OFFSET BANKING IN NEW ZEALAND

Towards sustainable development, with insight from international models

A thesis submitted in partial fulfillment of the requirements for the Degree of Master of Forestry Science

JEMMA P S S DENNY

New Zealand School of Forestry

University of Canterbury

June 2011

CONTENTS

LIST OF TABLES

LIST OF FIGURES AND BOXES

ACKNOWLEDGEMENTS

I wish to extend sincere gratitude to those who have helped me achieve the work compiled here.

In particular, financial support from the Pukehou Poutu Scholarship, the Resource Management Law Association, Meridian Energy, the McKelvey Fund, The New Zealand Federation of Graduate Women Canterbury Brach (especially Judith for her continued support despite shaken ground) and the National Mitigation Banking Association USA.

To David Norton of the New Zealand School of Forestry, I greatly valued working with someone who could provide the questioning and contesting that helped me better rise to the challenges this research entailed. I extend heartfelt thanks for his supervision, academic support and continued commitment especially though the personally and professionally trying times of the 2011 Christchurch earthquakes.

I would like to thank all those in New Zealand, Australia and across the United States who kindly agreed to be to be interviewed for my research. All those listed in the appended interviewee list shared their valuable time, insight and experience. Particular acknowledgement is due to Scott Hickie and Derek Seller in New South Wales; Sherry Teresa, Craig Denisoff, Travis Hemmen and Christopher Theriot in the United States, for allowing me to follow up their contributions via email and further discussion after initial interviews. All gave their time and support generously and made invaluable contributions by doing so.

Marie Brown, Jessica Rese and Craig Denisoff all deserve particular acknowledgement for the generous time they took to review and comment on my drafts. Each of their unique perspectives have helped me better express my research and become a better writer, and for this selfless support I am extremely grateful.

Personally, the support of my friends and family deserves distinct acknowledgement. In particular my dear husband Isaac for his patience and selfless personal support of the requirements this research placed on both him and myself. Finally, without the backing of Mr Wayne White this thesis and my career would not have been possible. His enthusiasm, belief and continued dedication to my research enabled me to extend this research to the level I demonstrate in the work that follows.

ABSTRACT

Biodiversity loss is an important issue for New Zealand: for the domestic environment, economy and society, but also for New Zealand as a member of the international community. Biodiversity offset banking is making an important contribution to addressing such issues in a number of countries around the world. Developing the ability to participate and take advantage of possible benefits requires comprehensively understanding both the fundamental principles and varying concepts, and supports the analysis necessary for New Zealand to progress towards offset banking. New Zealand can learn much from observing and investigating overseas models and use them as valuable templates. California and New South Wales provide examples of potential policies and frameworks (both economic and social) to establish and operate successful offset banking systems.

Discussions of offset banking, both in theory and practice, frequently concern the potential failings of the system. These issues can be conceptualised as various forms of risk. Considering offset banking as sustainable development, this thesis addresses such risks to reflect the tripartite biological, financial and social framework of sustainable development. Biologically, risk is in the potential biodiversity outcomes are inadequate, unexpected or undesirable. Scientific uncertainty underlies this, both inherently and from the limits of current scientific disciplines. Through expanding scientific knowledge and experience, measures for reducing or accommodating the risk of uncertainty are emerging. Financial risk represents concerns that individual banks may lack the monetary support to achieve the specific biodiversity conservation required for the site. Also the system of interacting banks, bankers and traders may fail to produce financial outcomes that support effective and efficient biodiversity conservation over the breath of the scheme. Social risk lies in the potential that societies' individuals conduct themselves in ways that conflict with achieving biodiversity conservation through malfeasance or negligence. Additionally, there is social risk that an offset banking system fails to respond appropriately to broader society and human, such as equity and intergenerational justice.

Here, deliberating these risks is primary to appreciating how design elements and emergent properties minimize risks. Given comprehensive understanding, components of a system can be designed and allow informed policy, regulations and rules to offer successful risk mitigation. For this reason policy, rules and regulations observed within California and New South Wales helps to discuss this and establish guidance for New Zealand offset banking design to draw upon. Californian systems are achieving promising conservation and continued growth; New South Wales' Biobanking scheme is robustly designed and in its early stages. Each contrasts in design and carries varying criticisms. California has been observed as potentially shortcoming biologically, whereas New South Wales Biobanking has been questioned based on the strength and character of its economic underpinnings.

In addition to these considerations, New Zealand has significant societal perspectives to incorporate given current popular, socio-democratic conservation modus operandi.

Identifying the three forms of risk present highlights the importance of allocating appropriate consideration and expertise to the biological, economic and social components of offset banking. Successful sustainable development, biodiversity conservation and risk mitigation may be achieved through designing mechanisms, regulations and governing policy for offset banking. New Zealand may therefore expand the success and application of current offsetting by taking guidance from examples and analysis presented here.

Key words: Biodiversity conservation, New Zealand, Biobanking, Biodiversity offset, offset banking, credit trading, risk management, biological risk, financial risk, social risk, sustainable development, environmental policy.

CHAPTER ONE

INTRODUCTION

1.0 Environmental conservation: the challenge of the 21st century.

Biodiversity is declining in virtually ever region of the world at a rate previously un-encountered (Sala et al., 2000; Chapin III et al., 2000; Bishop et al., 2010). Exponential population growth, economic and technological advancement, and other aspects of global environmental change are driving extensive *habitat* loss, which is recognised as a primary cause of biodiversity decline (Lister 1997; Geneletti 2003; Glennon and Porter 2007; Polasky et al., 2008). The consequences predicted from this are uncertain, but potentially catastrophic. A range of issues for human societies are predicted, as changes in the resources and *services* provided by natural *ecosystems* result from a reduction in the biodiversity which supports essential functions and processes. Issues predicted include incapacity for water purification and control of pest species populations, inadequate provision of food, shelter or fuel, and altered climate regulation increasing fire frequency and greater temperature extremes (Chapin III 2000; O'Riordan and Stol-Kleenmann 2002). The economic impacts from these issues such as crop failure, and social issues such as increases in poverty and geographic and cultural displacement, are an equally pressing cause for concern (Ki-Moon, 2010; Sukhdev 2010). This situation has begun to galvanise the prioritisation of biodiversity decline by individuals and communities alike, across regions, nations and international bodies (Costanza et al., 1997; Agius 2001; Hooper et al., 2005; Knight 2005; Hillman and Instone 2010; Bishop et al., 2010). Addressing biodiversity decline and averting predicted negative impacts requires concerted action by all countries, from national and international perspectives, New Zealand being no exception (NZBS 2000; MfE 2007).

Opinions differ within and between nations regarding the best solutions to pursue (Mebratu 1998; Statistics New Zealand 2009). Some consider that continued growth and progress of nations and societies should be maintained as a priority, accepting biodiversity decline as an unfortunate consequence (Housman 1992; Lehmann 1995; Mebratu 1998; Lloyd 2007). Alternative perspectives assert the prioritisation of biodiversity and environmental issues for reasons intrinsic, life supporting or philosophical, or as an irreplaceable resource base (Dobson 1999; ten Kate, Bishop and Bayon 2004; Ekins, Hillman and Hutchison 1992a,b; Mebratu 1998). The growing majority within this spectrum acknowledge neither approach can be expected to dominant in the foreseeable future, so solutions integrating these perspectives are urgently required (Barrow 1995; Dobson 1999; ten Kate 2003, 2003a; Bishop and Bayon 2004; Daly and Farley, 2004; Ginn 2005; Moran and Ostrom 2005; Lloyd 2007; Engleman 2009). *Offsetting* is a mechanism proposed for improved environmental conservation; *offset banking* is one approach developing within this (Crowe and ten Kate 2010).

As a discussion of offset banking, this thesis is based on two underlying assumptions:

Some arguments favour unrestricted development and resource consumption; others the immediate protection, preservation or restoration of the world's remaining natural ecosystems, yet neither is expected to supersede the other within the foreseeable future.

The supporters and critics of these competing arguments preclude this as universally supported assumption; existence of illegal, subversive or counter-productive behaviour besetting other compromised-based human systems stimulate debate of the balance of benefits of offsetting compared to such potential sources of failure (Anton, Fisk and Holstrom 2000; Lawton 2007; Burgin 2008; Walker et al., 2009). Discussion in the following chapters addresses the importance of this debate but as secondarily important to the potential opportunities within such an evolutionary and dynamically responsive system (Bekessy et al., 2010).

The second assumption is therefore taken that:

Potential misapplication, malfeasance, misuse should not detract from the merit of investigation and endeavour in itself.

1.1 Environmental compensation, offsetting and offset banking

The evolution of environmental *compensation* has given rise to the development of biodiversity offsetting (ten Kate 2003; ten Kate, Bishop and Bayon 2004; Ginn 2005; Foxall, Grigg and ten Kate, 2005; Burgin 2008; Bayon, Carroll and Fox 2008; BBOP 2009c; Kiesecker et al., 2009a; Hillman and Instone 2010).

"The chief purpose and benefit of environmental compensation is to maintain environmental capital against depletion by cumulative developments that pass through the net of environmental planning regulations. Environmental compensation is directly related to the harm done in each case."

Memon and Skelton (2004) p. 179

The term biodiversity offset broadly refers to actions with the purpose of addressing overall biodiversity loss caused by development activities (ten Kate, Bishop and Bayon 2004; Memon and Skelton 2004; Ginn 2005; Burgin 2008; BBOP 2009c; PCoE 2010). When required, project proponents predict negative biodiversity impacts and undertaking actions to specifically compensate or offset[1] this consequential, unavoidable damage. This typically involves conservation through preservation, restoration or *creation* of another area of biodiversity value, frequently after the project has been implemented (Burgin 2008; Mead 2008; BBOP 2009d). In best practice, offsets are not viewed as reducing environmental damage, but instead as a mechanism of adjusting the final net effect of the proposal on biodiversity and the environment to produce a neutral or positive conservation outcome (DEWR 2007; Counsell, Evans and Mellsop 2010).

Examples of offsetting attempts to date have not universally produced neutral or positive environmental outcomes, or adequately accounted for residual impacts (Redmond et al., 1996; Goldman-Carter and McCallie 1996; Brown and Lant, 1999; Robertson and Hayden, 2008; Mead 2008; Fleischer and Fox 2008; Bekessy et al., 2010; Hillman and Instone 2010). Within the United States, where some of the first offsetting was established, several studies have reviewed the process and concluded that in many instances, biodiversity loss has failed to be adequately offset through lack of implementation or unsuccessful conservation actions, among other reasons. Offsetting therefore does not offer guaranteed outcomes, making it extremely challenging to effectively address negative development impacts and produce truly neutral or positive net outcomes (De Weese 1994; Lawhead 1997; Brown and Lant, 1999; Robertson and Hayden 2008; Fleischer and Fox 2008; Walker et al., 2009; Bekessy et al., 2010).

Offset banking has been developed to offer specific improvements in biodiversity offsetting outcomes, as one option under offsetting, and the broader environmental conservation umbrella (Marsh 1996*;*

1 "

2 Note also principle 16 from the Rio Declaration (1992) which states that: "National Authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the costs of pollution, with due regard to the public interest and without distorting

Heal 2000; Nelson and Sharman 2007; Mead 2008; Robertson and Hayden, 2008; Carroll Fox, and Bayon 2008; USFWS 2009; Hillman and Instone 2010; eftec IEEP et al., 2010). Developed from earlier offsetting programs, offset banking is an alternative path to address residual development impacts, potentially increasing implementation capacity and to satisfy offset objectives prior to impacts occurring (Lawhead 1997; Carroll, Fox and Bayon 2008; Hartig and Drechsler 2009; USFWS 2009; Bekessy et al., 2010). Under proper design, benefits of offset banking include facilitating the protection of existing biodiversity values, creating an economical and practical framework for biodiversity restoration and recreation, and offering pre-emptive as opposed to reactionary impact *mitigation* for development projects (Hallwood 2007; Bekessy et al., 2010; Crowe and ten Kate 2010). A range of contextually-specific offset mechanisms will continue to significantly contribute to biodiversity conservation, with offset banking supplementing this range, offering additional and complementary benefits (Heal 2000; Carroll, Fox and Bayon 2008; Hartig and Drechsler 2009; USFWS 2009; Bekessy et al., 2010; eftec, IEEP et al., 2010).

1.2 New Zealand's conservation context

New Zealand has unique and vulnerable indigenous biodiversity (MfE 2007, 2007 a; Statistics New Zealand 2009). Maintaining New Zealand's biodiversity is recognised as an important component of achieving sustainable development:

> "Biodiversity contributes essential products and services to human welfare and provides environmental and economic resilience. Maintaining biodiversity helps sustain the natural ecological processes on which life depends. It also underpins industries such as tourism and fishing. New Zealand has a large number of species that are found naturally only in this country, and is therefore a significant contributor to global biodiversity." Statistics New Zealand (2009) p. 21

Sadly, this flora and fauna has experienced extensive destruction with extinction of more than 31% of vertebrate fauna, and one of the highest rates of threatened species in the world (MfE 2007b). Over 63% of native vegetation cover has been removed, only 10% of wetland areas remain, and more than 1000 species are declining or threatened with extinction (MfE 2007; NZBS 2000; Hitchmough, Bull and Cormarty 2005). At least eight unique ecosystems are also under extinction threat, while a quarter of the land area has been cleared by more than 90%, contributing to the loss of several native ecosystems (NZBS 2000; MfE 2007).

"It is estimated that New Zealand has at least 80,000 native species. However deforestation, over-harvesting, habitat destruction, pollution, and the introduction of exotic animals and plants threaten the survival of many native species. Between 2002 and 2005, the threat status worsened for 40 species and improved for only five. Of these 40 threatened species, 5 were previously classified as 'not threatened'. In addition to these 40, seven were confirmed as extinct, although actual extinction may have occurred many years ago (see figure 2a). In 2005, New Zealand listed 2,788 native species and other taxonomic units (groups of organisms) as threatened (see figure 2b), up from 2,372 in 2002."

p. 22, Statistics New Zealand (2009)

Awareness and appreciation for environmental conservation is substantial in New Zealand society. An extensive system of government-protected areas has been established. Approximately 30% of New Zealand's land mass is conserved for its environmental values and biodiversity (Memon and Skelton 2004; Walker, Price and Stephenson 2008; MfE 2007). Despite a proud record of active environmentalism in society, extant flora and fauna continue to suffer from direct and indirect human impacts and numerous species require intensive management to remain above the extinction threshold (Atkinson and Cameron 1993; MfE 2007). Conservation of remaining values is therefore a high priority for New Zealanders (Walker et al., 2008; MfE 2007; Statistics New Zealand 2009).

New Zealand's island geography means it is heavily impacted by invasive pest species (Atkinson and Cameron 1993; Stephens 1999). The isolated, evolutionary history of New Zealand's biota has produced a number of species particularly vulnerable to the impacts of invasive species (NZBS, 2000; Norton 2009; MfE 2007a). Modern patterns of international human movement, and the significant roles of international trade and tourism in New Zealand are significant contributing factors and consequently the impact of invasive species is one of the most pressing conservation issues (Stephens 1999; MfE 2007a,b;). Current technology means that invasive species management makes conservation in New Zealand necessarily intensive and on going (Norton 2009).

1.3 The current situation: a role for biodiversity offsets

Despite notable achievements, current conservation frameworks remain inadequate (Walker et al., 2006; Walker, Price and Stephenson 2008; PCE 2010b). Productive/lowland ecosystems are poorly represented in the Public Conservation Estate, are in particular demand for agriculture and farming and predicted to be increasingly important for public infrastructure and housing in the future (MfE n.d.a; Memon and Skelton 2004; MfE 2007a). Significant biodiversity values are, sometimes exclusively found in lowland regions, predominantly in private ownership on valuable agricultural land and creating a significant gap in current protection and management (MfE 2001; Memon and Skelton 2004; PCoE 2010; Walker Price and Stephens 2008).

In recent years, large-scale development projects have received a society profile via popular media exposure, as groups concerned about the resulting environmental impacts contest decisions (Hinchey and Hogg 2009; Christensen 2010). Equally, New Zealand must also continue to make decisions to support development required by a robust economy for the growing populations (Statistics New Zealand 2009). Such development must also respond to the increasing pressures of climate change, necessitating novel renewable energy alternatives (Statistics New Zealand 2009). Considerable project delays have been caused by lengthy environment court proceedings, absorbing significant time and money resources. Such inefficiencies drive the impetus for change and improvement in New Zealand's biodiversity conservation today.

New Zealand has shown a dichotomous approach to land-use and environmental conservation to date, which has shaped societal attitudes towards biodiversity and the environment. Conservation has primarily occurred under government control, on public land reserved exclusively for that purpose. Private land has remained dedicated to consumptive, productive and economical uses, with prioritisation of the rights of the private property owner (Meuk and Swaffield 2000). Such noticeable division between the consumptive resource use and its *preservation* and conservation is expressed in the NZBS (2000), with biodiversity management divided into three discrete categories: resource management, conservation management and bio-security management.

