tool which was able to facilitate all of these factors was the Confluens website. Unlike the ICM website and the online videos which focused on presenting information

(translating), Confluens was able to assist in the multidirectional exchange of information and dialogue both within and outside the boundary of science. This process was helped over the lifetime of the programme due to an increase in internet use within the catchment and by an escalation of interest in the website by the researchers involved in the programme. The ICM programme's failure to implement Confluens earlier in the programme is not surprising given the technical and social barriers which existed in this period (early 2000s).

The Motueka ICM programme had no shortage of tools, processes and events which aimed to both educate and bring together different members of the public to engage in activities. While some of these were limited to communication roles others proved to be effective tools and processes for facilitating coproduction of knowledge and coherence. By engaging with people from different social worlds through a range of tools and processes set in different environments (internet, art gallery and modelling) these boundary objects managed to move catchment research out of isolation and into the public realm, which in return, increased the programme's knowledge attributes.

6.6 Summary

When examined alongside the theoretical framework and the evaluative criteria produced for this study, the Motueka ICM programme clearly showed its ability to successfully produce and balance salient, credible and legitimate knowledge within the boundaries of science and policy. The successful production and management of these knowledge attributes can be attributed to a number of factors, such as the programme's strong focus on bringing members of the community, stakeholders and iwi into the research; focusing on relevant catchment issues and transferring this science into layperson's language; building strong social networks; structuring the programme around a joint research-local government partnership; the use of tools and processes which shared information and encouraged collaboration (boundary objects).

Chapter 7

Conclusions

This final chapter summarises this study's main findings and takes these findings a step further to raise questions about boundary organisation theory, ICM, and possible avenues for further research.

7.1 How did the Motueka ICM programme negotiate the interface between science and policy?

Under the linear and loading-dock models, scientific information is assumed to be uncomplicatedly transferable between researchers and policymakers as a one-way flow of information which requires little dialogue or interaction between the disciplines of science and policymaking. It is this presumed one-way flow and lack of interactions, Duncan (2013) argues, that underpin the epistemic authority of both science and policy. While the limitations of these models, which embedded simplistic notions of the information transfer have been documented by a number of authors, for example Jasanoff, 1987; Lövbrand, 2007; Pielke, 2004, these studies have focused on the science-policy framework within Europe and North America.

This study has sought to illustrate how the Motueka ICM programme managed the science-policy interface from a New Zealand perspective. Through outlining different strategies, processes and tools used within the ICM programme, it has been shown how the programme was able to successfully redesign and manage many aspects of the science-policy relationship. While this research highlights the programme's success, it also sheds light on the internal and external issues the programme faced in challenging New Zealand's traditional linear science-policy model and its overarching environmental legislation (RMA).

Boundary organisation theory provides a useful lens to analyse ICM and its science-policy aspects. ICM aims to bring these two domains together alongside members of the public, iwi and stakeholders to address environmental issues at a catchment scale. By bringing these different actors and groups together the Motueka ICM programme aimed to undertake

interdisciplinary research, build resilient and informed catchment communities and produce effective policy outputs.

Through the lens of boundary organisation theory we have been able to see how the Motueka ICM programme attempted to redefine the science-policy relationship from a catchment scale. This was done by focusing on the boundary organisation functions of convening, translating, mediation and collaborating, which were used to establish a set of evaluative criteria. Through using these criteria we were able to see how the ICM programme attempted to replace the linear science-policy model with one based around multidirectional forms of communication and collaboration.

Although workshops and meetings brought people together, this did not necessarily result in effective communication between the different actors and groups within the programme. In order to address this issue, the programme employed a number of tools and processes such as models, platforms (social learning) and workshops, which helped to reduce jargon and open up dialogue. These convening and translating events and processes tended to break away from the linear model, as they provided a location where information was exchanged from a number of directions (science, policy and local knowledge) as opposed to the common mono-directional flow of scientific information as seen in the linear model. This open flow of translated information proved to be productive for both sides of the science-policy boundary, thanks to both researchers and policymakers being able to share their insights, experiences and needs.

While public, stakeholder and Maori participation processes do exist within New Zealand's environmental policy framework under the RMA, these processes are, according to Memon et al. (2010), often poorly managed and so do little to promote collaboration. Rather than relying on traditional public, iwi and stakeholder engagement processes, the ICM programme instead created its own processes and events, which focused heavily on engaging with stakeholders, iwi and members of the public, as well as including them within the research programme. The ICM programme used a number of tools and processes to both educate and bring together the wider catchment communities within the programme. Many of these were based around the social learning platforms which were managed by the programme's social researchers. Events and processes such as the Travelling River Exhibition

and Confluens website proved to be effective tools and processes for increasing both communication and collaboration between the researchers, stakeholders, iwi and members of the public.

By embedding members of the public, stakeholders and iwi within the programme alongside researchers and policymakers, the ICM programme was able to include local and cultural values and knowledge within its different research projects. This was achieved through using tools such as the IDEAS model and Cultural Health Index, which were designed to include the information and values which normally did not fit within the traditional scientific paradigm. This inclusion of local knowledge and values within the programme's research projects was likely to have increased the programme's credibility and legitimacy in the eyes of the public and stakeholders.

Thanks to the programme's focus on sharing information and building collaboration, catchment issues such as erosion and water quality were much better understood within the catchment communities. This knowledge and understanding about these catchment issues then encouraged some members of the catchment communities, in particular those in the Sherry River, to take a proactive approach to addressing environmental issues impacting their catchment.

The Motueka ICM programme has been highlighted by a number of authors (e.g. Lawrence, 2010; Smith et al., 2010) for its ability to produce a wide range of useful social and scientific outcomes. These include: advances in catchment dynamics research, guidelines for riparian planting and increasing community resilience. Many of these outcomes have since been adopted by a number of actors, groups and institutions outside of the Motueka area, an example of this being the Clean Streams Accord which was developed by New Zealand's largest dairy farming company, Fonterra, using research from the Sherry River project. Given the large number of research outcomes produced by the ICM programme, it is surprising that only a relatively small number of these outcomes were picked up at a regional and local scale and turned into policy by the TDC.

As the TDC is responsible for the management of natural resources within the Motueka catchment and was also a partner of the ICM programme, many of the researchers and CRG

members involved in the programme believed that the TDC would be the main user of the programme's research. TDC's inability to use more of the ICM programmes research for policy documents such as Regional Plans, is in many ways the crux of the science-policy relationship, as without the creation of policy much of the research produced under the programme has no practical use.

Both within this study and in others (Lawrence, 2010; Smith et al., 2010), TDC's role within the ICM programme has been questioned and often criticised due to its lack of policy outputs and inability to be fully integrated into the programme. These critiques tend to focus on a lack of interest within the Council to work in partnership with the programme, and an absence of capacity within the TDC to deal with such a large long-term programme as well as the restrictive nature of the RMA effects-based framework.

This research illustrates that the ICM programme's inability to effectively integrate the TDC within the programme and failure to make full use of the programme's research, also relate to a number of factors outlined within Memon et al's. (2010) study of ICM implementation in New Zealand. Memon et al. (2010) argue that councils in New Zealand face many internal and institutional challenges when they attempt to implement ICM, such as a lack of strategic spatial planning, silo mentalities within staff, and lack of central government support. Many of these challenges are difficult to overcome for small councils such as TDC, due to the fact that some of these issues require policy changes and guidance at central government level. Another issue which may be limiting the use of research with TDC policy is that of time. Although the ICM programme operated for ten years, it only finished operating two years ago (2010). Given that many policy and planning cycles operate in five to ten year cycles, there is a strong likelihood that the programme's research findings will be seen in TDC policy documents in years to come. While this issue highlights the slowness of the science-policy relationship, it raises the question of how this time delay affects the credibility and salience of research. Many environmental catchment issues such as water quality can change greatly in short time frames. If the research which is produced to address these issues is going to take 5-10 years to be transferred into policy, it will likely be out of date and unpractical by the time policy action is taken.

Given the lack of integration between TDC and the ICM programme and the barriers which ICM implementation in New Zealand faces, it should be of little surprise that the TDC struggled to convert the programme's research to policy outputs. While the TDC and the ICM programme could no doubt have taken steps to overcome some of these issues (for example Smith et al. (2010) suggest TDC employing a full-time ICM information officer), there is also only so much that can be done to improve this relationship from a local scale. These findings tend to support the Memon et al. (2010) argument that ICM implementation is a complex procedure, which requires guidance and support from all levels of government in order to succeed.

The Motueka ICM programme's integrated and collaborative design and focus helped to redefine the science-policy relationship from a catchment scale. By opening up the research processes to input from a range of actors, groups and institutions, the programme was able to produce salient, credible and legitimate research outcomes while also increasing awareness and resilience within the catchment's different communities. The ICM programme used a number of processes and tools which successfully shared information and built understanding between the programme's researchers and TDC policy staff. Although these tools and processes were seen as useful and productive by both sides of the science-policy boundary, they were unable to address many of the complex issues which limited TDC's ability to turn the programme's research into policy. The TDC was not the only agency/ organisation with a practical use for the programme's research, and as a result a number of national-scale policy documents (e.g. Clean Streams Accord) have been influenced as a result of the programme's research. The fact that ICM research had possibly more of a policy impact on a national scale as opposed to a local scale (Motueka) once again illuminates the barriers which existed between the ICM programme and the TDC.