Given this context, opinion is divided over future conservation policy. Drawing on various social concerns, strong support exists for increased government funding of conservation programs and extending the public conservation estate; such government provision being the most desirable (or only) option for biodiversity conservation (Walker et al., 2009). Supporters of this position question the feasibility and integrity of conservation activities by private, commercial entities. This potential antipathy is observed in a number of other countries and regions internationally (ten Kate, 2004). An alternative view is that private individuals and corporate entities should be more involved in conservation activities on public and private land and be able to generate profit to sustain biodiversity conservation. Undesirable corporate examples of misuse and damage notwithstanding, successful, exemplary conservation and mitigation efforts are increasingly being demonstrated in New Zealand and internationally, showing significant potential for growth given an accommodating environment (BBOP, 2009h; Norton 2009; Crowe and ten Kate 2010; Madsen, Carroll and Moore Brands 2010).

1.4 New Zealand's international considerations

New Zealand's biodiversity conservation is domestically significant, yet it is also increasingly important New Zealand responds to mounting international recognition of the global threat of biodiversity, driving pressure towards improved standards and best practices for biodiversity conservation within the international community (MEA 2003; Foxall, Grigg, ten Kate 2005; Bol'shakov, Lushchekina and Neronov, 2009; PwC 2010). New Zealand has been involved in several international initiatives on biodiversity conservation, originally through the Rio Earth Conference (1992), which formally established biodiversity's importance and contribution to humanity and life on earth, and resulted in the Convention on Biological Diversity (CBD), June 1992 (CBD 1992; eftec IEEP et al., 2010; see also Costanza et al., 1997; MEA 2003). This international agreement came into force on the 29th of December 2003, with New Zealand ratifying the agreement on the 16th of September that same year. New Zealand joins with other nation-states ("Contracting parties") in recognising:

"… the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components… also of the importance of biological diversity for evolution and for maintaining life sustaining systems of the biosphere…that the conservation of biological diversity is a common concern of humankind…that States are responsible for conserving their biological diversity and for using their biological resources in a sustainable manner…that is vital to anticipate, prevent an attack the causes of significant reduction or loss of biological diversity at source…that the fundamental requirement for the conservation of biological diversity is the *in-situ* conservation of ecosystem and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings… determined to conserve and sustainably use biological diversity for the benefit of present and future generations..” p. 2 CBD, (1992)

As signatory and party to the convention, New Zealand is bound to address the issues of biodiversity loss, recognise social, biological and economic components, and require sustainable use and protection (ten Kate 2003a; Foxall, Grigg and ten Kate, 2005; Burgin 2008; BBOP 2009b; Walker, Price and Stephenson 2008; Bol'shakov, Lushchekina and Neronov, 2009). The Articles stipulate the approaches necessary for achieving the Convention's ideals, specifically: requirements at an organisational and governance level, improving information and monitoring of biodiversity stocks, and appropriate processes of conserving these stocks. New Zealand is expected to have mechanisms to protect existing values while also increasing areas of protection. Of particular relevance when considering offset banking, Article 11 specifies parties must[2]:

"… adopt ***economically*** and socially sound measures that act as ***incentives*** for the conservation [of biodiversity]." p. 9 CBD (1992) *emphasis added*

Article 14 requires the use of Impact Assessments to facilitate identification and consequential minimisation of adverse impacts from development projects. New Zealand law requires impact assessments under the Resource Management Act (RMA)(1991). The Convention's articles address the financial support for biodiversity conservation, recognising that poverty and economic constraints represent a major impediment to environmental sustainability and conservation globally. While New Zealand does not have poverty and economic inequalities comparative on an international level, these provisions emphasise the pivotal influence of the underlying economic context. The NZBS (2000) highlighted the economic importance of biodiversity to the New Zealand economy, estimating that New Zealand's biodiversity may be worth more than double the national gross domestic product (GDP)[3] and reiterating biodiversity's significant value and the economic relevance of conservation in New Zealand (NZBS 2000; Statistics New Zealand 2009 *c.f.* Costanza et al., 1997).

2 Note also principle 16 from the Rio Declaration (1992) which states that: "National Authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the costs of pollution, with due regard to the public interest and without distorting international trade and investment." Page 35, eftec, IEEP et al., 2010

3 In 1994, the GDP was calculated at NZ$84 billion, with the total value of national biodiversity for that year estimated at NZ$230 billion. NZBS 2000

Signatories to The Convention are bound to meetings (Conference of the Parties - COP) and to report progress in achieving compliance with the Articles. New Zealand has met many aspects of these requirements, particularly in comparison to some developing countries. However, The Convention includes additional expectations and formally establishes New Zealand's biodiversity conservation obligations in the international political context. New Zealand's strategies and policies for biodiversity conservation must be established with consideration for both international and domestic concerns and associated political, social and environmental perspectives. It is firmly within New Zealand's best interests for international relations and reputation to uphold the obligations. Future conservation is predicted to become increasingly challenging, involving novel, unexpected and unpredicted pressures, so an offset banking system potentially has a role to aid meeting New Zealand's obligations under the CBD, making active consideration and evaluation of offset banking relevant and timely (Crowe and ten Kate 2010).

1.5 Progress under the CBD

The New Zealand Biodiversity Strategy (NZBS) was produced in 2000 in order to fulfil part of New Zealand's requirements under The Convention on Biological Diversity. It established goals for the protection and preservation of national biodiversity, identified a range of actions required to reverse biodiversity loss nationally, and promoted sustainable use outside protected areas (MfE 2007). The third of its four primary goals[4] addressed the need to conserve indigenous biological diversity within a comprehensive, representative range of New Zealand's habitats and alongside sustained and fully functioning ecosystems.

The NZBS, as a non-statuary document, lacks strength to meaningfully contribute to conservation in New Zealand (Walker, Price and Stephenson 2008). It lacks clear or specific targets and specifies few measureable criteria to assess whether the range of intended outcomes have been reached. While many of the goals and ideas compiled within the NZBS certainly direct New Zealand conservation towards admirable outcomes, this has been seen as amoung the only contribution it makes to the issues.

4 As specified in the NZBS (2000)

The CBD stipulates requirements for progress reporting, which the Third National Report on New Zealand and The Convention of Biological Diversity (2007) was produced to satisfy. The NZBS constitutes a significant basis of this report (MfE 2007). The report details a number of goals and targets that New Zealand has not yet reached [5]. Given these shortcomings, there is room for improvement in New Zealand's efforts to satisfy The Convention.

The 2007 MfE report discusses achievements in meeting requirements such as national-level targets, indicators, processes and frameworks legislatively supported for achieving and sustaining conservation on public conservation land managed by the Department of Conservation. However, when concerning values on private land, the report highlights areas where values are not currently adequately protected under current frameworks[6]. It also fails to provide details of a commensurate level of protection and provision relating to private lands when comparing frameworks applicable to those held under the public conservation estate.

Requirements under The Convention and subsequent COPs include evidence of increases in the role of financial incentives to expand private involvement, and implementation of legislation for the development of market and non-market forces. The minimal description of these aspects within the report highlights gaps in meeting such requirements. It is in light of this that offsetting and offset banking requires closer consideration. Economic structures and financial incentives emphasised by the CBD will be of particularly importance in New Zealand, where, as the Report's government-appointed author observes:

> "The size of the problem is far greater than the small NZ economy and population can afford"
>
> p. 171, MfE (2007)

The report states that government funding is the only financial support for The Convention currently available, that implementing market-based subsidies is not supported under New Zealand's existing

5 For example, note goal 11, target 2, target 4 as stated in the Report (2007).

6 For example, the report notes some difficulty adequately and appropriately accessing conservation on private land, such as Important Plant Areas identified in relation to national aims under Target 4 and the protection of 50% of the most important plant areas.

policies, and improved spending efficiency and technological advancements are preferred solutions (MfE 2007). Offset banking is particularly important to discuss given this context, as a *market-based mechanism* to diversify sources of finance for conservation by directing currently under-accessed revenue from the private development sector, and the potential for increased efficiency (Crowe and ten Kate 2010) (see Chapter 2 Section 2.1.4).

1.6 Biodiversity conservation and offsetting in New Zealand: current room for improvement

The Resource Management Act (RMA)(1991) is New Zealand's primary legislation protecting a diversity of environmental values that development on private land may impact and is New Zealand's most market-based mechanism available for biodiversity conservation (Jackson and Dickson 2007; Counsell, Evans and Mellsop 2010[7]). Under this framework, consent-based offsets have occurred, as well as voluntary offsets independent of RMA consent requirements (BBOP 2009c; Norton 2009). There is a range of accompanying commentary, within New Zealand and internationally, suggesting that some aspects of current process and offset examples are unsatisfactory and require significant improvement and highlight potential issues and concerns requiring improved approaches (BBOP 2009c; Christensen and Burge 2010). Offset banking can contribute potential solutions to improve offsetting capabilities, advancing sustainable development by effectively mitigating negative development and economic impacts, and achieving important biodiversity conservation goals.

1.7 The future of conservation in New Zealand

The context for New Zealand conservation presented in 21st century is one of unexperienced, rapid change. A competitive, fluctuating global economy underpinned by shifting international balances of power together with the urgency and pressures of global climate change create novel and significant challenges for New Zealand. Increasingly sustainable solutions are required to provide for a growing population (Statistics New Zealand 2009). Success requires innovation and pragmatism (Gunningham and Young 1997). It is becoming increasingly perilous to allow conservation and economy to compete for the limited resources they currently do. The partisan attitude of last century's conservation efforts may require adjustment to a more synergistic approach of sustainable development (Meurk and

7 See also Brian Eastons' 1998 analysis (Counsell, Evans and Mellsop 2010)

Swaffield 2000). The shift in attitudes likely required, is a considerable hurdle for New Zealand society. Nevertheless, such shifts are essential to adopt new approaches presented, and to continue to respond to the pressures of both conservation and the wider economic environment, domestically and internationally.

As signatories to the CBD, New Zealand is well-advised to follow international directions in focusing on the necessity and relevance of engaging commercial sectors in biodiversity conservation[8], and addressing how the role of market incentives and financial mechanisms are increasingly adopted as being vital to environmental conservation on the international stage (Gunningham and Young 1997; Bishop et al., 2010). The business and economic issues resulting from continued biodiversity loss are of increasing international concern, with documents such as the TEEB (Bishop et al., 2010), and increasing business and media commentary, emphasising the importance of meeting biodiversity challenges and seriousness of the negative implications that are likely in the absence of action (Bishop et al., 2010; Anderson 2010; a; b). Continued access and power in trade, diplomatic relations, and New Zealand's international reputation as a modern, forward moving country are pivotal to the geographically distant and export-driven economy. In the 21st century this must be given proper prioritisation against domestic concerns for biodiversity conservation and investigate developing an offset banking system in this context.

1.8 Thesis outline

This thesis firstly describes the processes and principles by which an offset banking system operates. By exploring offset banking systems in New South Wales, Australia and California, United States of America, I take these as valuable exemplars supporting the discussion of how optimal system design may occur in New Zealand. Observations, analysis and critiques of these examples alongside evaluation and consideration of the current discussion within academic literature provide valuable guidance and direction for approaches and mechanisms appropriate for a New Zealand scheme (Darbi et al., 2009; Crowe and ten Kate 2010). Adopting a system of offset banking requires design of economic mechanisms, implemented through policy and regulation (Crowe and ten Kate 2010). It represents a

8 Decision VIII/17, adopted March 2008 by COP8

system of sustainable development and economic market-based trading, so appropriate capacity and understanding of these concepts is essential and is highlighted in Chapter Two.

The process of designing policy and regulation represents a system of risk mitigation, with successful outcomes being a result of adequately mitigating and balancing risk: both risk of biodiversity loss that offset banking intends to address, and also risks that manifest from the sustainable development and economic approaches involved. Chapters 4, 5 and 6 discuss the distinct yet interdependent risks posed by biological systems, finance and economics, and the role of human involvement.

The incorporation of these components - sustainable development, economic market mechanisms and risk mitigation - informs the process of offset banking design in New Zealand. Chapter 7 summarises the necessary requirements to enable New Zealand to take these directives and apply them to the development and implementation of an offset banking system.

CHAPTER TWO
SUSTAINABLE DEVELOPMENT AND THE ROLE OF ECONOMICS

An international consensus is establishing around the importance and urgency of environmental and biodiversity issues, yet the optimal solutions are a source of active debate which sustainable development intends to resolve (Mebratu 1998; Dobson 1999; Harding 2006). Policy and regulation are required to support offset banking (Crowe and ten Kate 2011). Representative of modern environmental management broadly, offset banking occurs within the sustainable development paradigm so must be designed based on comprehensively understanding and adopting sustainable development principles (Saeed 2004; Hickie 2010; Nelson and Stenman 2007 Hanson 1995; Veld and Kraan 1991; Elliot 2009; Martin and ver Beek 2006). The application of economic theory and principles is also an inextricable component of *credit* trading under offset banking policy and so a firm foundation of accurate economic knowledge and understanding is necessary:

"Habitat banking is entirely a product of the *regulations* that establish it, and hence the instrument design … and all other factors discussed above can be determined through analysis of optimal ecological and *economic* design."
p. 94 eftec, IEEP et al., (2010) *emphasis added*

In this Chapter, I summarise theories and concepts relevant to establishing appropriate and informed the policy and regulation required to operate offset banking. While a system of free-market trading, regulation and policy are essential for successful implementation and this requires expert application of the economic and sustainable development concepts reviewed in this chapter.

2.0 Sustainable development

The term sustainable development most popularly originates from the Bruntland Report (*Our Common Future* by the World Commission on Environment and Development 1987: 43, Barrow 1995; Mebratu 1998; Jacobs 1999; Harding 2006; Elliot 2009) that defines sustainable development:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." p 67

This represented a formal recognition that economic systems and their growth must operate within due regard to considerations of the environment, in order to maintain both the economy and the environment itself, but also human welfare, in a sustainable manner that would provide for the future. Over the concept's development, a variety of interpretations have been taken across academic disciplines, social debates and national and international contexts driven by alternate focuses on the three aspects - economy, environment and society - and how to both define, implement and achieve sustainable development outcomes (Dobson 1999; Jacobs 1999). Sustainable development represents an approach to address both the pressures of exponential population growth, and environmental and biodiversity degradation to prevent potentially negative future outcomes (Barrow 1995; Rodgers 1996; ten Kate 2003a; Daly and Farley 2004; Lloyd 2007). The popularised term has come to be represented as a goal, rather than as a process, whereby the resources of the natural, biophysical world are utilised in a manner not jeopardising their productive capacity into the future (Redclift 1992; Barrow 1995; Gilpin 2000; Elliot 2009).

Sustainability recognises that some patterns of use irreversibly deplete resources, reducing their capacity to provide goods and services long term. Long-term provision is possible when resources are used sustainably; the inherent capacity for self-renewal and regeneration that characterises these resources is not compromised by current patterns of use (Redclift 1992; Barrow 1995; Gilpin 2000; Lee 2001). Analogies are drawn with interest and capital:

> "Sustainable yield means living off the interest, rather than the capital or stock of a resource."
> p 90, Gilpin 2000.

The World Bank's Environmentally Sustainable Development (ESD) Triangle[9] depicts the interwoven relationship social, economic and ecological systems (Gilpin 2000; Elliot 2009 *see also* Barrow 1995 ten Kate 2003a; Ten Kate, Bishop and Bayon 2004). These three systems must be considered together to achieve sustainability goals; each must achieve satisfactory individual functioning, but it is equally and vitally important that interactions and interdependencies between the systems are prioritised and maintained (Elliot 2009). Success or failure of one system in isolation jeopardises overall success so policy must respond to the need to balance all three (Harding 2006). Biodiversity offsetting and banking is a prime example of sustainable development: offset banking provides

[9] Note also the definition of sustainable development that sees these three aspects as nested/concentric circles, the largest being the environment, then the social, then in the smallest centre, the economic (e.g. Mebratu 1998; Statistics New Zealand 2009)

perpetual protection and promotion of *biodiversity resources* along with income and occupation for current land-holders, without reducing potential benefits from development projects at the present time, (Rodgers 1996; Morris et al., 2006; Kiesecker et al., 2009a; Walker et al., 2009).

Recognising links between the economy and society, and society and the environment, has been established in many disciplines for some time. Equal recognition of the links between environment and economy has been more recent and continues to develop; society's unease in this integration is a familiar process as new ideas emerge (Ekins 1993; Gilpin 2000). As a result, trade-offs which sustainable balance requires are not unequivocally endorsed, stemming from conflicting perspectives on sustainable development principles. How necessary such tradeoffs are underlies debates over proffered benefits (Redclift 1992; Mebratu 1998; Dobson 1999). Sustainable development's critics fundamentally question environmental tradeoffs, generating of much of the broader resistance to offsetting.

Without embracing sustainable development, successful adoption of offset banking is unlikely and therefore discussions must include consideration of sustainable development as requisite. Arguably, sustainable development has emerged tamely in New Zealand government policy, so the necessity of understanding and embracing principles of sustainable development is a particularly relevant precursor to discussing adopting offset banking in New Zealand (Statistics New Zealand 2009; PCE 2010b; Browning 2011). Harding (2006) summaries the requirements of policy and institutions for sustainable development:

> "Beyond these structural arrangements, economic and regulatory drivers also need to facilitate decisions in favour of sustainability outcomes. The right price needs to be paid for scarce natural resources, but with recognition of and means to treat, possible equity issues."
>
> P. 235 Harding (2006)

2.0.1 Ecological modernisation and sustainable development

Discussions regarding policy, regulation, the role of government and the achievement of sustainable development have been described by Ecological Modernisation Theory (Mol and Sonnenfeld 2000; Fisher and Freudenburg 2001), borne from the social and political awakening to environmental issues developed during the 1970s (Barrow 1995; Mol and Sonnenfeld 2000; Fudge and Rowe 2001).