If future ICM programmes in New Zealand wish to approach the science-policy relationship from a different approach than the current linear model they can learn some important lessons from the Motueka ICM Programme. Regional and local authorities such as the TDC are, like any government body, limited by resources, management structures and national policies and legislation. Future ICM programmes wishing to work with councils need to understand these issues and limitations when outlining their goals and expectations for policy outputs. Unless councils are willing to truly embrace the ICM concept through

increasing their capacity levels and rethinking their policy development cycles (with support and guidance from central government), it seems unlikely that councils will be able to work effectively with ICM programmes. For this reason it is vital the ICM programmes do not limit their policy focus to just regional and local authorities, but instead include other organisations and companies whose activities or roles influence catchment issues. While improving environmental policy should remain a goal of ICM programmes, it should not be seen as the only means to manage catchment resources. The Motueka ICM programme has shown that ICM can have positive effects for people and the environment from a grassroots perspective with only limited policy influence.

7.2 Compared with the theory, how effectively did the ICM programme operate as a boundary organisation in practice?

According to Cash et al. (2006) boundary organisations can successfully manage the boundaries between science and policy if they fulfil the functions of convening, translating, mediation and collaboration to achieve knowledge that is salient, credible and legitimate. Through examining the Motueka ICM programme this study concluded that the programme was able to fulfil these four institutional functions and three knowledge attributes. While these functions and knowledge attributes were overall achieved by the ICM programme their level of compliance varied (e.g. convening and collaboration).

According to Cash et al. (2006) if boundary organisations are operating correctly both sides of the science-policy boundary win; policymakers get the information they need to address complicated issues, while scientists get the information they require to undertake practical and relevant research. If this argument is applied to the Motueka ICM programme, then one would expect that the programme was able produce high-quality outputs from the disciplines of science and policy as a result of the boundary organisation's functions being achieved. This study has shown that while the programme was able to produce numerous science-related outputs, its ability to produce policy outputs from a local scale (TDC) was overall limited and disappointing given the high-quality research available to policymakers.

The fact that the Motueka ICM programme managed to fulfil all the functions of a boundary organisation while maintaining high levels of salience, credibility and legitimacy, yet was only able to produce a limited amount of policy outputs through its resource management partner (TDC), illustrates the challenges of operating at the science-policy interface.

This study has shown that while the boundary organisation functions of convening, translation, mediation and collaboration as outlined by Cash et al. (2006) helped to improve the creation, uptake and transfer of research within scientific institutions and catchment communities, they are unable to push much of this information within the policy development cycle. Boundary organisations, according to Guston (1999) facilitate the transfer of relevant and usable knowledge between science and policy, in order to improve the science-policy relationship. Guston's (1999) theory seems to be based on the assumption that policymakers will use the best information provided to them in order to write policy. My research has found that this assumption is incorrect as it does not take into account issues which influence policymaking such as time, resources, policy cycles and existing institutional arrangements. This assumption that the salient, credible and legitimate information will be picked up and used by policymakers also seems to have existed within the ICM programme in regard to the science-policy relationship with TDC.

The assumption that good science will result in positive policy outcomes is nothing new, and has been highlighted by both Collingridge and Reeve (1986) and Pielke (2004) as being a common flaw of the linear science-policy model. Although both boundary organisations and the ICM programme attempt to move away from the traditional linear model through focusing on communication and collaboration, it appears that these approaches were not enough to cause sufficient policy change or remove the linear model completely from the ICM programme.

The ICM programme ended up operating within the linear model even though it attempted to avoid this approach, which is not surprising given that it was a research-driven ICM programme which was funded and overseen by scientific organisations and environmental policy (RMA) firmly entrenched in the linear model. The fact that these scientific organisations and institutes are entrenched within the linear model is not surprising when you take into account their role. As Sarewitz (2004) argues, scientists' role (which they do

very well) is to answer questions not fix problems. What happens with their research is not particularly their concern; getting research into policymaker's hands is not their job description.

Cash et al.'s (2006) and the ICM programme's attempts at redefining the science-policy relationship have focused on the assumption that coproduced knowledge which is seen as salient, credible and legitimate will transcend the linear-model limitations and result in productive policy outcomes. While the ICM programme's focus on producing coproduced knowledge has proven to be an effective way to work with iwi, stakeholders and community groups and inspire grassroots action, it has proven to have only a limited impact on influencing policy outcomes.

Boundary organisation theory and the ICM programme's failure to fully comprehend the science-policy interface lies not in their inability to provide spaces to connect these two disciplines (they both did this very well), but in their inability to understand the broader issues of why people do not or cannot act on knowledge even when it is salient, credible, and legitimate.

This study has shown that while boundary organisations provide a means to open up communication and collaborate within the science-policy interface, they (within a New Zealand context) fail to leave behind many of the bad attributes and assumptions of the linear model. If boundary organisations are to truly offer an alternative to the linear model of science and policy, and result in more productive policy outcomes, more attention needs to be placed on understanding the decision-making process policymakers use when deciding to act using scientific information. Through understanding the factors (e.g. structural, political and institutional) which affect this decision-making process, boundary organisations will have the knowledge needed to move their knowledge more effectively into the policy development cycle.

7.3 Research limitations and future research

The main limitation of this study was a lack of insight into the policymaking process within the TDC. The majority of the interviews undertaken for this study involved ICM researchers as opposed to a more even split between researchers and policy analysts. If more policy analysts had been interviewed, this study would have likely gained a better understanding of the science-policy interface from a policymaking perspective.

This study's findings and limitation opens up some interesting avenues of further research in regard to the science-policy relationship and ICM in New Zealand. Further research is needed to investigate the decision-making process policymaker's use, in order to see why action is taken on some issues but not others. Through gaining a better understanding of this decision-making process, researchers can learn how to influence the policymaking cycle more effectively. This study has shown that much high quality research is often wasted and never used within resource management plans and policies. If we wish to truly address the many environmental issues we face, this needs to change.

From an ICM perspective, more research is needed in order to see how ICM can be successfully implemented in New Zealand. Future research should aim to establish strategies for overcoming the barriers which limit ICM implementation; these strategies will likely involve issues surrounding the role of councils in ICM programmes and how the RMA framework can be altered to better suit ICM philosophy and its application.

References

- Agrawala, S., Broad, K., & Guston, D. H. (2001). Integrating climate forecasts and societal decision making: Challenges to an emergent boundary organization. *Science, Technology & Human Values*, 26(4), 454-477.
- Allen, W. (2006). *Learning about sediment in the ICM research programme*. Nelson: Landcare Research. Retrieved from http://icm.landcareresearch.co.nz/knowledgebase/publications/public/Sediment_Learning_Group_article.pdf
- Allen, W., Fenemor, A., Kilvington, M., Harmsworth, G., Young, R., Deans, N., . . . Ataria, J. (2011). Building collaboration and learning in integrated catchment management: The importance of social process and multiple engagement approaches. *New Zealand Journal of Marine and Freshwater Research*, 45(3), 525-539.
- Ashton, P. (2000). Integrated catchment management: Balancing resource utilization and conservation. *AWIRU Occasional Paper*(5).
- Atkinson, M., Fenemor, A., & Peacock, S. (2004). *Travelling River: A collaboration of artists, scientists and people of the Motueka River catchment*. Nelson: Manaaki Whenua Landcare Research.
- Atkinson, M., Kilvington, M., & Fenemor, A. (2009). *Watershed Talk*. Nelson: Manaaki Whenua Press.
- Bechky, B. A. (2003). Object lessons: Workplace artifacts as representations of occupational jurisdiction. *American Journal of Sociology*, 109(3), 720-752.
- Bocking, S. (2004). *Nature's experts: Science, politics, and the environment*. New Brunswick: Rutgers University Press.
- Bowden, W. B. (1999). Integrated catchment management rediscovered: An essential tool for a new millennium Symposium conducted at the meeting of the Manaaki Whenua Conference
- Bowden, W. B., Fenemor, A., & Deans, N. (2004). Integrated water and catchment research for the public good: The Motueka River–Tasman Bay initiative, New Zealand. *International Journal of Water Resources Development*, 20(3), 311-323.
- Buhrs, T., & Bartlett, R. V. (1993). *Environmental policy in New Zealand*. Auckland: Oxford University Press.

- Burton, L., & Cocklin, C. (1996). Water resource management and environmental policy reform in New Zealand: Regionalism, allocation, and indigenous relations. *Colorado Journal of International Environmental Law and Policy*, 7, 331.
- Calder, I. R. (1999). *The blue revolution: Land use & integrated water resources management*. London: Earthscan.
- Carr, A., & Wilkinson, R. (2005). Beyond participation: Boundary organizations as a new space for farmers and scientists to interact. *Society and Natural Resources*, 18(3), 255-265.
- Cash, D. W. (2001). "In order to aid in diffusing useful and practical information": Agricultural extension and boundary organizations. *Science, Technology, & Human Values*, 26(4), 431-453.
- Cash, D. W., Borck, J. C., & Patt, A. G. (2006). Countering the loading-dock approach to linking science and decision making. *Science, Technology, & Human Values*, 31(4), 465-493.
- Cash, D. W., Clark, W., Alcock, F., Dickson, N., Eckley, N., & Jäger, J. (2002). *Saliency, credibility, legitimacy and boundaries: Linking research, assessment and decision making*. Cambridge: Harvard University Kennedy School of Government.
- Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., . . . Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences*, 100(14), 8086.
- Collingridge, D., & Reeve, C. (1986). *Science speaks to power: The role of experts in policy making*. London: Pinter.
- Daly, C., & Fenemor, A. (2007). *Integrated catchment management among New Zealand regional and unitary councils*. Nelson Landcare Research
- Duncan, R. (2011). Science, policy and knowledge: Is there a better way for the tourism and recreation sector ? . In L. Crase & S. O'keefe (Eds.), *Water Policy, Tourism, and Recreation Lessons from Australia* (pp. 157-173). Oxon: RFF Press.
- Duncan, R. (2013). Converting community knowledge into catchment nutrient limits: A constructivist analysis of a New Zealand collaborative approach to water management. *Nature and Culture*, 8(2).
- Dunn, K. (2000). Interviewing. In I. Hay (Ed.), *Qualitative research methods in human geography*. Melbourne: Oxford University Press.
- Edgar, N. (2004). *Integrated catchment management project: Final report for the Landcare Research Trust and the Ministry for the Environment*. Christchurch: NZ Landcare Trust.