Several instrumental international documents recognised the increasingly significant contribution and limitations of the biosphere. Publications such as The Bruntland Report, *Our Common Future* (1987) and the World Conservation Strategy (IUCN, UNEP and WWF 1980), along with outcomes from the 1992 United Nations Conference on Environment and Development (UNCED) helped to establish sustainable development and environmentally-responsible governance at the local, regional and national level (Barrow 1995; Mol and Sonnenfeld 2000; Fudge and Rowe 2001; Elliot 2009; eftec, IEEP et al., 2010; Hickie 2010). In describing The Brandt Report (1980) Barrow (1995) succinctly encompasses the importance of the combination between economics and the environment:

> "[The Brant Report was] … calling for a 'new, holistic ethic in which economic growth and environmental protection go hand-in-hand.' That may be one of the most crucial calls made in the twentieth century." p 66 Barrow (1995)

In parallel, Ecological Modernisation Theory concerns how societies, having expanded industrially and economically, inevitably recognise environment limitations. This may result in dramatic social, economic and/or industrial re-organisation to accommodate ideas of environmental sustainability - economic growth at the expense of the environment no longer deemed acceptable[10] (Mol and Sonnefeld 2000; Editorial 2000; Fisher and Freudenburg 2001; Fudge and Rowe 2001; Loyd 2007). This is represented as five key changes or 'clusters' directly relating to policies for environmental management. Internationally, governments are moving towards policy with an ecologically modern framework (e.g. see Young et al. 1996; Elliot 2009), and these clusters provide a framework for the policy directions required to achieve sustainable development and a context for offset banking. (Table 2.1)

[10] Note the U-Shaped Hypothesis: with initial economic growth human societies will deteriorate their environment to a certain point after which social and political reaction will drive pollution control and resource conservation efforts; long-term economic growth (as measured by GDP currently) reduces deterioration and lessens per capital environmental impacts (Gilpin 2000). Editorial (2000, *Geoforum*) summarize examples from research which support these observations, such as measures of GDP expansion and growth show to de-couple from rates of environmental damage (Sagoff 2007). This suggests an observable change in highly industrialised societies such as Germany and Sweden, regarding how their development moves towards a manner producing reduced environmental (and by proxy biodiversity) degradation and loss, alongside continued economic success. Examples such as these are used to support Ecological Modernization theory (Editorial 2000; Fudge and Rowe 2000).

Table 2.1 The Five 'clusters' of ecological economics. Clusters taken from Mol and Sonnefeld 2000. (See also Fisher and Freudenburg 2001; Fudge and Rowe 2001).

Ecological Modernization 'cluster'	Description
"Changing role of science and technology"	Greater emphasis is placed on the role on innovation and technological advances to achieve environmental sustainability; such developments are specifically encouraged and facilitated by parallel processes of ecological modernization in government policy and society
"Increasing importance of market dynamics and economic agents"	Inclusion of market-based mechanisms, ideas of economic efficiency, entrepreneurial activity and trading principles into policy and institutions designed to drive reform. Inclusion of environmental sustainability in multiple and varied aspects of industry, economy and society at all stages of operation as drivers of increased sustainability.
"Transformation of the role of the nation-state"	Rather than government and extensive developed bureaucracy managing affairs of the environment and industry, these roles are increasingly decentralised and participatory, less reliant on bureaucracy and top-down control. Developing roles of NGO, environmentalist, industry and community groups in environmental regulation.
"Modification in the position, role and ideology of social movements."	Increased role and efficacy of social movements, civil society and cultural institutions in decision-making and regulation for environmental reforms.
"Changing discursive practices and emerging new ideologies"	Shift in focus away from a dichotomous division of economic and environmental interests, with more focus on collaboration, interdisciplinary action and inclusive attitudes towards the two spheres.

Contunuing biodiversity decline and suggestions of continually un-checked economic growth highlight the difficulties achieving sustainable development (Ekins, Hillman and Hutchinson 1992a;1992b; Elliot 2009). Commentators question the accuracy of the concepts and the expectation of improved envrionmental awarenss and sustainable development (Fisher and Freudenburg 2001). Active civil societies and wider socail participation are suggeted to be key to achieving stronger ecological modernisation (Fisher and Freudenburg 2001; Fudge and Rowe 2001), and call attention to social and cultural apsects of environmental policy.

2.1 ECONOMICS: AN IMPORTANT ROLE

Reflecting the three components of sustainable development, offset banking is a system of conservation, but equally a system of economics. It operates in a context where recognising the interdependence of the environment and the economy is increasingly undeniable (MacNeill 1995; Mebratu 1998; Hickie 2010; ten Kate 2003a; Darbi et al., 2009).

All biodiversity conservation involves direct and indirect costs. Also, financial driers of economic growth and development are most often responsible for biodiversity loss (Ten Kate 2003; Ten kate, Bishop and Bayon 2004; PwC 2010; Wissel and Watzold 2010). As instrumental as the economy is in the problem, so it must be considered within proposed solutions (Gunningham and Young 1997). It is widely promoted (and equally disputed) that environmental problems may be addressed within economic frameworks (Hanley and Splash 1993; Gale and Barg 1995; Heal 2000; Gin 2005; Martin and ver Beek 2006). The TEEB Report (Bishop et al., 2010) acknowledges this:

> "TEEB has assembled much evidence that the economic invisibility of nature's flows into the economy is a significant contributor to the degradation of ecosystems and the loss of biodiversity. This in turn leads to serious human and economic costs which are being felt now, have been felt for much of the last half-century, and will be felt at an accelerated pace if we continue 'business as usual.' "
>
> p. 1 Sukhdev (2010)

Economic theory occupies an extensive reach in academic, politics and governance. A diverse range of economic tools, mechanisms and systems has been successfully given rise across societies' history in to important achievements and developments. Economics has informed conservation in a variety of ways and many argue it is possible to extend such potential and experience and contribute to solving current problems of sustainability and biodiversity decline (Gunningham and Young 1997; Heal 2000; Ginn 2005; Daily and Ellison 2004; Gale and Barg 1995; Martin and ver Beek 2006; Ring 2010). An increasing number of examples demonstrate individuals and businesses successfully solving environmental issues and conflicts, using economic market-based mechanisms (Costanza and Daly 1987; Gale and Barg 1995; Ginn 2005; Daily and Ellison 2002; Sagoff 2004; van Patten 2009; eftec, IEEP et al., 2010). Tradable credits and banking are recent developments gaining considerable momentum with potential application to a range of environmental challenges (Aguis 2001; Pannell, McFarlane and Ferdowsian 2001; Ginn 2005; Sagoff 2004; Godal and Klaassen 2006; Hartig and Drechsler 2009; eftec, IEEP et al., 2010).

Challenges remain in the process of applying economic theory to environmental issues. Increasing interaction of economics and ecology brings together experts unfamiliar with each other's paradigm. Disjunction between systems, communication and ideas limits the flow of information necessary to support designing and operating optimal systems (Norton 1995). This is one of the major challenges facing approaches that combine economics and ecology, and may appear insurmountable. However, with increased understanding, knowledge-sharing and trans-disciplinary developments, systems such as offset banking have significant potential to address environmental issues (Crowe and ten Kate 2010).

Economics must be discussed and understood in order to assess how it can contribute, but also whether these contributions (and their intrinsic limitations) are capable of satisfying desired goals within a context such as biodiversity conservation. To appreciate how economics and biodivestity may be intergrated in credit trading under offset banking, it is beneficial to discuss the underlying assumptions and premises of economic theory. The instruments of economic theory directly inform, rather than replace, policy and regulation, together forming the foundation for any offset banking system implemented.

"In practice, there is no strict dichotomy between [*regulation and economic*] instruments because economic instruments rely on a substantial underpinning of government regulation for effective implementation. [*Tradable permits*], for example, incorporate the flexibility and cost-effectiveness of market approaches but are supported by a degree of government regulation that reduce the risk of systematic breach."

p. 276 Gunningham and Young (1997)

2.1.1 Introduction to economics

"Today the science of economics is regarded as being concerned with the allocation of resources, prices or unprices, between alternative individual and social uses; the distribution of output amoung individuals and groups; the ways in which production and distribution change over time; the effiencies and inefficiencies of economic systems; and the implications of sustainable development."

p. 2 Gilpin (2000)

The economic system is a creation of human society, based upon human conventions, behaviour and culture (Gilpin 2000; Daly and Farley 2004). While initially this may suggest it cannot work with non-human resources such as biodiversity, upon analysis this is one of the strengths of the economic model. As a human-created system, it is better designed to deal with those operating under the system: humans. A system based on human culture and behaviour, focusing on mediating human activities especially environmental impacts, is suggested to succeed where traditional efforts focused on controling the (human and natural) environment have been insufficent (Gunningham and Young 1997; Daly and Farley 2004).

Government decision-making under centralised environmental planning is a product of current knowledge and collection capapcities, and associated gaps or inaccuracies (Tullock 1991; Lawton 2007; Ring 2010). In contrast, those making decisions in an economically-driven system are the individuals to whom the benefit ascribes, with superior access to knowledge of their desires, preferences and optimal choices for their welbeing, and behave based on this (Hanley and Splash 1993; Gunningham and Young 1997; Ring 2010). Economists argue this is a superior distribution of information; individual, informed decisions are coordinated and aggregated through economic activity and the economy's participants are in the optimal position to contribute to outcomes best serving their needs, which is translated to the wider society (Vald and Kraan 1991; Ekins, Hillman and Hutchunson 1992; Daly and Farley 2004).

2.1.2 Economic principles: efficient allocation

Fundamentally, economics is a system designed to produce, allocate and distribute; provision is an external consideration. An economic system is concerned with the resources society has (both those provided by nature and the environment, or created by humans) and achieving the maximum outcome possible from the use of these via the most efficient allocation (Gilpin 2000; Daly and Farley 2004; Sagoff 2004; Counsell, Evans and Mellsop 2010). Debate exists over what these outcomes should be, what society actually desires from these resources and how this may be achieved[11], leading to multiple branches of economics (Dobson 1999; Anton, Fisk and Holstrom 2000).

In the broadest sense desired outcomes may be defined as allocating resources, and the goods and services that they produce, in a manner that members of society most want, achieving the maximum level of 'welfare' or 'satisfaction' and leaving the smallest gap possible between current allocation and

[11] Note three categories of efficiency in Gilpin 2000; Also note Counsell, Evans and Mellsop 2010 - see footnote 10.

what is wanted or needed (Daly and Farley 2004; Counsell, Evans and Mellsop 2010). This is the basis for efficacy, central to economics. Efficiency is achieved when the distribution of resources (goods, services, environmental, natural and human-made commodities) is such than no other distribution would make anyone better off, without making someone worse off, or that all 'win-win' opportunities are exploited[12] (Gilpin 2000; Daly and Farley 2004; Heal 2000; Counsell, Evans and Mellsop 2010). This achieves maximal 'welfare' possible in contextual parameters (predominantly a function of the kind and amount of resources available). It is important to recognise that this does not consider the equity of this distribution; whether everyone has the same (or the 'right') amount of such goods and services or if the resources are distributed in a way that is fair, just, allows access to all, or provides for the future generation. This approach only considers maximum welfare as an aggregation of individuals being satisfied (Ekins, Hillman and Hutchison 1993; Anton 2000; Fisk 2000; Light 2000; Sagoff 2004; Counsell, Evans and Mellsop 2010). Current global concern for biodiversity resources is one reflection of the dissatifaction in the manner the environment is allocated under exsisting economic sysytems, and a failure to arrive at the desired biodiversity outcomes (Anton, Fisk and Holstrom, 2000; Light 2000; Hanna and Munasinghe 1995; Ackerman, Heinzerling and Massey 2007; Harris 2007; Shields 2008). With these inadequacies in mind, new approaches and interactions between economy, society and the environment are sought.

2.1.3 A new, economic, perspective for conservation

The basis of economics - the pursuit of efficiency - contrasts with how environmental and biodiversity conservation has commonly been approached in the past (Gilpin 2000; Anton 2000; Daly and Farley 2004). Discourse on social justice, equality, intergenerational equality, liberalism, socialism, welfare and human rights in the management of the environment, are seen to be relevant given the essential, life-supporting function of the environment (Dobson 1999; Anton 2000; Fisk 2000). The consensus comes from diverse origins, but for most, the environment and its values are viewed as intrinsically valuable in their own right, from their very existence, independent of any benefit or interaction and so value is placed on areas of nature being maintained as pristine or un-modified. As all humans benefit from biodiversity and the environment, it is important to ensure it can be enjoyed freely by all, without threat of removal (Costanza and Daly 1987; Einkin, Hillman and Hutchison 1993; Costanza et al., 1997; Joahnsson-Stenman 1998; Anton 2000; Beder 2000; Fisk 2000; MEA 2003; Donald 2003; Sagoff 2004; Doremus 2006; Ackerman, Heinzerling and Massey, 2007; Muller 2007).

[12] Specifically, this is Pareto Efficiency (Daly and Farley 2004; Gilpin 2000). See the GLOSSARY

The New Zealand Biodiversity Strategy demonstrates significant non-use values in the New Zealand context, stating that:

"Apart from the value of biodiversity in sustaining our present quality of life, to many people biodiversity has intrinsic value — the value of the variety of life in itself. As mentioned above, for Maori, indigenous biodiversity is an integral aspect of their world-view, and they have a special role and responsibilities as *kaitiaki*[13] of our indigenous biodiversity. The responsibility of humans towards other living things and our obligations to future generations provide a strong moral basis for their conservation and underlie the requirements in the Convention on Biological Diversity."

p. 4 NZBS (2000)

Much of New Zealand's environmental protection has focused on ensuring these 'intrinsic' benefits are protected for reasons completely unrelated to money and the economy, favouring preservation and conservation over alternative, economically productive land uses as required. Reflecting an egalitarian and democratic society, equality and social justice strives for the provision of environmental benefits to all of the current and future generations. Because everyone stands to benefit, the environment and biodiversity should not be the domain of a limited few. This has supported the majority of conservation in New Zealand occurring under government ownership, funding and management.

Traditional efficiency-based economics operates independently to the environment's intrinsic value and value to all of society, for which it has been criticised (Ekins, Hillman and Hutchison 1993; Anton, Fisk and Holstrom 2000; Light 2000; Sagoff 2004). Unrealistic expectations may preordain such dissatisfaction and criticism. Broader understanding of the functional potential and limitations of economics holds the key to addressing these issues. Economics may not offer universal solutions - rather it provides specific mechanisms to address specific issues. Failure to understand the constraints and conditions necessary for smooth functioning will limit what economics can offer. Increased interdisciplinary collaboration will support optimal application of economics to environmental issues and the realisation of the possible benefits that economics can offer.

To adopt more 'ecologically modern' approaches such as offset banking, differences between economic theory and existing conservation paradigms must be reconciled. Economics may prove inappropriate in some situations but the magnitude of current trends in biodiversity loss cannot be ignored. The

[13] Maori term for 'guardian', p. 2 NZBS 2000

discipline may hold the key to valuable solutions but this will only possible if it is given proper consideration. It is for this reason that a consensus on the role of economic ideas is necessary to accompany New Zealand's discussion of offset banking. Applying economics to the environment is an approach still being refined. It should not be viewed as comparable to, replacing, or superior to established paradigms of government-directed, socially-focused conservation, but as an alternative system, to be assessed under a different, framework of economics - principally, efficiency (Crowe and ten Kate 2010).

2.1.4 Efficient biodiversity conservation

Offset banking uses economics to achieve efficient allocation of land and money for conservation to achieve sustainable use of biodiversity (Gunningham and Young 1997; eftec, IEEP et al., 2010 e.g. Hartig and Drechsler 2009). Efficiency is achieved when conservation would not occur any better under another process, than under offset banking. This may be financial efficiency, whereby, if the same amount of money could produce more conservation through an alternative or parallel conservation program (for example a national park system), then offset banking is not optimally efficient (Gunningham and Young 1997; eftec, IEEP et al., 2010).

Similarly, conservation is spatially efficient where conservation is conducted at locations whereby the maximum amount of biodiversity can be conserved based on finances allocated (Polasky et al., 2008; Hartig and Drechsler 2009). Certain locations in a landscape are more costly to conserve due to direct costs imposed by the input requirements of the specific site, or indirect opportunity costs realised as a result of forgoing other land-uses to pursue conservation (Polasky et al. 2008; Hartig and Drechsler 2009).

A successful offset banking system will achieve maximum conservation for given financial inputs, by locating biodiversity conservation efficiently in a landscape, and establishing the optimal price for biodiversity conservation (Gunningham and Young 1997). To achieve this, the right economic mechanisms, mediated via regulations, must be designed (Gunningham and Young 1997; Hartig and Drechsler 2009). This is explored further in Chapter 5.

It is critical to understand that efficiency is the primary function of offset banking. Great care must be taken to ensure this is properly recognised, and that the achievement of efficient biodiversity conservation does not automatically work against the requirement for biologically, environmentally or socially appropriate conservation at the same time. It is for this reason that offset banking must operate in a context of a multi-dimensional conservation framework, with a variety of mechanisms allowing biodiversity to respond to desires that biodiversity be efficient, but also just, equitable, comprehensive and precautionary (Gunningham and Young 1997; Hartig and Drechsler 2009; Crowe and ten Kate 2010).