Emad, G., & Roth, W. M. (2009). Policy as boundary object: A new way to look at educational policy design and implementation. *Vocations and Learning*, 2(1), 19-35.

Ericksen, N. (2003). Planning paradise with the cheshire cat: Governance problems under the RMA Symposium conducted at the meeting of the New Zealand Planning Institute Conference, Hamilton, New Zealand.

Fenemor, A., Atkinson, M., & Peacock, S. (2004). *Travelling River: A collaboration of artists scientists and the people of the Motueka river catchment*. Nelson: Printhouse.

Fenemor, A., & Bowden, W. B. (2001). Integrated catchment management for the Motueka River: Bridging the gap between hydrology and the human dimension Symposium conducted at the meeting of the Innovative Approaches for Hydrology and Water Resources Management in Monsoon Asia, Tokyo.

Fenemor, A., Phillips, C., Allen, W., Young, R. G., Harmsworth, G., Bowden, W. B., . . . Davies-Colley, R. (2011). Integrated catchment management—interweaving social process and science knowledge. *New Zealand Journal of Marine and Freshwater Research*, 45(3), 313-331.

Fenemor, A., Young, R., Phillips, C., Davies-Colley, R., Stuart, B., Allen, W., . . . Burton, A. (2011). *Facilitating voluntary action to reduce rural land use impacts in the Motueka River catchment*.

Retrieved 1 October,

2012, from http://icm.landcareresearch.co.nz/knowledgebase/publications/public/DIPCON2011_SherlyLandOwnersICM_AndrewFenemor.pdf

Fischer, F. (2000). *Citizens, experts and the environment: The politics of local knowledge*. Durham: Duke University Press Books.

Fujimura, J. H. (1992). Crafting science: Standardized packages, boundary objects, and “translation.”. In A. Pickering (Ed.), *Science as Practice and Culture* (pp. 168-211). Chicago: The University of Chicago Press.

Gaiser, T., & Schreiner, A. (2009). *A Guide to Conducting Online Research*. London: Sage Publications.

Gieryn, T. F. (1983). Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American sociological review*, 48, 781-795.

Gorman, G. E., & Clayton, P. (2005). *Qualitative research for the information professional* (2 ed.). London: Facet Publishing.

Greater Christchurch Urban Development Strategy (2009). Retrieved 3 December, 2011, from <http://www.greaterchristchurch.org.nz/Background/TrendsAndIssues/NaturalEnvironment/>

Guston, D. (1999). Stabilizing the boundary between US politics and science: The role of the Office of Technology Transfer as a boundary organization. *Social Studies of Science*, 29(1), 87-112.

Guston, D. (2001). Boundary organizations in environmental policy and science: an introduction. *Science, Technology, & Human Values*, 26(4), 399-408.

Harmsworth, G. R., Young, R. G., Walker, D., Clapcott, J. E., & James, T. (2011). Linkages between cultural and scientific indicators of river and stream health. *New Zealand Journal of Marine and Freshwater Research*, 45(3), 423-436.

Holling, C. S., Berkes, F., & Folke, C. (1998). Science, sustainability and resource management. In F. Berkes & C. Folke (Eds.), *Linking social and ecological systems: management practices and social mechanisms for building resilience* (pp. 342-362). Cambridge: Cambridge University Press.

Ingram, M. (2007). Disciplining microbes in the implementation of US Federal Organic Standards. *Environment and Planning* 39(12), 2866-2882.

Jasanoff, S. (1987). Contested boundaries in policy-relevant science. *Social Studies of Science*, 17(2), 195-230.

Jay, M., & Morad, M. (2006). Crying over spilt milk: A critical assessment of the ecological modernisation of New Zealand's dairy industry. *Society and Natural Resources*, 20(5).

Joy, M. (2009). *Temporal and land-cover trends in freshwater fish communities in New Zealand's rivers: An analysis of data from the New Zealand Freshwater Fish Database – 1970 – 2007*.

Wellington: Ministry for the Environment.