2.1.5. Allocation through the co-ordination of individual choice

Economics is based on the idea that society is made up of individuals, and if each can achieve their own satisfaction (and they are the ones in the best position to do this) then in aggregation, this will achieve it for society as a whole (Holstrom 2000; Daly and Farley 2004; Sagoff 2004; Counsell, Evans and Mellsop 2010). Greatest 'satisfaction' or 'welfare' is achieved when maximal benefit is achieved at least possible cost to that individual, or at least a cost commensurate to the ensuing benefit. Through mechanisms of price, trade, and exchange within a free-market it is intended that individuals will make informed choices based on the balance of costs and benefits, thereby achieving their own satisfaction (Heal 2000; Daly and Farley 2004; Sagoff 2004)[14].

> "The logic behind this [tradable permit] approach is rather simple. In a perfectly competitive market, permits flow towards their highest valued use. Those that would receive lower value from using the permits (due to higher costs, for example) have an incentive to trade them to someone who would value them more. The trade benefits both parties. The seller reaps more from the sale than she could from using the permit, and the buyer gets more value form the permit than he pays for it."
>
> p. 200 Tietenberg (2003)

Economic systems use the consolidation/agglomeration of individual choice and satisfaction as achieving benefits on a society-wide scale, and therefore maximum possible 'welfare' and 'satisfaction'

[14] There is an extensive body of literature concerned with how the concepts of human welfare, satisfaction, happiness and economic participation are considered within economics; argument suggests it is incomplete or inappropriate. For example see: Hanley and Splash 1993; Bockstael et al., 2000; Sagoff 2004; Ackerman, Heizerling and Massey 2007; Daly 2007; Johansson-Stenman 1998; Jorgensen, Jamieson and Martin 2010; Ekins, Hillman and Hutchison 1992; Binswanger 2006; Dean 2007; Dodds 1997; Ahuvia 2008; Chapin III et al., 2000

(Heal 2000; Daly and Farley 2004; Counsell, Evans and Mellsop 2010)[15]. For this to occur, costs and benefits must be aligned in support (Ring 2010).

2.1.6 Costs and benefits

Alignment occurs when individuals benefiting pay costs associated with reaping such benefits, and those who bear costs to provide these, can take some direct benefit in return (Heal 2000). Within offset banking, those profiting from degrading biodiversity (via profitable land-uses possible only after some level of biodiversity reduction) pay costs associated, by purchasing credits. As will be described in later chapters, these costs reflect what is required to sustain the benefits to society, whose members share none of the direct profit from the changed land use, but suffer loss from biodiversity reduction. Offset banking also provides a framework where those who provide benefit to society by preserving, restoring, protecting or enhancing biodiversity generate monetary benefit directly from these actions, so aligning benefit with the costs involved (Gunningham and Young 1997; Ring 2010). When costs and benefits are aligned, individuals are able, indeed expected, to make choices that maximise benefits and minimise costs, with economics supporting this across society as a whole (Gilpin 2000; Heal 2000; Daly and Farley 2004; Counsell, Evans and Mellsop 2010).

It is fundamental to appreciate the role and mobilisation of individual choice through economic systems such as trading under offset banking. It is a process where biodiversity conservation occurs because it is in the best interest of the individual, rather than through coercion previously applied through regulation, taxation or other mechanisms (Gunningham and Young 1997; Nelson and Sharman 2007; Hartig and Drechsler 2009). Consequently, if costs and benefits are misaligned then an individual's best interest may not align with the interests of the overall system, so failing to provide desired societal benefits, such as biodiversity conservation (Hartig and Drechsler 2009).

> "A system of tradable property rights or credits offers significant potential for harnessing individual action to conserve biodiversity on private land, while providing the **incentive** and **income** to do it."
> p. 493 Agius (2001) *emphasis added*

[15] For an overview of opposition to traditional economic welfare, satisfaction and the assumptions of aggregated individual choice, see Sagoff 2000, 2004.

Understanding the pivotal role of costs, benefits and incentives for individual choices (and limitations consequently associated) may represent a departure from established conservation approaches (Ginn 2005). It is for this reason that design of economic instruments is so influential, requiring the support of comprehensive economic knowledge. Inadequate regard for economics and its relevant capacities and limitations may be a source of disillusionment and dissatisfaction with offset banking, potentially leading to failure.

2.1.7 The role of price

Costs and benefits are closely related to prices and valuation, as the price of a good or service has direct implications for how its costs and benefits are viewed by individuals (Heal 2000). Properly aligning costs and benefits requires understanding and consideration of price and value in economics. Prices are conventionally expressed in monetary terms, with increases in money equating to increased benefit (Heal 2000). Credit trading within offset banking involves monetary pricing of biodivesity credits, which requires appreciation of how economic pricing and valuation works. Detailed analysis of the influences and interactions of consumer supply, producer demand and price within the economic market equation are beyond the scope of this discussion. Nevertheless, it is important to recognise that the price of a good or service is determined by the supply and demand for that good or service[16] (Gilpin 2000; Heal 2000; Daly and Farley 2004).

As price represents the present balance between supply and demand, it provides a common platform for individuals to communicate the many aspects of valuation an individual may consider, so that goods and services may be traded under a common currency (Daly and Farley 2004). Price is taken to reflect value as highly beneficial goods and services are deemed to have high value. The higher an item is valued, as a function of the benefit obtained, the more individuals are willing pay for that item, increasing the market price as people are expected to pay more for things they demand (or prefer) more of (Hanley and Splash 1993; Heal 2000). It is most efficient to allocate items to those who benefit most greatly from them, as indicated by their willingness to pay a higher price for them (Daly and Farley 2004; Sagoff 2004). In real-world markets, the interaction between price, valuation, supply

---

[16] "If demand for a good exceeds its supply, then its price rises, strengthening incentives to produce it. Conversly should supply of a good exceed the demand for it, then its price will fall, leading to less incentive for its production. If an input to production is scarce, then its price will rise, directing producers to both economise on its use and also to develop sustitutues." p. 24 Heal (2000)

and demand is significantly more complex(Hanley and Splash 1993), yet this description is a useful starting point.

2.1.8 Valuation

Value of biodiversity, like all goods and services, has variously been estimated through association with financial returns surrounding its use, preservation or *restoration* (Heal 2000; O'Riordan and Stoll-Keehmann 2002; Sagoff 2004; Ten Kate, Bishop and Bayon 2004; Daily and Ellison 2005; Ginn 2005; van Patten 2009). This form of money-centred value is how other economically traded goods and services are categorised. Attaching dollar values to the environment and its many facets has occupied much economic research and literature (Hanley and Splash 1993; Mebratu 1998; Chapin III et al., 2000; Gilpin 2000; Daily and Ellison 2002; Martin and ver Beek 2006)

Two forms of value may be distinguished: value in trade being the money that biodiversity may be exchanged for (or could be purchased for); alternatively, value based on the importance the owner places on their use of biodiversity - referred to as non-use values (Hanley and Splash 1993; Donald 2003; Sagoff 2004). It is assumed that trade with the free-market will align these values and the exchange value will equate to use and non-use values and be reflected as a market price (Heal 2000).

Value judgements incorporate multiple influences, particularly when concerning the numerous components and aspects of biodiversity (Gilpin 2000; Day-Rubenstein and Frisvold 2001; Darbi et al., 2009). For example, a tree may be important because of the money that the wood can be sold for, or the habitat it provides to birds that are important to recreationalists such as bird-watchers. The landscape values that the forest of trees contributes to may be valued by local communities for aesthetic values; by local tourisms operators generating income from tourists who consider the landscape important enough to travel to view, or for soil and water conservation benefits provided to downstream communities. The tree may provide fruit that is culturally significant to indigenous groups, or down-slope landowners may generate income from land-use possible because of the erosion-prevention properties of the tree's roots (Costanza et al., 1997; Heal 2000). For added complexity, there are those who advocate that as humans, all individuals derive some psychological, spiritual or emotional benefit from being close and having access to pristine natural ecosystems or components of those systems. Further, this benefit may even be derived from the mere knowledge that they exist, irrespective of physical proximity. (Housman 1992; Costanza et al., 1997; Chapin III et al., 2000; Gipin 2000; Agius 2001; Sagoff 2004; Lucht 2007).

The variety of influences on valuation of biodiversity and other environmental components has resulted in a number of alternative methods to capture these in market prices. For example: costs to replace or recreate biodiversity values removed; costs to find human-made substitutions to provide the same benefit; financial losses that may result in the absence of biodiversity; the money that may be directly generated through various 'uses' of biodiversity (such as food, shelter, tourism etc.); and the financial representation of the benefit derived from biodiversity, have been used to define prices[17] (Hanley and Splash 1993; Day-Rubenstein and Frisvold 2001; Daily and Ellison 2002; Ginn 2002; Heal 2005; Ackerman, Heinzerling and Massey 2007). There has been much discussion as to the accuracy, limitations and appropriateness of these approaches (Costanza et al., 1997; Daily and Ellison 2002; O'Riordan and Stol-Kleemann 2002; Sagoff 2004; Martin and ver Beek 2006; Ackerman, Heinzerling and Massey 2007). Offset banking establishes a price for biodiversity through a composite of influences, specifically appropriate to the context of credit trading, (see Chapter 5, section 5.4.1 - 2).

Valuation of nature expressed as a common price and determined by supply and demand of resources by individuals is the foundation of economic markets, and tradable credits in biodiversity. These are the mechanisms that coordinate economic efficiency. Consequently, economic markets have been charged by some as inadequately allocating environmental resoucres such as biodiversity (Ekin, Hillmand and Hutchison 1993; Anton, Fisk and Holstrom 2000; Agius 2001) This situation has been related to the way biodiversity is valued through pricing or lack of pricing of resources, and how demand and supply is able to allocate environmental resources such as biodivesity to achieve sustainable use (Housman 1992; Hanley and Splash 1993; Costanza et al., 1997; Mebratu 1998; Gilpin 2000; Riordan and Stoll-Keehmann 2002; Sagoff 2004; Ackerman, Heinzerling and Massey 2007; Christensen 2007; Darbi et al., 2009). As such, management of biodiversity via economic mechaninsms, requires proper understanding and regard for the role of price and valuation (Aguis 2001).

[17] For example see Costanza et al., 1997, and reviews.

2.2 Ecological economics

Concepts described above (efficency, allocation, costs, benefits, pricing, valuation and individual choices) establish the basis of economics, however modern economic theory has divided into a number of branches, reflecting different perspectives relating to how economics may be developed to better serve societies interests (Costanza and Daly 1987; Ekins, Hillmand and Hutchison 1992; Daly 1997; Mc Daniel 2007; Ackerman, Heinzerling and Massey 2007; Muller 2007). *Environmental economics* applies economic principles to include environmental resources into markets, where previously external to established economic systems. Economic principles so allocate resources as efficiently as other goods and services, and (with appropriate cavetes) supporting conservative use (Gilpin 2000; Hanley and Splash 1993 *also* Sheilds 2008). From this, *ecological economics* focuses on achieving production and resource allocation in a sustainable manner (Costanza and Daly 1987; Daly and Farley 2004; Muller 2007). Traditional economics considers the environment an internal component of the economic system, providing resources and absorbing wastes around which the economy may expand exponentially. Ecological economics instead consideres the economy a component bound within a finite environment. The economy therefore has the potential to grow to a size that overwhelms the confines of the environment, restricting resource flow and waste absorption, and inevitably causing both environmental and economic collapse (Daly and Farley 2004; Ekins, Hillman and Hutchison 1993) (See Figure 2.1)

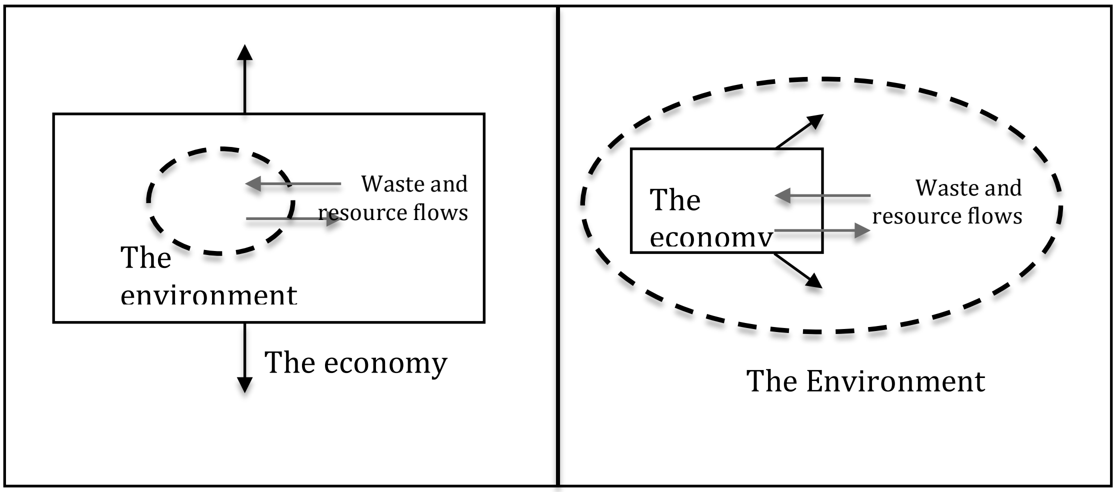

Figure 2.1: Two perspectives on the environment and the economy. Left: traditional economic perspective. Right: ecological economic perspective. Broken lines represent bounds of the environmental system; solid lines represent the bounds of the economic system. Black arrows denote economic expansion. Smaller grey arrows represent flows of resources from the environment to the economy, and flows of wastes from the economy to the environment. Based on figures 2.1 (page 18), 2.3 (page 22) and 3.2 (page 51), Daly and Farley 2004

Ecological Economics argues that traditional concepts fail to recognise these environmental limits, or consider the long-term provision of efficient allocation (Costanza and Daly 1987; Ekins, Hillman and Hutchinson 1993; Anton, Fisk and Holstrom, 2000; Daly and Farley 2004; Christensen 2007; Muller 2007). Traditional efficiency is about achieving the maximum under current conditions and so arguably disregards provision in the future. The finite nature of environmental resources requires recognition that certain patterns of use cause irreversible depletion, halts essential provision of goods and services, and compromises future provision (Costanza and Daly 1987; Daly and Farley 2004; Sagoff 2007; Llyod 2007; Daly 2007; Bishop et al., 2010). Drawing on research, The Living Planet Report 2000, by UNEP and the World Wildlife Fund finds that:

"[The 1997] ecological footprint of the Earth's population was at least 30% higher than the Earth's biological reproductive capacity. This deficit is made up by consuming or drawing down natural capital, thus 'borrowing from' or perhaps 'robbing' the future."

p. 35 Daly and Farley 2004.

Given the apparent speed of depletion and predicted consequences of complete resource exhaustion (opinions range from challenging to catastrophic) traditional economic efficiency is no longer considered optimal for managing natural resources, including biodiversity (Saeed 2004; Sagoff 2004; Daly and Farley 2004). Yet production and distribution may continue indefinitely if the system is constrained to maintain the system's productive capacity, and voids depleting underlying resource stocks (Daly and Farley 2004). This is more aligned with environmental perspectives desiring sustainable development and providing for future generations. It requires establishing new parameters for economic growth with increasing focus on sustainable use of biodiversity.

Introducing a system of tradable credits through offset banking imposes financial constraints to development, intending to restrict economic expansion to that not jeopardising long-term biodiversity provision. Expanding ecological economics hopes to contribute to designing economic mechanisms within offset banking systems, and offer mechanisms to achieve sustainable development.

2.3 Economic efficiency and sustainable development in New Zealand

The Resource Management Act (RMA) (1991) is the basis for applying biodiversity offsets in New Zealand and seeks to achieve efficient allocation of biodiversity resources via market-based mechanisms (as opposed to central planning) to mitigate negative effects of resource use[18] (Grundy and Gleeson 1996; Counsell, Evans and Mellsop 2010). The RMA recognises three forms of efficiency[19]: Static efficiency is divided into allocative efficiency intending to achieve maximal net benefit, and productive efficiency that intends maximum output for a given resource input. The third form is dynamic efficiency: allocation that maximises benefits into the future through efficient investment and innovation.

The increasing importance given to dynamic efficiency and sustainable development to provide for future generations is expressed in "Measuring New Zealand's Progress using a Sustainable Development Approach" (Statistics New Zealand 2009). Here, efficient resource use is identified as a desired outcome, and sustainable development for New Zealand is defined as:

> "… development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development means ensuring that well-being is at least maintained over time. The principle of fairness within and between present and future generations should be taken into account in the use of environmental, economic, and social resources. Putting these needs into practice requires living within the limits of the natural environment."
>
> p. 7, Statistics New Zealand (2009)

New Zealand's desire to prioritise sustainable development and efficient resource use is also demonstrated in the RMA:

> "A position that maximises welfare, or equivalently the net benefit to society, is one that achieves economic efficiency."
>
> Section 7(b) RMA, p. 5 Cousell, Evans and Mellsop (2010)

---

[18] See http://www.mfe.govt.nz/rma/index.html (accessed 18/06/2011).

[19] *C.f.* three categories of efficiency in Gilpin 2000 "Productive efficiency, in which the output of goods and services is being provided for the least cost; allocative efficiency in which resources are being allocated for the production of goods and services the community requires; and distributional efficiency, in which output is distributed in such a way that consumers would not wish … to spend their income in any other way…" page 9

Therefore, adopting sustainable development and economically efficient mechanisms has been established as a necessary and desirable focus for New Zealand's future environmental management and biodiversity conservation (Grundy and Gleeson 1996; Jackson and Dickson 2007). Importantly, this establishes a suitable context within which a system such as offset banking may be developed.