Kemmis, D. (2002). Science's role in natural resource decisions. *Issues in Science and Technology*, 18(4), 31-34.

Kilvington, M. (2010). *Building Capacity for Social Learning in Environmental Management* (Ph.D). Lincoln University, Christchurch.

Kilvington, M., Allen, W., & Fenemor, A. (2011). Three frameworks to understand and manage social processes for integrated catchment management. *New Zealand Journal of Marine and Freshwater Research*, 45(3), 541-555.

- Kilvington, M., Atkinson, M., & Fenemor, A. (2011). Creative platforms for social learning in ICM: The Watershed Talk project. *New Zealand Journal of Marine and Freshwater Research*, 45(3), 557-571.
- Lambright, W. H. (2008). Government and science: A troubled, critical relationship and what can be done about it. *Public Administration Review*, 68(1), 5-18.
- Landcare. (2010a). *Map of Motueka catchment* Retrieved November 25, 2012, from <http://icm.landcareresearch.co.nz/knowledgebase/atlas/other.asp>
- Landcare. (2011). *Motueka ICM Innovative Engagement: Watershed Talk & Travelling River*. Retrieved 25 July, 2012, from http://www.youtube.com/watch?v=dD5epRC_osU&feature=youtu.be
- Lawrence, J. (2010). *Stakeholder/ Research End - User Survey Intergrated Catchment Management Landcare Research NZ Ltd (C09X0305): PS Consulting Ltd*.
- Lennox, J., Proctor, W., & Russell, S. (2011). Structuring stakeholder participation in New Zealand's water resource governance. *Ecological Economics*, 70(7), 1381-1394.
- Lövbrand, E. (2007). Pure science or policy involvement? Ambiguous boundary-work for Swedish carbon cycle science. *Environmental Science & Policy*, 10(1), 39-47.
- Maarleveld, M., & Dabgbégnon, C. (1999). Managing natural resources: A social learning perspective. *Agriculture and Human Values*, 16(3), 267-280.
- McGregor, D., & Gully, B. (2007). *Water allocation and trading - A New Zealand perspective*. Auckland: Bell Gully. Retrieved from http://www.bellgully.co.nz/resources/pdfs/water_allocation.pdf
- Memon, A. (1993). *Keeping New Zealand green: Recent environmental reforms*. Dunedin: Otago.
- Memon, A. (1997). Freshwater management policies in New Zealand. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 7(4), 305-322.
- Memon, A., Painter, B., & Weber, E. (2010). Enhancing potential for integrated catchment management in New Zealand: A multi-scalar, strategic perspective. *Australasian Journal of Environmental Management*, 17(1), 35.
- Memon, A., Painter, B. D. M., & Weber, E. (2009). How to harness the full potential of integrated catchment management as a pathway to sustainability. *Lincoln University Planning Review*, 1(2), 16-20.
- Merton, R. K. (1968). Science and democratic social structure. In R. K. Merton (Ed.), *Social theory and social structure* (pp. 604-615). New York: Free Press.

- Meurk, C. (2004). *Vegetation and landscape potential, Styx River Catchment*. Christchurch: Christchurch City Council.
- Miller, C. (2001). Hybrid management: boundary organizations, science policy, and environmental governance in the climate regime. *Science, Technology & Human Values*, 26(4), 478-500.
- Mitchell, B., & Hollick, M. (1993). Integrated catchment management in Western Australia: Transition from concept to implementation. *Environmental Management*, 17(6), 735-743.
- Montes de Oca Munguia, O., Harmsworth, R., Young, R., & Dymound, J. (2009, 13-17 July). The use of an Agent Based Model to represent Maori cultural values Symposium conducted at the meeting of the The 18th World IMACS Congress and MODSIM09 International Congress on Modelling and Simulation, Cairns, Australia
- NIWA. (2003). *Overview of New Zealand Climate*. Retrieved 15 January, 2012, from <http://www.niwa.co.nz/education-and-training/schools/resources/climate/overview>
- NIWA. (2010). *Analysis of national river water quality data for the period 1998–2007*: National Institute of Water & Atmospheric Research.
- Paulsen, C. A., & Dailey, D. (2002). *A Guide for education personnel: Evaluating a program or intervention*. Washington, DC: Elementary and Middle Schools Technical Assistance Center. Retrieved from <http://www.air.org/files/eval.pdf>
- Petit, O., & Baron, C. (2009). Integrated water resources management: From general principles to its implementation by the state. The case of Burkina Faso. *Natural Resources Forum*, 33(1), 49-59.
- Phillips, C., Allen, W., Fenemor, A., Bowden, W. B., & Young, R. (2010). Integrated catchment management research: Lessons for interdisciplinary science from the Motueka Catchment, New Zealand. *Marine and Freshwater Research*, 61(7), 749-763.
- Pielke, R. A. (2004). When scientists politicize science: making sense of controversy over The Skeptical Environmentalist. *Environmental Science & Policy*, 7(5), 405-417.
- Pielke, R. A. (2007). *The honest broker: Making sense of science in policy and politics*. Cambridge: Cambridge University Press.
- Poole, A. L. (1983). *Catchment control in New Zealand*. Wellington: Ministry of Works and Development, Soil and Water Division.

- Proffitt, F. (2010). *How clean are our rivers?* Retrieved 13 August, 2012, from <http://www.niwa.co.nz/publications/wa/water-atmosphere-1-july-2010/how-clean-are-our-rivers>
- Quinn, R. (2009). *Trends in nuisance periphyton cover at New Zealand National River Water Quality Network sites 1990-2006*. Hamilton: National Institute of Water & Atmospheric Research Ltd.
- Rodda, J. C. (1976). Basin studies. In J. C. Rodda, R. A. Downing & F. M. Law (Eds.), *Systematic Hydrology*. London: Newnes-Butterworth.
- Sarewitz, D. (2004). How science makes environmental controversies worse. *Environmental Science & Policy*, 7(5), 385-403.
- Schilling, C., Zuccollo, J., & Nixon, C. (2010). *Dairy's role in sustaining New Zealand- the sector's contribution to the economy*: NZIER. Retrieved from <http://www.fonterra.com//wps/wcm/connect/fcf7000044f43b8bb2b2fbac5c5d2692/NZIER+economic+report+to+Fonterra+and+DNZ+2010.pdf?MOD=AJPERES>
- Scott, K. (2007). *Engaging urban communities: Six case studies of Auckland community-based restoration projects* (LC0607/113). Auckland: Landcare Research.
- Siebenhüner, B., & Barth, V. (2005). The role of computer modelling in participatory integrated assessments. *Environmental Impact Assessment Review*, 25(4), 367-389.
- Simons, H. (2009). *Case study research in practice*. London: SAGE.
- Smith, W., Camkin, J., Petch, T., & Skerrett, M. (2010). *Review integrated catchment management* (C09X0305). Wellington: Foundation for Research Science and Technology & Landcare Research Ltd.
- Star, S., & Griesemer, J. R. (1989). Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, 19(3), 387-420.
- Stevenson, W., Hayward. (2010). *An overview of the state and trends in water quality of Canterbury's rivers and streams* (R10/117). Christchurch: Environment Canterbury.
- Strickert, G. (2011). *Mixing With The Mountains* (Ph.D). Lincoln University, Christchurch.
- Stuart, B. (2010). *Sherry River Project: Improving water quality through farm environmental planning*. Hamilton: NZ Landcare Trust.

- Tyson, B., Panelli, R., & Robertson, G. (2005). Integrated Catchment Management in New Zealand: A Field Report on Communication Efforts in the Taieri River Watershed. *Applied Environmental Education & Communication*, 4(1), 73-80.
- Vant, B. (2008). *Trends in river water quality in the Waikato Region, 1987-2007* (2008/33). Hamilton: Waikato Regional Council.
- Wallington, T. J., Maclean, K., Darbas, T., & Robinson, C. J. (2010). *Knowledge – action systems for integrated water management: National and international experiences, and implications for South East Queensland (1836-5566)*. Brisbane: Urban Water Security Research Alliance.
- White, R. (2006). Doing evaluation research In M. Walter (Ed.), *Social research methods: An Australian perspective*. Melbourne Oxford University Press.
- Williams, J. (2006). Resource management and Māori attitudes to water in southern New Zealand. *New Zealand Geographer*, 62(1), 73-80.
- Yin, R. (2002). *Case Study Research: Design and Methods* (Vol. 5). Thousand Oaks: SAGE.

Appendix

Interview questions for scientist (social & biophysical) and natural resource managers involved in the Motueka ICM Programme

Please do not state individuals' names in your answers, instead describe the profession or activity of the person involved and /or the organisation they are associated with (e.g. dairy farmer, local fisherman, Landcare scientist).

Please write your answer below the numbered question, feel free to write as much as you think is necessary.

A. General questions

- 1. Please state your current professional position and how long you have been working in this industry?*
- 2. Tell me about your role within the Motueka ICM programme? (Position, responsibilities)?*
- 3. How long were you involved with the ICM programme and how much of your workload during this time was dedicated to the ICM programme?*
- 4. What does integrated catchment management mean to you?*
- 5. What issues instigated the establishment of the ICM programme?*
- 6. What were the aims and objectives of the ICM programme? Who was involved and who were the drivers of the ICM programme?*
- 7. Who did you work with most closely?*
- 8. What were your original thoughts about the ICM programme and did this view change over time? If so, how?*
- 9. What do you view as the most positive outcome of the ICM programme?*