2.4 Summary: sustainable development and economics

Offset banking requires policy and regulation based on sustainable development and ecological modernization (Crowe and ten Kate 2010). Given such context, offset banking intends to achieve biologically, economically and socially beneficial outcomes together. Without recognition of the integration required between economics, biology and society, and the tradeoffs made under sustainable development, policy and regulation for offset banking is likely to remain contentious and limited in its success. The right policy and regulation promotes optimal functioning in terms of conservation and economic viability (Gunningham and Young 1997). Robust understanding of both biodiversity and the economics behind market mechanisms are required; concepts the chapter describes must retain central focus within offset banking discussions. Economics has a pivotal role yet the path of continued exploration and understanding, and development of novel approaches, naturally attracts scrutiny and debate. With interaction and collaboration amongst the diverse disciplines towards comprehensive distribution of economic knowledge, the potential of economic approaches may be realized. Rather than be limited by constraints and instead apply and optimize the economic discipline, a comprehensive biological basis must be matched by proper regard for a firm understanding of economic theory, as a basis for all sustainable development intending to conserve biodiversity.

CHAPTER THREE

BACKGROUND TO OFFSET BANKING: BANKING IN CALIFORNIA AND NEW SOUTH WALES

3.0 OFFSET BANKING IN CONTEXT

To discuss devloping New Zealand offset banking, it is firstly important to understand scheme components within a broader biodiversity conservation context. Offset banking history and developments provide nessary background, expanded here by two case-study examples and applied as a basis for discussion within this thesis; specifically, Californian and New South Wales banking systems. Examples are used to demonstrate and analyse the practical application of offset banking concepts (Hartig and Drechsler 2009) [20]. These case-studies are a learning resource, providing New Zealand with insight to inform the development of policy, regulation, risk management and mitigation. They highlight the advantages and disadvantages of design and implementation decisions (Brown and Lant, 1999; Agius, 2001; Nelson and Sharman 2007; Burgin 2008; Carroll, 2008; Darbi et al., 2009; Davis 2009). In this chapter I provide a descriptive overview of the components of an offset banking scheme, drawing on how these are applied in exsisitng systems within California and New South Wales.

3.0.1 The nature of the offset banking system: some general principles

The IEEP identifies banking systems as a form of environmental impact offsetting, specifically:

> "This project defines habitat banking as: A market where the credits from action with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time."
>
> p. 9 eftec, IEEP et al., (2010)

[20] Around the world, many schemes have been or are, being developed and as a result, many terms are used to refer to these market-based offsets for examples of different terms see: Chomitz, Thomas and Brandao, 2004; Brown and Lant, 1999; Agius, 2001; Burgin 2008; PwC 2010; eftec IEEP et al., 2010). This thesis uses the term offset banking as an encompassing term for all compensation or mitigation-realted enrionmental credit trading systems. For additional defintitions used in this thesis see the GLOSSARY

Offset banking schemes may operate on a local, regional, or national level based upon a common framework: credtis are genrated (or supplied) by regulating bodies granting tradable credits in recognition of identifyable, positive *conservation actions* (Agius 2001; Nelson and Sharman 2007; Wissel and Watzold 2010). Concurrently, those undertaking activities which result in negative environmental outcomes (e.g. land development such as subdivision, resource extraction, infrastructure building) are required to purchase these credits. This represents the demand within the system (Aguis 2001; Wissel and Watzold 2010). Credit trade between suppliers and project prponents functions as mitigation for unavoidable environmental impacts of a project (Albert and Wenzel 1996; ten Kate, Bishop and Bayon 2004; Mead 2005;Darbi 2009; Wizzel and Watzold 2010; Moilanen et al., 2008). Financial returns from credits are structured to provide an income stream enabling perpetual protection and active, on-going management of the environmental values (Aguis 2001; Burgin 2008; Darbi et al., 2009; EDO 2008c; 2010a). The overall system of trading credits is intended to produce a cumulative long-term outcome for the envrionment or biodiversity of a region; *no-net-loss* and net spatio-temporal gain are popular but not universal objectives.

Whether such overall or long-term outcomes are possible, in theory or practice, is the source of much debate (McElfish and Nicholas 1996; Redmond et al., 1996; Aguis 2001; Spieles, Coneybeer and Horn 2006; Hartig and Drechsler 2009; Palmer and Filoso 2009; van Patten 2009; Walker et al., 2009; Bekessy 2010; Maron et al., 2010). There is also debate surrounding how varrious design features can be modified to better achieve market and conservation goals, and respond to broader societal concerns (Agius 2001; Shabman, Scodari and King 1996; Bekessy et al., 2010). Discussions presented here are not intended as arguments for or against offset banking or acceptability of offsetting overall; I consider instead the conditions undder which offset banking may or may not work. This importantly parallells wider societal, political and scientific debate discussing how economic activity, development impacts and the environment are best managed.

Discussing offset banking system must consider opperational contexts (Aguis 2001; P Martin Pers. Comm. 2010). Many challenges face sustainable development and successful biodiversity conservation; credit trading mechanisms should be viewed as one approach. Numerous advantages are possible yet offset banking needs to be discussed in light of a suite of approaches required to address worldwide environmental concerns (Marsh et al., 1996;

McElfish and Nicholson 1996; Albrecht and Wenzel 1996; Doremus 2003; ten Kate 2009; Hartig and Drechsler 2009; Ring et al., 2010; Wissel and Watzold 2010). Offset banking policy, regulation and risk management mechanims offer specific biodiversity conservation outcomes. Additional desired outcomes may be best addressed through other approaches at various organisational levels, to complement offset banking (Gunningham and Young 1997). Literature extensively supports addressing overall biodiversity and environmental conservation through multiple, interactive and complementary approaches at a wide range of spacio-temporal scales (Ostrom 1999; Moran and Ostrom 2005; Burke 2001; Yang et al., 2009; Dietz et al., 2003). This important point is reiterated in later chapters, in particular when considering offset banking regulation and policy.

3.0.2 Offset banking as a form of biodiversity offseting

Environmental and biodiversity offsets encompass a number of approaches based on principles of the economic market. The intention is for development project operations to be brought into alignment with impacts on broader social and environmental values and associated costs. Offsetting represent attempts to internalise these costs by the body profiting from the environments' exploitation and a mechanism whereby some of the previously private returns from the impacts can be directly focused back to biodiversity conservation (Goldman-Carter and McCallie 1996; Aguis 2001; Saeed 2004; Burgin 2008; Curnow and Fitz-Gerald, 2006; Bedward et al., 2009; Darbi et al., 2009; Suvantola 2009; Crowe and ten Kate 2010). Importantly, finance from these previously marginal sources supports the protective preservation of biodivese areas, but also generates funding to sustain the active management required increasingly recognised as essential to reach conservation goals unlikely to be acheived through preservation alone (Wilson et al., 2007). Such compensatory and mitigation approaches are referred to as biodiversity or environmental offsetting; a broad, umbrella term under which offset banking sits (eftec, IEEP et al., 2010; Crowe and ten Kate 2010).

Leading international research, consultation and best-practice development group Business and Biodiversity Offsets Program, (*BBOP*) define biodiversity offsets as[21]:

[21] See also Pricewaterhouse Cooper (2010); eftec, IEEP et al., (2010)

"measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people's use and cultural values associated with biodiversity."

p. 8, BBOP (2009c)

Given the variety of development projects and numerous environmental locations, each offset has unique characteristics (BBOP 2009; Masden, Carroll and Moore Brands 2010; Wissel and Watzold 2010). Each is specifically designed to the conditions of the project site, nature of impacts and values concerned. Conservation actions are designed specific to the contextual conditions. Many complex decisions must be made before either the development project or compensatory habitat can be successfully implemented. (Ten Kate, Bishop and Bayon 2004; Hallwood, 2007; Drechsler and Watzold 2008; Kieseker et al., 2009; BBOP 2009). Offset principles have been developed, such as those by BBOP or Norton (2009), that bring together and formalise the aims and objectives of implementing offsets. These provide a framework of how offsetting may be used to achieve optimal outcomes (see Appendix One: The Priniciples of Biodiveristy Offsetting) (Marsh, Sokolove and Rhodes 1996; ten Kate Bishop and Bayon 2004; Foxall Grigg and ten Kate 2006; see also Salzman and Rhul 2000; Wissel and Watzold 2010; PwC 2010).

3.1 Historical origins of offset banking concepts

For a number of years, independent offsetting projects have been implemented around the world, on various scales and with a broad range of characteristics (Marsh et al., 1996; ten Kate, Bishop and Bayon 2004; Blundel 2006; Bedward et al., 2009; Darbi et al., 2009; Crowe and ten Kate 2010; Madsen, Carroll and Moore-Brands 2010; PwC 2010). These direct compensation and mitigation ideas led to the development of the banking concept, with the pioneering approaches being seen in the United States with wetland mitigation development (Marsh et al., 1996; ten Kate, Bishop and Bayon 2004; Blundell et al., 2006; Burgen et a. 2008; Mead 2008; Darbi eta l., 2009). The *Mitigation Banking* system currently operating in California and other parts of the United States constitutes the oldest and most established environmental banking system (Memon and Skelton 2004; Masden, Carroll and Moore Brands 2006). In response to public concern for the environment in the 1970s, momentum for enhanced protection of valuable natural habitat culminated in the Federal Water Pollution Control Act of 1972, known as the 'Clean Water Act' (*CWA*). This was the first piece of federal legislation that placed restrictions on the draining, degradation or development of wetland areas (McElfish and Nicholas 1996; Committee on Mitigating Wetland Losses et al. 2001; Mead 2008).

In order to obtain a permit allowing these actions, applicants must demonstrate that their project would result in no overall loss of wetland function or area; a requirement met through approved mitigation actions onsite or elsewhere (USEPA, undated; Committee on Mitigating Wetland Losses et al. 2001; USFWS Memo Guidance Calif. 2003; Wilkinson and Thompson 2006; Environmental Law Institute 2007; Mead 2008; USWFS 2009). This requirement led to adoption of numerous mitigation projects, occurring independently and conducted directly by the developers causing the damage (hence the term '*permittee-responsible* mitigation'). Consequently, mitigation areas were commonly protected, enhanced or re-created in very small areas adjacent to the damaged wetland, selected by the developers themselves (USEPA, undated; Albrecht and Wenzel 1996; Race and Fonseca 1996; Lawhead 1997; Spieles 2005; Environmental Law Institute 2007; Nelson and Sharman 2007; Mead 2008; Darbi et al., 2009; EPA 2010).

By the mid 1990s much criticism had been directed towards the overall environmental outcomes from this approach (De Weese 1994; Goldman-Carter and McCallie 1996; Race and Fonseca 1996; Redmond et al., 1996; Lawhead 1997; Brown and Lant 1999; Aguis 2001; Robertson and Hayden 2008; Palmer and Filoso 2009). Early mitigation approaches and Act administration led many to conclude that despite the no-net-loss objectives, large areas of wetlands had been drained across the United States, with mitigation to account for this loss not achieving appropriate outcomes (for further discussion see of such risks see Chapter 4 and Chapter 5) (De Weese, 1994; Marsh et al., 1996; Redmond et al., 1996; Brown and Lant 1999; Memon and Skelton 2004; Mack and Micacchion 2006; Mead 2008; Roberston and Hayden 2008).

Despite unsatisfactory outcomes and negative perceptions, these initial mitigation attempts offered a valuable opportunity to successfully redesign and re-legislate to ensure the effective operation in the future (Committee on Mitigating Wetland Losses et al. 2001). Attempting to increase the ecological value and conservation outcomes of future mitigation projects, agencies and regulators began directing mitigation requirements to larger sections of land, at locations other than the impact sites. Here conservation actions by multiple parties could be aggregated to provide superior economies of scale - ecologically and economically. Concurrently, between the mid- 1990s and the turn of the last decade, multiple federal guidance and policies were released addressing the notable shortcomings of previous mitigation processes[22] (USEPA, undated; Redmond et al., 1996; Wilkinson and Thompson 2006; Environmental Law Institute 2007). Such approaches represent the origin of mitigation banking; a system to improve the ecological outcomes of wetland mitigation (Gardner and Radwan 2005; Environmental Law Institute 2007).

Currently more advanced, successful wetland banking is occurring in the United States,; aditional guidance's, regulations and policy administration requiring significant improvement to previous quality and quantity in both process and outcomes (Troyon Environmental Consultants Inc undated; USEPA, undated; Shabman, Scodari and King 1996; Gardner and Radwan 2005; Nelson and Sharman 2007; Robertson and Hayden 2008; Aguis 2001; Mak and Micacchion 2006; Kieseker et al. 2009; Masden, Carroll and Moore Brands 2010).

3.1.1 Origin of Conservation Banking: focus on California

The Endangered Species Act (ESA), the seminal and formative legislative instrument for conservation banking, was signed into law in 1973 (United States Department of the Interior 1973; Studt and Sokolove 1996; The Katoomba Group 2008; Carroll, Fox and Bayon 2008). Primarily designed to halt and reverse concerning rates of species decline in the United States, this Act created the process by which federally important species were legally recognised and categorised as being threatened or endangered, and created the illegality of 'taking' or harming of species[23] (Studt and Sokolove 1996; Environmental Law Institute 2007). This also created the second piece of legislation (together with the CWA) that formed the basis of offset banking in the United States. Both originally created under legislation with independent

[22] Refer to Appendix Three: Acts, and other official policy documents in California and New South Wales.

[23] "*Taking*" is defined under the ESA as any harassment, harm, pursuing, hunting, shooting, wounding, trapping, killing, capturing, collecting or an attempt to engage in any of these, in relation to any species on the Federal Endangered Species List (ESA 1972).

purposes, this explains why the United States systems have developed distinct mitigation and conservation banking systems. Those impacting wetlands come under the jurisdiction of the United States Army Corps of Engineers (USACE), while those impacting species were now answerable to the US Fish and Wildlife Service (USFWS) (ten Kate, Bishop and Bayon 2004; USFWS Memo. Guidance Calif. 2003; Environmental Law Institute, 2007).

Consent to conduct activities limited by the ESA normally requires an Incidental Take Permit (ITP) which requires applicants demonstrate that no overall residual jeopardy to the continued existence of the species will occur as a result of the project (Studt and Sokolove 1996; USFWS Memo. Guidance Calif. 2003; Environmental Law Institute, 2007). In relation to the conservation banking that would develop, the FWS issues species take permits, approves conservation banks, and issues guidance and policy to guide the system operations. Subsequent regulations allowed for off-site conservation; by the developer themselves, the services of an in-lieu fee, or through purchase of credits from an approved *Conservation Bank* (ten Kate, Bishop and Bayon 2004; Wilkinson and Thompson 2006; Wilkinson, Thompson and Thompson 2006; Environmental Law Institute 2007; Hallwood 2007; Crowe and ten Kate 2010; see also Darbi et al., 2009).

In 1995, the ESA was amended and Habitat Conservation Plans (HCPs) were introduced. A HCP describes:

> "…the anticipated, unavoidable impacts on species by the proposed project, including the type and amount of incidental take of each species to be covered under the plan, and how these impacts will be minimised and mitigated."
>
> p. 20, Mead (2008)

A Natural Community Conservation Plan (NCCP) is a larger-scale HCP; the concept originated in California under the Californian Department of Fish and Game, and is considered to have launched conservation banking in the state (Lawhead 1997). In San Diego County, a Multiple Species Conservation Plan was the first NCCP to be developed, incorporating multiple NCCP-HCP's and over 15 conservation banks for species such as the California gnatcatcher and multispecies credits for coastal sage scrub (Lawhead 1997; ten Kate, Bishop and Bayon 2004). Both HCPs and NCCPs have been used by state and federal agencies to identify where development is most appropriate and the location of high priority conservation habitat. This has facilitated improved land-use planning by simultaneously allowing allocation of development land and providing for the mitigation of these impacts, and created a space for efficiently designed and optimally located conservation banks (Lawhead 1997; Mead 2008).

With the two distinct regulations (the ESA and the CWA) as foundations, California has two distinct systems of banking: Conservation Banking and Mitigation Banking. A Conservation Bank may be publically or privately owned land managed for its natural resource values, where the signatory to the banking agreement is legally bound to the regulating government agency, concerning specific species values or in some cases, *ecosystem* values (e.g. CDFG, USFWS, USACE) (Toyon Environmental Consultants Inc., undated; ten Kate, Bishop and Bayon 2004; USFWS Memo. Guidance Calif. 2003; Nelson and Sharman 2007; USWFS 2009; Masden, Carroll and Moore Brands 2010). *Mitigation Bank* refers to a '*wetland' bank* created to satisfy the wetland compensation requirements of the CWA and the regulatory approval of the USACE to mitigate drainage, filling or polluting wetland areas through mitigation of wetland function and/or acreage (United States Environmental Protection Agency, undated; USFWS Memo. Guidance Calif. 2003; CDFG 2009; Darbi et al. 2009; EPA 2010). In situations where multiple species are concerned, multiple agencies are consequently involved in authorising and overseeing the banking process including bank establishment, credit issuance and credit trade (Californian Government Department of Fish and Game, 2009). Under the banking structure in California the given level of species classification (county, state or federal) determines which agency is responsible for administrating the banking process.

The EPA (1973) states that current Conservation Banks are required to comprise four distinct components (Robertson 2004)[24]:

- "The bank site: the physical acreage restored, established, enhanced, or preserved;
- The bank instrument: the formal agreement between the bank owners and regulators establishing liability, performance standards, management and monitoring requirements, and the terms of bank credit approval;
- The Interagency Review Team (IRT): the interagency team that provides regulatory review, approval, and oversight of the bank; and
- The service area: the geographic area in which permitted impacts can be compensated for at a given bank."

[24] See EPA (2010) http://www.epa.gov/owow/wetlands/facts/fact16.html (accessed 18/06/2011)

3.1.2 Establishing the entrepreneurial industry and banking in the new century

The establishment of enabling legislation, policy and guidance in the US has ignited a promising *entrepreneurial* conservation banking industry (McElfish and Nicholas, 1996; Redmond et al., 1996; Shabman, Scodari and King 1996; ten Kate, Bishop and Bayon 2004; see also Roberston and Hayden 2008; Robertson 2004). The first '*Entrepreneurial Banks'* and 'bankers[25]' began in California in 1995. Numerous regulations, guidance's and other influential documents have been issued at agency, state and federal levels[26] since, and activity has rapidly increased. These aimed to improve the operation of the system and remove obstacles identified, such as via increasing uptake of the program (and hence conservation achieved as a result) through reducing approval time for smaller projects; encouraging inclusion and prioritisation of areas of high biodiversity value; encouraging entrepreneurial banking by private landowners and project proponents; and improving mitigation ratios to encourage banking more aggressively in identified priority conservation areas (Shabman, Scodari and King 1996). Recent estimates suggest more than 106 conservation banks have been created in California, with 23 in 10 other states conserving 111 species in total[27]. Many more mitigation banks for wetland impacts have been created, with 1137 stream and wetland banks (active, inactive, pending or sold out; 32 status unknown) recognised by Ecosystem Marketplaces' 2011 Market Update[28]. Conservation and mitigation banking is now active in at least 37 states (ten Kate, Bishop and Bayon 2004; Madsen et al., 2011).

In 2000, the USACE, EPA, USFWS and NOAA issued guidance allowing the establishment of an *in-lieu-fee program* to enable developers to fulfil mitigation obligations financially in areas where the specific credits they required are not yet available (DECC 2006; Wilkinson and Thompson 2006; ten Kate, Bishop and Bayon 2004). As at the time, banks were taking many months or even years to develop to the point of credit sales, the in-lieu fee establishment

---

[25] Private companies or individuals operate conservation or mitigation banks by purchasing land or land-rights then creating, protect ing or restoring conservation values to generate credits, subsequently selling these for a market-based priced to either public or private projects with mitigation requirements

[26] See APPENDIX THREE: Acts, and other official policy documents in California and New South Wales.

[27] Data according to us.speciesbanking.com/pages/dynamic/states.search.php# accessed 10th June 2011; The USACE tracking system RIBITS lists 921 bank and in-lieu-fee (ILF) sites across the United States, including active, pending, sold-out or terminated banks or ILF sites. This number does not represent all banks however as there are some states yet to contribute their data to the system, and banks administered by FWS (i.e. conservation banks) are also currently in the process of being added so this number under-represents the total number of banks in the US.

[28] Madsen, Becca; Carroll, Nathaniel; Kandy, Daniel; Bennett, Genevieve, 2011. State of the Biodiversity Markets Report: 2011 Update. *In Press* Available at: http://www.ecosystemmarketplace.com/xxxx expected 2nd June 2011.

helped over-come potential stagnating trade. Compared to permittee-responsible mitigation, it was intended that In-lieu-fee programs would better involve professional conservation personnel and therefore produce higher quality mitigation while aggregating smaller mitigation projects into areas of an ecologically-meaningful size (Wilkinson Thompson and Thompson 2006; Darbi et al., 2009; Bendor 2009). Accredited in-lieu fee holders collect fees: either private non-profit conservation agencies (such as The Nature Conservancy, Ducks Unlimited and The Centre for Natural Lands Management[29]), or state, local government or other public entities (Wilkinson and Thompson 2006). Monies are then directed to suitable mitigation and conservation projects once enough money has been collected to produce effective results (Wilkinson, Thompson and Thompson 2006; Crowe and ten Kate 2010).

Despite this sound rationale, the outcomes from in-lieu fee programs have been criticised and continue to be an issue of industry debate (Wilkinson and Thompson 2006; Wilkinson, Thompson and Thompson 2006; Bendor 2009; Masden, Carroll and Moore Brands 2010). A number of fee programs have failed to produce promised mitigation through lack of timely mitigation work, increasing land-prices devaluing the purchase/conservation power of the monies held, and poor regulatory over-site and enforcement. Sadly this occurs after the development impacts have been irreversibly completed, and thus introduces a significant temporal lag that banking is designed to address (Wilkinson, Thompson and Thompson 2006; Fleischer and Fox 2008; Denisoff, 2008; Bendor 2009). With recognition of the limitations of both permittee-responsible, and in-lieu-fee mitigation and conservation, entrepreneurial mitigation and conservation banking has become increasingly popular and robust, with more companies entering the market and existing companies continuing to grow and expand, from California throughout many other states. In 2008 growth was supported by the released of two important documents: “The New Rule” federally issued by the USACE, and clearer standards for permittee-responsible mitigation, In-lieu-fee, and mitigation/conservation banking enacted USFWS. The New Rule was interpreted by many as encouraging authorising agencies to prefer use of mitigation and conservation banks with the three options, to reflect the increased reliability in mitigation or conservation outcomes banks have come to provide. Confidence in the mitigation and conservation banking industry also increased with the issuance shortly after of a range of template documents for the establishment and operation of mitigation and conservation banks in the Public Notice issued collectively by USACE, USFWS, CDFG, California

[29] Center for Natural Lands Management http://cnlm.org/cms/; Ducks Unlimited http://www.ducks.org/; The Nature Conservancy http://www.nature.org/

Resource Agency, NMFS, EPA and NRCS. Such progressive development provides useful background to how offset banking approaches have been refined and developed into current operating systems. This development process illustrates how the components of offset banking have come together.

3.2 Distinguishing features of the oofset banking system

There are multiple parties or components present within an offset banking system, as detailed in Table 3.1 below.

Table 3.1 Parties with involvement, or potential involvement, in a offset banking scheme. See *Glossary* for definition of terms

Party	Role (varries across schemes and areas of operation)
Regulator	The local, regional or state, or national administrative body over-seeing operations; usually assuming responsibility for the processing of applications for bank creation, credit issuing, credit purchasing and impacting project consent. They may also issue documents regulating/guiding scheme's operation, and may be directly involved with management and enforcement e.g. funding, monitoring, trading requirements, and land tenure restrictions.
Law-making/ legislative body	The government body producing legally binding law, statues and legislation creating the requirement for compensation of negative biodiversity impacts, authentication of *biodiversity credit* creation and trading to satisfy this (as the only, or one of various, options for compensation. See also Appendix Three: List of Acts and other official policy documents in California and New South Wales.)
Offset/ Mitigation/ Conservation *Banker*	The signatory of the legal documents establishing the bank. The banker is issued with the credits and receives proceeds directly from the credit sales. This entity may or may not own the bank land or undertake the management depending on characteristics of the scheme's design.
Credit Purchaser	An entity (potentially public or private) required by regulation to purchase credits to obtain consent for a development project which negatively impacts biodiversity
	A commercial entity voluntarily purchasing credits to ameliorate negative biodiversity aspects associated with their operations, without being required to do so by law or regulation, but due to a 'business case', such as marketing, reputation and commercial access to resources or markets[30].
	A private or public entity purchasing credits without being required to by law or regulation but utilising the system for the advancement of conservation goals.
Consultant	A private or public entity which may advise one or more of the parties

[30] The business case for Biodiversity offsetting is presented in the BBOP Document: Business and Biodiversity Offsets Programme (BBOP). 2009. Business, Biodiversity Offsets and BBOP: An Overview. BBOP, Washington, D.C. See also TEEB – The Economics of Ecosystems and Biodiversity Report for Business - Executive Summary 2010 from http://www.cbd.int/business/role/ accessed 10th June 2011

	regarding issues of law, economics, finance, management, ecology, biology and conservation management, usually conducting biological/impact assessments and further monitoring as required.
Land Owner	Entity which hold ownership title to the area of bank land. According to the scheme, the bank owner may or may not be the biodiversity banker. The land owner may change over the bank's life time.
Land Manager	Entity held responsible for conducting and co-ordinating activities required to maintain the continuing quality, integrity and perpetuity of the bank's values. This role may be held by the land owner, a consultancy entity, the banker, or an independent entity specific to the task - profitable, non-profit, government, private or community-based. The requirement for perpetual active management of banked values is a characteristic of offset banking (Agius 2001).

3.2.1 The bank site: aggregating values into one area

An important component of offset banking, distinguishing the systems from a *location-specific offset*, is the utilization of a '*bank'* (bio-, conservation, species or mitigation) (Lawhead 1997; Martin and ver Beek 2006; Nauman, Vorwerk and Brauer 2008). The bank site is the physical geographical location of the biodiversity values to which credits have been awarded (Crowe and ten Kate 2010). The legal, organisational and operational structure of the banking process provides protection and preservation for an indefinite length of time and are 'banked' safely away, analogous to funds in a savings bank. The impact which the credits will ultimately be traded in relation to need not be defined at the time of bank-creation, similarly to how initial deposits into a savings account are independent of future purchases, yet prospective purchases drive decisions related to the funds (eftec, IEEP et al., 2010). Offset banking values may be conserved, restored and protected prior to commencement of development project impacts, or even prior to any development plans (Redmond et al., 1996; ten Kate, Bishop and Bayon 2004; Darbi et al., 2009; Bendor 2009eftec, IEEP et al., 2010).

An important part of offset banking is the abilty of the bank site to have credits available in advance, without waiting for a development project to fund conservation. This is because the abilty to sell credits for a market-based price provides security favoring finacial investment in bank sites without awaiting development to occur. Premptive bank creation avoids time lags: where degradation and threats to potentially banked values continue until a mitigation-requiring project comes to fruition. Conservation can be done in a pre-emptive, preventative manner facilitating more effective conservation outcomes (Wissel and Watzold 2010).

Additionally, project proponents need not conduct lengthy and risky *re-creation* of values, nor wait for the conservation offset to be completed before the outcome can be assured. Presence of time-lags and uncertainly of conservation outcomes were significant criticisms of pioneering banking efforts (mack and Micacchion 2006; Wissel and Watzold 2010). Time-lag issues are discussed in more detail in Chapter 4 section 4.1.1.2; it is important to note here that offset banking offers a mechanism to address such issues.

A potential bank site may comprise multiple ecosystem types and multiple biodiversity values; accordingly a bank may be awarded one of many credit types (Aguis 2001; Crowe and ten Kate 2010). As credits may be created independent of impacting projects, credits from one bank may be sold to a number of purchasers requiring mitigation[31], allowing conservation and mitigation for multiple impacts be aggregated in larger parcels of land (Albrecht and Wenzel 1996; Redmond et al., 1996; USFWS Memo. Guidance. Calif. 2003; ten Kate, Bishop and Bayon 2004; Nelson and Sharman 2007). It is well documented in the ecological literature that larger geographic sections of ecosystems, as a rule, have higher functioning and biodiversity values than multiple smaller sections collectively (Shabman, Scodari and King 1996; Rodgers 1996; Pankhurst et al., 2002; Spieles 2005; White 2008; Wissel and Watzold 2010).

Alternatively, a developer may potentially purchase credits from multiple banks and/or bank-sites. This allows mechanisms for both small packages of habitat such as important habitat corridors, and large expanses of landscape to be effectively and economically included under offset banking. Huxel and Hastings (1999) note the equal importance of mechanisms which support the protection of small patches, where environmental perturbations such as disease outbreaks may be of concern. The aggregation of biodiversity values, and the preservation of larger contiguous land areas provides superior outcomes via economies of scale (both ecological and economical), with less risk[32] than can be achieved through individual, location-specific offsetting (McElfish and Nichols 1996; Marsh and Young 1996; USFWS Memo. Guidance Calif. 2003; Mack and Micacchion 2006; Spieles, Coneybeer and Horn 2006; Roberston and Hayden 2008).

---

[31] Note that individual credits may only be sold once, but that the total number of credits available at a bank site may be divided among more than one purchaser.

[32] For full discussion of risk see Chapters 4, 5 and 6

3.2.2. The trading of biodiversity values

As a market-based approach to biodiversity conservation, economic trading principles are fundamental to offset banking. The commodity - the *biodiversity credit* - is created, bought and sold by independent parties [33] (Shabman, Scodari and King 1996; ten Kate, Bishop and Bayon 2004; Moilanen et al., 2008; Nelson and Sharman 2007). In location-specific offsetting, mitigation is frequently achieved though customised negotiations, with a monetary figure agreed between parties involved and based on the specific context (Lawhead 1997; Walker et al., 2009; for examples see ten Kate, Bishop and Bayon 2004;). Given the highly specific nature of many environmental impacts and the conservation activities required to mitigate them, it has proven difficult to measure mitigation decisions against each other. As a result, issues of transparency, accountability, credibility and replicability have been raised (Goldman-Carter and McCallie 1996; ten Kate, Bishop and Bayon 2004; Nelson and Sharman 2007; EDO 2008b; Crowe and ten Kate 2010).

The use of a single metric such as a credit represents a more standardised method of measuring, monitoring, transacting and demonstrating outcomes. This makes the process more easily understood and observed by multiple parties, potentially reducing uncertainty around transactions, time-frames and labour costs. The benefits of a single metric, such as a credit, do not outweigh the difficulties surrounding metric design (Goldman-Carter and McCallie 1996; Shabman, Scodari and King 1996; Marsh and Young 1996; Steh, Tabatabai and Ambrose 2000; ten Kate 2003; Parks et al., 2003; see also EDO 2007a,b). Designing a system of commodity trading involves multiple components (Agius 2001; Crowe and ten Kate 2010). In a trading market, credits represent units of gain from conservation actions, and are ideally established as legal *property rights* through legislation (Crowe and ten Kate 2010). Chapter 2, section 2.1.8[34] discusses how to place a monetary value on a credit once it has been created (i.e. quantification), and Chapter 4, section 4.6, discusses issues surrounding how to measure the components of an ecosystem and assign an appropriate credit value to aspects of biodiversity (i.e qualification). This challenge introduces questions regarding the observation and measurement of complex biodiversity values, and subsequently attaching a meaningful metric to those values that relates to other values at that, or other, locations

[33] Discussion of economic theory related to offset banking, see Chapter 2.
[34] See also Chapter 5, section 5.4.1

(Goldman-Carter and McCallie 1996; Marsh ,Sokolove and Rhodes 1996; Stein, Tabatabai and Ambrose 2000; Aguis 2001; Nelson and Sharman 2007; Possingham et al., 2007; Crowe and ten Kate 2010). These challenges are being met through various approaches, to varying degrees of satisfaction[35] (Shabman, Scodari and King 1996; Aguis 2001; Darbi et al., 2009; Madsen, Carroll and Moore Brands 2010; see also ten Kate, Bishop and Bayon 2004; Crowe and ten Kate 2010).

3.2.3 No-Net-Loss and net gain as foundations

Concepts of *No-Net-Loss* (NNL) and *net-gain* are important components of offsetting and offset banking; defining and directing credit transactions[36] (Studt and Sokolove 1996; Albrecht and Wenzel 1996; Marsh, Sokolove and Rhodes 1996; ten Kate 2003; Nelson and Sharman 2007; EDO 2007a; Fleischer and Fox 2008; Moilanen et al., 2008; Bendor 2009; Kiesecker et al., 2009a; eftec IEEP et al., 2010). As a function of the way transactions are conducted, values lost in one location through development and are replaced elsewhere in the landscape via the purchase of credits, resulting in a stable, or preferably increasing, level of 'value' over time. Concepts of NNL have proved contentious and debate centres around whether credit trading achieves NNL on a long term basis and how it depends on the activities generating credits[37]. (Goldman-Carter and McCallie 1996; Brown and Lant 1999; Turner, Redmond and Zedler 2001; Hilderbrand, Watts and Randel 2005; Nelson and Sharman 2007; Walker et al., 2009; Maron et al., 2010). (Albrecht and Wenzel, 1996; Environmental Law Institute 2007; Darbi et al., 2009; BBOP ODH 2009f; Maron et al., 2010). Achieving NNL is a foundation of offset banking yet the principles to achieve this continue to be refined and developed (Crowe and ten Kate 2010).