B. Boundary organisations

1. *How would you describe the role of Landcare in the ICM programme?*
2. *How do you view the relationship between science and policy in ICM?*
3. *Did the ICM programme influence your views on this relationship?*
4. *Who was Landcare accountable to for the ICM programme and how did this impact their role in managing the ICM programme?*
5. *What tools were used to promote information sharing and collaboration (e.g. models, exercises, maps, workshops)?*
6. *Who developed these tools and how were they used?*
7. *Were stakeholders involved in creating and implementing these tools?*
8. *Was the information created by Landcare Research available to be used by different groups (e.g. councils, communities groups, academic journals)?*
9. *What was the level of communication between different groups (e.g. scientist, community) within the ICM programme?*
10. *In what ways was monitoring utilised within the research projects of the ICM programme?*
11. *Did any form of technical innovation occur as a result of the ICM programme? (If yes) what role did information sharing and collaboration play in supporting this kind of technical innovation?*

C. Policy implementation

1. *How was the information you developed utilised and by whom?*
2. *Did you view the role of your research as one to influence policy, or to simply research and increase knowledge on the issue?*
3. *The ICM programme produced a large quantity of published scientific articles, did this wide range of published material have any impact outside of the scientific community?*

Interview questions for community reference group members.

Please do not state individuals' names in your answers, instead describe the profession or activity of the person involved and/or the organisation they are associated with (e.g. dairy farmer, local fisherman, Landcare scientist).

Please write your answer below the numbered question, feel free to write as much as you think is necessary.

A. General questions

- 1. Tell me about your role within the Motueka ICM programme? (Position, responsibilities, length of involvement)?*
- 2. What does integrated catchment management mean to you?*
- 3. What brought about the establishment of the ICM programme?*
- 4. What did you see as the aims and objectives of the ICM programme? Who were the drivers of the ICM programme?*
- 5. Who did you work with most closely?*
- 6. What were your original thoughts about the ICM programme and did this view change over time? If so, how?*
- 7. What do you view as the most positive outcome of the ICM programme?*

B. Boundary organisations

- 1. How would you describe the role of Landcare in the ICM programme?*
- 2. Was the information created by Landcare Research useful, if so how?*
- 3. Do you think Landcare Research facilitated communication between scientists and policymakers?*

4. *Were any tools used to promote information sharing and collaboration (e.g. models, exercises, maps, workshops)?*
5. *(If yes) Who developed these tools and how were they used?*
6. *As a local community stakeholder, were you involved in creating or providing input to these tools?*
7. *What kind of access did your community group have to the information created by the ICM programme?*
8. *What was the level of communication between different groups (e.g. scientist, community) within the ICM programme?*
9. *What role did monitoring play within the ICM programme?*

C. Policy implementation

1. *Do you think the Tasman Council used the information and outputs created by the ICM programme to the best advantage?*
2. *Did you observe any improvements in the services provided by the Tasman Council which can be attributed to the ICM programme?*

Interview questions for policy analysts involved in the Motueka ICM Programme

Please do not state individuals' names in your answers, instead describe the profession or activity of the person involved and/or the organisation they are associated with (e.g. dairy farmer, local fisherman, Landcare scientist).

Please write your answer below the numbered question, feel free to write as much as you think is necessary.

A. General questions

- 1. Please state your current professional position and how long you have been working in this industry?*
- 2. Tell me about your role within the Motueka ICM programme? (Position, responsibilities, length of involvement)?*
- 3. What does integrated catchment management mean to you?*
- 4. What issues instigated the establishment of the ICM programme?*
- 5. What were the aims and objectives of the ICM programme? Who was involved and who were the drivers of the ICM programme?*
- 6. Who did you work with most closely?*
- 7. What were your original thoughts about the ICM programme and did this view change over time? If so, how?*
- 8. What do you view as the most positive outcome of the ICM programme?*

B. Boundary organisations

- 1. How would you describe the role of Landcare Research in the ICM programme?*
- 2. How do you view the relationship between science and policy within ICM?*
- 3. Did the ICM programme affect your view on this relationship?*
- 4. What tools were used to promote information sharing and collaboration (e.g. models, exercises, maps)?*
- 5. Who developed these tools and how were they used?*
- 6. Were stakeholders involved in creating and implementing these tools?*
- 7. Was the information created by the ICM available to be used by different groups (e.g. councils, communities groups, academic journals)?*

8. *What was the level of communication between different groups (e.g. scientist, community, council) within the ICM programme?*

C. Policy implementation

1. *Did the scientific information produced out of the ICM programme influence any policy or plans at a local, regional or national level? (if yes, name the policy/plan)*
2. *Was the scientific information presented in such a way that it could be easily implemented into policy?*
3. *As an information user do you think your policies represented the data created by the information providers who took part in the Motueka ICM programme?*
4. *Has your experience with the ICM programme affected how you now produce policy?*
5. *How do you see your objectives in ICM differing from those of scientists?*