3.2.4 Broadening stakeholder participation and engement of private landowners

Private land owners have an important and distinctive role to play in offsetting (Aguis 2001; O' Riordan and Stoll-Kleemann 2002; Doremus 2006; Nelson and Sharman 2007; DECC 2006;

---

[35] Economic theory supporting trading and market-based mechanisms: see Chapter 2. Discussion of privatization and commodification: see Chapter 5, section 5.2.5

[36] Note additional discussion on NNL in Chapter 4, section 4.1.1

[37]This is further discussed in Chapter 4, section 4.1.1.4

EDO 2008b, 2009a). It is important to include private landowners through active involvement in biodiversity conservation, particularly those in rural areas with increased likelihood of having significant biodiversity values on their land (Froude 1999). Such values are often inaccesible to conservation programs outside regulatory or philanthropic mechanisms, and unavailable to government agencies due to private property rights; these may therefore be most vulnerable to clearance and degradation (Memon and Skelton 2004). Biodiversity conservation also directly competes with more economically favourable land uses such as agriculture, horticulture and livestock-raising, increasing threats of clearance further. The opportunity to generate income from conservation activities on private land creates incentives more attractive to a wider range of landowners not engaged by public-benefit or altruistic approaches, particularly when regulation is involved (e.g., through planning restrictions) (Gunningham and Young 1997; Doreum 1006; Agius 2001; Martin and ver Beek 2006; Golman et al., 2008; EDO 2009a). Offset banking creates a mechanism able to access previolsy inaccessible values, offering competitive incentives to protect, restore and enhance, potentially expanding the biodiversity values under active management and strengthening the system's contribution as a conservation mechanism (Gunningham and Young 1997; Agius 2001; Nelson and Sharman 2007; DECC 2006; Crowe and ten Kate 2010; Wissel and Watzold 2010).

Offset banking creates opportunities for credit traders, brokers and speculators, depending on the system's design. (see for example Section 127ZZ, TSA NSW 1995; Masden, Carroll and Moore Brands 2010; Crowe and ten Kate 2010). Credits may be traded directly between landowner and developer, or through a central exchange or holding facility managed by governments or NGO's or specifically created private companies (Agius 2001). There is also potential for credits to be brought by traders or speculators who would then sell them on for profit, speculating on a fluctuating credit price (should credit prices be designed to fluctuate[38]) (Crowe and ten Kate 2010). Increasing the buying and selling activity within a market increases levels of stability and success, enabling more conservation to be achieved with more parties and transactions involved (Shabman, Scodari and King 1996; Agius 2001; ten Kate, Bishop and Bayon 2004; Wissel and Watzold 2010).

Additionally, there is potential that an area of land may be eligible (according to system rules and design) for both carbon credits and biodiversity credits (Walsh 1999; Aguis 2001; Crowe

[38] For expansion on how credit price or trading protocol may respond to scarcity and other factors via flexibility in value, see Wissel and Watzold 2010. Also note discussion of credit pricing in section 5.4.1, Chapter 5.

and ten Kate 2010; Ring et al. 2010). Some suggest that allowing both credit types to be generated from one parcel of land may increase the environmental benefits of carbon trading activities by favouring more ecologically defensible practices while also making attractive to a wider range of groups and individuals as a result of potentialy increased financial revenue (Walsh 1999; Bekessy and Wintel 2008; Bekesy et al. 2010; Ring et al. 2010). Increasing participation in the scheme is essential to success, intending to conserve biodiversity values currently mismanaged or misrepresented under current approaches (Martin and ver Beek 2006; BBOP 2009g).

Offset banking offers novel and additional opportunities to attract and involve an extended range of stakeholders (Gunningham and Young 1997; Crowe and ten Kate 2010). NGO's such as community groups and environmental and conservation organisations may be represented and actively involved by holding covenants/easements, operating in-lieu-fee funds, providing consultation and management expertise, purchasing or creating credits, and via involvement with enforcement and reporting (for example Centre for Natural Lands Management in California[39] and the Missionaries of the Sacred Heart in New South Wales (Appendix 4); Gunningham and Young 1997; ten Kate Bishop and bayon 2004; BBOP 2009g; Ring et al. 2010; Teresa 2008; Mead 2008; Wilkinson and Thompson 2006; BBOP 2009g). Groups may also own and operate offset banks as private or charitable entities (for example, Ducks Unlimted[40]). Others such as schools, scouts or family trusts could have interests in purchasing credits for reasons of public and corporate image, or to advance an organisations conservation objectives. For example conservation groups, community groups, individuals interested in conserving biodiversity, and non-regulated companies aiming to benefit their environmental reputation (Gunningham and Young 1997; Wissel and Watzold 2010).

Offset banking may therefore provide mechanisms and incentives for a wider group of people to show interest, through presenting conservation in a more identifiable credit format with increased appeal to those outside of the economic and environmental spheres (Martin and Verbeek 2006[41]; BBOP 2009g). Increased participation, further extending current engagement, may develop a representative and diverse body of stakeholders required to

[39] www.cnlm.org
[40] www.ducks.org
[41] Martin and Verbeek (2006) discuss how changes in individuals' behavior are related to the provision of information, whereby "People are more able to absorb information about the environment if it is presented in ways that are consistent with their existing thinking and knowledge." Page 38

appropriately represent society's interests (Gunningham and Young 1997; BBOP 2009g; Smith undated; Marsh and Young 1996; ten Kate Bishop and Bayon 2004). Considerations of how social policy contributes to achieving conservation outcomes are discussed in Chapter 6.

An important strength comes from the potential to build upon exsisting government and non-government conservation programs and projects potentially involving one or many of the potential stakeholders described above. Based on the intention to build upon current measures and increase overall conservation (DECC 2006), offset banking offers a way to improve information sharing, co-operation and capacity as stakeholders participate in one scheme with the potental to be more unified, strategic and integrated (Gunningham and Young 1997; BBOP 2009g; Martin and Verbeek 2006). Offset banking therefore contributes to a suite of conservation measures offering a complementary, rather than replacement, process to increase biodiversity conservation success (Gunningham and Young 1997; McElfish and Nicholas 1996; DECC 2006; Doremus 2006; EDO 2009a; Ring et al., 2010; PwC 2010).

3.3 Case-sudy examples

As examples, California and New South Wales banking schemes provide appropriate frameworks to understand how offset banking works through their similarities and contrasts (eftec, IEEP et al., 2010)[42]. Descriptive overviews of these two systems are detailed below and summarised in Appendix Two: Summary table comparing the key components of New South Wales Biobanking, and Conservation Banking in California, USA. While many countries are currently developing frameworks to support banking systems, both California and New South Wales are useful examples for a New Zealand context as they are amongst the most developed worldwide (eftec, IEEP 2010; Masden, Carroll and Moore Brands 2009). The comparatively stable, westernised, mixed-economy countries compare directly with the New Zealand political context. Differences between the schemes offer additional insight and allow investigation and direct comparison between the many regulatory, political, legal and operational avenues that are open for New Zealand to pursue (c.f. research by Darbi et al., 2009).

[42] See Appendix Two: Summary table comparing the key components of New South Wales Biobanking, and Conservation Banking in California, USA.

3.3.1 Biobanking in New South Wales, Australia - an introduction

NB: At time of research, the New South Wales Biobanking Scheme had been in operation for a notably shorter period of time compared to Californian systems and as such, limited literature is available on its operation. The State Government Department administering the scheme (The Department) provides the majority of information available about the scheme and is a significant source of the information discussed bellow. Additionally, much of the information provided bellow was collected via as series of Interviews conducted in Sydney in August 2010. Details of the organisations and interviewees are supplied in Appendix Four.

The state of New South Wales in southeastern Australia has one of the world's newest and most comprehensive conservation banking systems (DECC 2007; 2009g; Shields 2008; eftec, IEEP et al., 2010). The NSW State government established Biobanking within Part 7A of the Threatened Species Conservation Act 1995, and in the "Biobanking Bill" in 2008 (The Threatened Species Conservation (Biodiversity Banking) Regulation 2008)(TSA 1995; DECC 2007; TSR 2008; 2009i). This formalized biodiversity offsetting negotiation and initiated the *Biobanking scheme* (DECC 2009)[43]. The scheme focuses on being a measureable, consistent, secure, transparent and strategic system to respond to significant biodiversity loss on the east coast of NSW, predominantly in the face of extensive native vegetation clearing due to agriculture and urbanization pressure (Martin and ver Beek 1995; Agius 2001; DECC 2007; 2009j; Farrier, Kelly and London 2007; Burgin 2008; Shields 2008; Gibbons et al. 2009; Suvantola 2009).

3.3.1.1 *Credit types*

There are two kinds of credits traded in the NSW system (BAM 2008; DECC 2009i; Suvantola 2009). Ecosystem credits correspond to specific vegetation and habitat types indigenous to NSW. Species credits are issued for species whose presence cannot reliably be predicted by ecosystem or vegetation type (DECC 2007; 2008; 2009i; EDO 2008). Numerous classifications of vegetation types occur within the two credit types. Each credit, or group of identical credits,

---

[43] "The Act includes requirements for agreements, statements, biodiversity credits, trust fund, enforcement, public registers. The Regulation provides additional rules for specific aspects of the scheme (such as fees, operation of Trust Fund, criteria for biobank sites)" DECCW 2009i. See Appendix Three: Acts, and other official policy documents in California and New South Wales.

is categorized based on CMA[44] region, vegetation type, formation, surrounding vegetation, patch size and quality, producing a *credit profile* (BAM 2008). In NSW there are approximately 1600 vegetation types, 99 vegetation classes, 12 vegetation formations, 14 CMA regions, 4 classes of surrounding vegetation and 4 classes of patch size (NSW Vegetation Database). With 1600 different types this suggests that potentially, 1600 ecosystem credits, or credit profiles may be bought and sold.

Multiple kinds of species credits may be created, each pertaining to a different threatened or endangered species (DECC 2007; Suvantola 2009). Threatened and endangered species in NSW are identified and listed through the procedures outlined in the Threatened Species Conservation Act 1995 (TSA 1995), and accessed via the Threatened Species Profile Database (BAM 2008). Currently this database lists 135 separate species therefore conceivably, 135 different species credits could be created (NSW Vegetation Database; TSA 1995). In addition to this procedure, a developer may plan a project that potentially impacts a 'red flag' area, which is an area of particular value or vulnerability to loss (EDO 1008c; 2010b; BAM 2008). This is discussed in more detail in section 6.2.3, Chapter 6.

3.3.1.2 *Credit purchase*

Scheme participation is initiated when land put forward for development is surveyed for potential areas of native vegetation that may be impacted. Environmental assessments indicate potential for participation in the Biobanking scheme (Agius 2001; TSA NSW 1995; Farrier and Langdon 2007; EDO 2008c; DECC 2009i). Currently the scheme is being run as a voluntary alternative to other legislatively required environmental impact procedures[45] (Christensen 2007; Suvantola 2009; DECC 2007, 2009i). A project that will result in impact upon threatened species or native vegetation requires consent from *The Department* and the *Minister* (Threatened Species Conservation Act 1995; Native Vegetation Act 2003). Consent application must evidentially demonstrate the impact site's biodiversity values will be improved or maintained as a result of the project; this is termed 'passing the *improve or maintain* test' (IMT). Participation in the Biobanking scheme and the purchasing and retiring of credits contributes to the satisfaction of these requirements (TSA NSW Part 7A, Section 127ZJ 1995/2007; Farrier and Langdon 2007; EDO 2008c).

---

[44] CMA: Catchment Management Authority. See GLOSSARY for terms.

[45] See APPENDIX THREE: Acts, and other official policy documents in California and New South Wales.

A specifically trained, independent Department-*Accredited Assessor* uses the Assessment Methodology and the *Credit Calculator* to conduct assessments of biodiversity values at a site (DECC 2009i). The methodology is based upon vegetation condition, built from the *Habitat Hectares* approach (ten Kate, Bishop and Bayon 2004; DECC 2009j), and is a central component specifically designed for the Biobanking scheme (BBOP 2009e; Suvantola 2009; see also Parkes, Newell and Cheal, 2003; McCarthy et al., 2004; Suvantola 2009). Measurements from the Assessment Methodology are made based on current values and compared to predicted values following development (development being either the activities creating the negative biodiversity impact, or the active conservation management increasing biodiversity on the *Biobank* site) (TSR 2008; BAM 2008; DECC 2009j; Suvantola 2009; see also Possingham 2007). Once completed, Assessment Methodology calculations are sent The Department to review and approve prior to a *Biobanking Statement* being issued. The Statement details the values being impacted on in number of credits and their associated characteristics or 'profile'. This figure represents the credits the developer is required to purchase and retire to satisfy the 'improve or maintain' test required for development consent (Div. 6, S. 127ZJ, 127Zk TSA NSW 1995; Suvantola 2009; EDO 2008c).

Included in the Biobanking Statement are any on-site conservation actions required. The Assessment Methodology requires that procedures to both avoid and limit as many on-site impacts - both direct and indirect - as economically practicable must have been undertaken in order to apply for a Biobanking Statement (S. 127ZN TSA 1995; BAM 2008; DECC 2009e). With the official Statement (or even preliminary reports) issued, the developer may then choose to redesign the planned development to reduce the environmental impact thereby reducing the number of credits required to purchase, or they may choose to accept the Biobanking statement and purchase requirements. Once the Statement is accepted, the consent *authority* such as a Council or Department of Planning will incorporate this into the development consent, requiring the credits to be purchased and retired in a set timeframe, prior to impact commencement (DECC 2007; Suvantola 2009).

3.3.1.3 *Credit creation*

Biodiversity credits are created by a process initiated when landowners identify areas of existing biodiversity or areas where there is potential to restore or recreate past values (DECC 2009i). An Accredited Assessor completes a formal assessment of these values and submits the required documents and calculations to DECC, in application of a Biobanking Agreement.

This document stipulates the current values of the proposed bank, the credit amounts to be awarded and their respective *credit profiles*, and the *management actions* required to maintain these values (EDO 2008c; TSA 1NSW 1995; Suvantola 2009). Credits issued by the Agreement reflect both the ecological values currently present, and values anticipated as a result of stipulated management actions predicted to increase the biodiversity values of the site, such as permanent legal protection over the land and protective measures such as fencing and stock removal (Currnow and Fitz-Gerald 2006; DECCW 2008c; EDO 2008c; Suvantola 2009).

Once both the landowner and the Minister have signed the Agreement, the credits are considered issued and may be traded via registration on the appropriate register or direct to waiting developers or other interested parties. The Agreement is registered with the NSW Department of Lands on the property's land title (DECC 2007) and represents a contractual agreement between the owner of the land and the Minister administrating the Threatened Species Act 1995, and therefore is a legally binding agreement for management and protection, in perpetuity, of the values identified within the document (Christensen 2007; DECC 2009g; Suvantola 2009).

3.3.1.4 *Credit trade and price*

Protocol for the trading of credits is detailed on the developer's Biobanking Statement, where the credit profile specifies the CMA region or sub-region where the credits must be purchased (EDO 2008c; BAM 2008). The *Biobanking Assessment Methodology* (BAM) describes the procedure for matching the credit profiles of Ecosystem Credits (BAM 2008; Suvantola 2009). Trade of species credits must be identical. Once the credit transaction is formalised, these credits will be retired. Credit retirement is an official change of status, preventing the credits being sold in the future, and is a requirement of the Biobanking Statement (TSA 1995; Nelson and Sharman 2007). This ensures biodiversity values are not sold multiple times, or offset multiple impacts; values are therefore protected and preserved for perpetuity while increasing the likelihood of satisfying the improve or maintain goal (DECC 2007; BAM 2008). All transactions and credit retirements are lodged on the public Biobanking Register, administered by The Department, as per legislative requirements (TSA 1995; DECC 2009i). These publically available databases are designed to enhance the transparency of the process and facilitate public and NGO inclusion. Other parties such as community groups, private individuals, trusts and independent companies may also voluntarily purchase and retire credits, independent of a

Biobanking Statement, for the purpose of furthering biodiversity conservation objectives (DEC 2007; Suvantola 2009).

Pricing of credits is not set by The Department, but is to be based on a combination of market forces of supply and demand, and costs related to the *management plans* and other characteristics specific to the values concerned (DECC 2007; 2009i; Suvantola 2009). The Department offers a spreadsheet document in order to enable assessment of approximate credit prices based on management costs. The minimum credit price is therefore set by the cost of meeting the ongoing of management obligations (i.e. the amount, per credit, required to meet the *Total Fund Deposit*). In addition, the credit sale price includes any costs associated with establishing the credits, at the bank owner's discretion (DECC 2007; Suvnatola 2009). This price may represent numerous considerations, including current supply and demand of credit profiles; direct, fixed costs such as legal, assessment and/or Department fees; and indirect costs such as opportunity cost, time discounting and land values. Within this there is room for the seller of the credits to incorporate any profit margin they seek (DECC 2007; Suvantola 2009).

This design allows that ecosystems with less intensive management (perhaps because the ecosystem is in good condition requiring only maintenance as opposed to establishment of values) would sell for a lower credit price (reflecting comparatively lower management costs). Conversely, a partly degraded ecosystem, or one which has potential to support more values than are currently present, has greater potential conservation gain per unit area, so more credits may be issued for that site. These considerations ensure that incentives are present, for both credit purchaser and creator, to bank established ecosystems and areas of highest value in currently in a landscape. While a higher credit price (such as for an area undergoing restoration) may produce a greater financial transaction at the point of credit sale, the majority of revenue will be directed to the Total Fund Deposit[46] and so does not automatically equate to increased financial gain for the credit seller. The profit resulting from credit sales is a function of the time the credit takes to sell (due to opportunity cost) and demand in the market (viewed as the amount the market will bear) (Shabman, Skodari and King 1996; Marsh et al., 1996). Because the landowner is required to conduct specified management of the bank site to maintain the values banked, and well-established habitat typically requires less intensive management, landowners are expected to see the lower-priced but faster-selling credits from

[46] See section **3.3.1.6, below**

established habitat as more desirable. These features of the scheme's design align well with the broader conservation objectives of incentivising the protection of existing, high-quality biodiversity values, providing protection from alterative land uses.

3.3.1.5 *Incentives for preservation, restoration and re-creation*[47]

Mechanisms described above may represent incentives for conservation of higher-quality habitat that are attractive from a credit purchaser's perspective also. Purchasers required to mitigate specific development projects buy a prescriptive number and profile of credits, with little choice of credit purchase types (although choice between credit sellers may exist). With price as the final comparison point, the higher quality habitat is desired, on a per credit basis, as it is expected to be less costly (see above). Reduced complexity and less intensive management requirements reduce the cost of credits from a bank of pre-existing values. It also reduces the risk that the credits or bank site may be vulnerable to enforcement or compliance-related complications due to questionable restoration or similar required activities. Less time and money may be directed towards accounting for unknown outcomes and this could reduce the cost of banking values already established (for further discussion on risk and risk management in offset systems see Chapters 4, 5 and 6). Should credits from preservation or protection of established ecosystems not be currently available this encourages the active restoration and recreation of these values at degraded sites, potentially increasing the level of biodiversity within an area (De Weese 1994; Suvantola O'Riordan and Stoll-Kleemann 2002; BBOP 2009e; Maron et al., 2010). Multiple aspects to management and credit price intend to establish a balance between active restoration and effective preservation of biodiversity values in a landscape, producing optimal biodiversity outcomes.

3.3.1.6 *The Trust Fund*

Annual income to enable and support the perpetual management actions required of the landowner is provided by the Biobank *Trust Fund*, a perpetual, self-sustaining trust fund established at the point of credit sale (Division 8, S. 127ZW,ZX TSA 1995; Marsh and Young 1996; EDO 2008c; Nelson and Sharman 2007; Suvantola 2009). During the initial years of the NSW Scheme a government department manages bank Trust Funds. As the scheme matures there is potential for these funds to be managed by other entities, public or private. The Total

[47] See Chapter 4 for discussions of no-net-loss and the role of both preservation and restoration/recreation in the offset banking system

Fund Deposit for each bank is managed as a separate entity and is calculated based on the management actions required for the bank (DECC 2007; Suvantola 2009). A designated portion of the interest earned from the Fund's investment is returned to the landowner as an income stream for management; being dependant on the land owner/manager satisfying annual reporting requirements (DEC2007). Another designated portion is re-invested to maintain the purchasing power of the initial Deposit amount over time accounting for inflation, and to provide some resilience against market instabilities. Additional payments may be made to the landowner if the interest returns over a certain threshold and certain conditions are met. Payments may be delayed or reduced should the interest returns fall below a minimum threshold.

While the NSW system is young and few transactions have taken place[48] to allow analysis of the scheme's impact, The Department has gone to significant lengths to design a scheme aimed at both conservation outcomes and financial success. Great importance has been placed on the Assessment Methodology and Credit Calculator, used by both development projects and Biobank assessment, to ensure transparency and equity. A scheme of Compliance Assurance has been published, and mechanisms updating protocol, regulations, Assessment Methodology, and industry standards have been designed. The smooth, successful operation of the credit market is an observation yet to be made however the intensive input The Department has made to the establishment of the system is encouraging.

3.3.2 Conservation and Mitigation Banking in California

3.3.2.1 *Bank systems and types in California*

As previously described, both conservation (for species) and mitigation (for wetlands) banking systems are operating in California. Banks may be publicly or privately owned within an individual banking program (under the FWS or USACE respectively) and may be owned, maintained, operated and monitored by a private or public banker. All are overseen and regulated by specific regulating agencies (Darbi et al., 2009; Wilkinson and Thompson 2006). Banks may also operate in integrated public-private programs, where a government body takes responsibility for the tracking, monitoring and accounting of the banks, and employs

[48] Refer to http://www.environment.nsw.gov.au/bimspr/index.htm (accessed 10th June 2011) where the Biobanking registries provide up to date details of trades that have occurred.

private bank owners to conduct maintenance and monitoring. In both cases credits are sold direct to buyers, but in an integrated public-private program the government body is the credit seller. In an individual banking program, the private or public bank owner also sells the credits direct to purchasers (Denisoff, 2008). A third form of 'banking' is considered to be in-lieu-fee funds and in-lieu-fee mitigation programs, as described above (Wilkinson and Thompson 2006; Denisoff, 2008; Darbi et al., 2009; Committee on Mitigating Wetland Losses, et al. 2001; Crowe and ten Kate 2010).

For conservation banks to gain approval, both the CDFG and the USWFS maintain three main requirements for banks (Mead 2008):

1. The land is protected in perpetuity through acceptable conservation easements (covenants), which exist in perpetuity. *Easements* are restrictions on land-use rights, which in the banking case, restricts land-uses conflicting with the conservation objectives of the bank site (USWFS 2009; Masden, Carroll and Moore Brands 2010). It is a requirement that easements be held by a third party (commonly a not-for-profit organisation or a government department - eligibility is determined based on enforcement capabilities) (The Katoomba Group 2008; Shabman, Scodari and King 1996; Marsh, Sokolove and Rhodes 1996). For example, the conservation easement held by CDFG for the Carlsbard Highlands Conservation Bank (one of the first in California), allows CDFG to enter the property unrestricted to carry out monitoring and compliance assurance investigations, the power to restrict activities with impacts not contingent with the property's conservation aims and the rights to the air, mineral and water resources that are required to sustain and protect the biodiversity values (Toyon Environmental Consultants Inc., undated; USFWS 2009).
2. The land is managed in perpetuity to maintain conservation values and meet aims directed by regional conservation strategies, where available. Management actions range from the minimum requirement of maintaining fences, signs, rubbish control and security patrols, to active conservation inputs such as weed control, vegetation *enhancement* or breeding-site facilitation (Toyon Environmental Consultants Inc., undated). These perpetual management actions are detailed and stipulated in a long-term management plan (Studt, Sokolove and Rhodes 1996; USFWS 2009). Funds to support this management must also be provided in perpetuity, required prior to the sale of credits and usually provided through a *non-wasting endowment* similarly to the New South Wales Trust Fund mechanism described above (Marsh, Sokolove and Rhodes 1996; Shabman, Scodari and King 1996; USFWS 2009). The total fund deposit required must be provided upfront, or within a few (set) years of the bank opening, as

per the formal banking contact (See section 5.1.2 - 7, Chapter 5) (Carroll, Fox and Bayon 2008; The Katoomba Group 2008; USFWS 2009).

3. Credit pricing based on free market mechanisms. Strength of the conservation banking system is based on the requirement that credits are traded according to free-market principles (Toyon Environmental Consultants Inc., undated; Katoomba Group 2008; Carroll, Fox and Bayon 2008; Californian Government Department of Fish and Game, 2009; Masden, Carroll and Moore Brands 2010). The sale price of the credits is determined by seller and constrained by the amount the buyer is prepared to pay. Price is naturally capped based on the competing costs, incurred if developers themselves conducted the conservation and mitigation actions. Credits are considered a "quantification of the species' or habitat's conservation values within a conservation bank" (p 25 Carroll, Fox and Bayon 2008) and as such, the value of each credit is specific to the bank to which it pertains and the species/habitat within (USFWS 2009).

3.3.2.2 *The process of bank creation*

The overall goal of the conservation banking industry is to further the objectives of the ESA; namely promote the recovery of endangered species. Conservation is defined in the ESA as:

> "… the use of all methods and procedures which are necessary to bring about any endangered or threatened species to the point at which the measures provided pursuant to the ESA are not longer necessary."
>
> p. 10 Carroll, Fox and Bayon (2008)

Credits may be quantified with the assistance of available conservation plans or strategies (Marsh, Sokolove and Rhodes 1996; Environmental Law Institute 2007). Relevant experts use numerous methodologies to compile the necessary reports relating to the values of the proposed bank site (or development impact site). These are submitted to the agencies for credit calculation, and must clearly define the methodology used. Approval may be processed when information is verified and the above conditions met. The banking arrangement is placed under contract through a *Conservation Bank Agreement* (as required by the USFWS) or a *Bank Enabling Instrument* (for Mitigation Banking under the USACE) (The Katoomba Group 2008)[49]. A Conservation Banking Agreement stipulates the credits the bank is authorised to sell, the

[49] For templates see Carroll, Fox and Bayon (2008) and US Army Corps of Engineers Alexandria (2006)

exact geographic location of the bank site, the habitats and species expected to benefit from the conservation actions, and the 'trading or *service area'* that the credits from the bank can be sold within (US Army Corps of Engineers Alexadria 1996; USFWS 2003, 2009;). Some banks may be designed based on specific species credits, and purchasers would be buying these credits to offset impacts on specific listed species. Alternatively, banks may provide a *habitat bank* where purchasers are looking to offset impacts to specific habitat types, such as vernal pools, and not to offset impacts to specific species (e.g. Wildlands Inc. in Sacramento; Toyon Environmental Consultants Inc., undated).

The management plan detail the land ownership and endowment status of the bank lands, parties taking responsibility for the management actions and the details of the Management Plan (Studt and Sokolove 1996; Toyon Environmental Consultants undated). Also specified are the management actions occurring before and after the establishment of the bank, the actions to be taken to maintain the values conserved and the monitoring and reporting to accompany these actions. Management Plans will also provide evidence of the supporting perpetual financial arrangements (the *Endowment*), as above (Toyon Environmental Consultants Inc. undated; Denisoff 2008; USFWS 2009).

Together with Mitigation Banking, Conservation Banking in the United States has spurred development of a new industry and economy, particularly in California (ten Kate, Bishop and Bayon 2004; Bayon Carroll and Fox 2008; EPA 2010; Masden, Carroll and Moore Brands 2010). Earlier projects attracted some negative attention, directed at the original wetland mitigation banks (Mead 2008). Recent success, attributed to improvement and refinement upon past discrepancies, has attracted attention from multiple international interests looking to learn from the failures, and now recent successes (Bayon, Carroll and Fox 2008; USFWS 2009; EPA 2010). There is growing interest from investment institutions and investors not previously active in conservation now wanting to invest money in this developing industry (Masden, Carroll and Moore Brands 2010). Positive attention is not unfounded. Banks opened prior to 2000 are sold out of credits (indicating a strengthening, active market for credits) and at least 66,400 ha (164,000 acres) are estimated as protected and/or restored under a Conservation Banking Agreement. Transactions within the market are estimated to contribute to an overall mitigation market in excess of 1 billion US annually, making a substantial contribution to

California's and the United States' GDP[50] (The Katoomba Group; Carroll, Fox and Bayon 2008; EPA 2010). Conclusive, quantitative, scientifically robust evidence of the long-term environmental impacts of the scheme remains to be published at time of research (Wilkinson, Thompson and Thompson 2006; The Katoomba Group 2008), yet current operations offer substantial optimism for the conservation of the United States' environments and ecosystems through biodiversity banking mechanisms (Carroll, Fox and Bayon 2008; USFWS 2009; Masden, Carroll and Moore Brands 2010).

3.4 In summary: the offset banking model

While demonstrating context-specific components, offset banking systems in both California and New South Wales demonstrate how the various components of offset banking may be brought together. Such examples illustrate how systems are established: a range of biodiversity-related credits are created, traded and regulated to mitigate residual negative environmental impacts of development projects, with a focus on achieving collective conservation outcomes. These observations of California and New South Wales provide valuable guidance to New Zealand in understanding the foundational components of offset banking. This supports analysis appropriate for contextually specific New Zealand design, and developing potential for an offset banking system.

[50] Note the 2010 publication by Masden, Carroll and Moore Brands, stating that there are 615 active or sold out banks currently, protecting or restoring 24,000 annually, representing a cumulative figure of 700,00 acres in total and estimates of total payments being made across the US being 2.4 Billion annually.

CHAPTER FOUR

RISK WITHIN THE OFFSET BANKING SYSTEM (BIOLOGICAL RISK)

4.0 Introduction to a tripartite framework of offset banking risk

The term risk refers to the perceived likelihood of undesirable outcomes. Sustainable development systems such as offset banking are a response to risk: a solution offered to reduce biodiversity loss and the negative consequences that may result. However, if offset banking fails to deliver intended outcomes, then biodiversity values will still be lost. Such potential risk of offset banking, both perceived and present, requires consideration and must be addressed to make offset banking a successful sustainable development tool. Proper understanding of the origin and nature of risks within offset banking is essential.

Poor decisions, management and conservation outcomes in the past have generated scepticism of new approaches with concern that they represent a situation where the stakes are high, and risk of failure is a great concern. The nature of this 'risk' debate can be broadly summarised as the likelihood that offset banking does not achieve the objectives intended, and fails to stop biodiversity loss (Bonnie and Wilcove 2008). Successful offsetting is based upon a comprehensive understanding and recognition of risk. With understanding, effective risk mitigation and management is possible. The following chapters (4, 5 and 6) address the many forms of risk present in offset banking (Gardner and Radwan 2005).

Chapter 4 begins discussions from the perspective of the systems' biological components. I introduce concepts of offset banking risk, first broadly categorising sources of risk within offset banking as potential loss of biodiversity (section 4.1) and risk present due to uncertainty in scientific knowledge (section 4.4.). This establishes a broader basis for the risk mitigation discussion following each of these overviews. Risk may also be present for financial/legal reasons or through the behaviour of humans or society; this is addressed in Chapters 5 and 6 respectively. Examples taken from the Californian and New South Wales systems illustrate mechanisms that are used in design and implementation of offset banking to address these risks.

To discuss the risks presented in Chapters 4, 5 and 6 two important points must be recognised. First, biodiversity conservation must consider the ecological, economic and social background within which offset banking occurs to achieve maximum efficiency and efficacy within the system (Gunningham and Young 1997; Hartig and Drechsler 2009). This is the basis for conceptual division of Chapters 4, 5 and

6 - biological failure, financial failure and human failure - and reflects offset banking as a sustainable development mechanism. Environmental, economic and societal risks must be balanced so that maximisation of one of these aspects does not undesirably affect the others. Reducing risks within offset banking must be appropriate to the balance of sustainable development and is a fundamental context for risk mitigation discussions.

Secondly, measures must consider risk relatively and comparatively. Discussion of risk must occur in the context of risks present in other options for biodiversity conservation more widely, rather than focusing on risk in isolation (Stephens 1999; Spieles 2005; Mack and Micacchion 2006; Bekessy et al., 2010). Specifically, an alternative option may be to continue with current conservation practices and mechanisms. Another is to adopt some potentially risky but potentially beneficial sustainable development mechanisms such as offset banking. A third option may exist, where debate continues without final decisions, potentially carrying far greater risk as biodiversity loss irrefutably continues. This perspective is also important when considering offset banking for specific sites and development impacts. Perceived risks must be assessed based on alternatives present, giving particular regard to the risk of biodiversity loss because values are expected to continue to decline without conservation. Without development providing an offset opportunity, a status quo of no conservation can be expected to persist so values will continue to decline and the risk of biodiversity loss will be realised regardless.

With this thesis' context of implementing offset banking, I discuss offset banking tools as fundamental components of risk mitigation: each has been proposed, developed or applied with the underlying requirement that risk is reduced when it is applied, given informed understanding and consideration. Risk mitigation is the underlying requirement that links discussion of the offset banking components discussed in these chapters. Without adequate understanding of the reasons for applying these tools it is unlikely that they will be utilised with maximum efficiency, effectiveness and success. Recognising this is fundamental to properly applying offset banking tools. If risks within offset banking are approached through informed application of the mechanisms reviewed here, then offset banking is able to offer a sustainable development option where definable and manageable risks are outweighed by significant benefits, for overall success for biodiversity in the landscape.

4.0.1 Recognising previous losses: why do banks fail?

Examples of unsuccessful banking operations to date have demonstrated the distinct risk that a bank will fail to achieve suitable outcomes (Gardner and Radwan 2005). Some suggest the offsetting premise is inherently flawed; others have used unsuccessful examples as an opportunity to refine and progress the system for the future (DeWeese 1994; Redmond et al 1996; Turner, Redmond and Zedler 2001; Robb 2002; Mack and Micacchion 2006; Hallwood 2007; Gibbons and Lindenmayer 2007; EDO 2007b, 2008b).

Studies have shown that projects may fail to reach ecological criteria and therefore mitigation outcomes (Spieles 2005; Spieles, Coneybeer and Horn 2006; Robertson 2004). Based on evaluation of ecological status of 45 wetland mitigation sites across 21 States of America, Spieles (2005) demonstrated shortfalls in appropriately meeting criteria (the prevalence of wetland vegetation, the pervasiveness of non-native species, and plant species richness) during study time frames, mostly between 5 - 10 years (Spieles 2005; Spieles, Coneybeer and Horn 2006).

Table 4.1: Summary of ecological compliance assessments available in 1996 as reviewed by Spieles 2005 p. 12

Source	State	Data
Allan and Feddma 1996	California	43% of 75 wetland mitigation banks met all success criteria
Cole and Shafer 2002	Pennsylvania	62% of 13 mitigation sites were judged successful by authors
Morgan and Roberts 2003	Tennessee	40% of 50 mitigation projects met the area requirements
		4% of 50 mitigation projects met all permit requirements
Robb 2002	Massachusetts	64% all mitigation sites (various habitat types) successful
Brown and Veneman 2001	Massachusetts	65% of 114 sites were in compliance

Table 4.2: Summary of findings from reviews of permit compliance

Source	State	Findings
Redmond et al., 1996	Composite	30% of required mitigation projects not implemented
		Low rates of compliance with mitigation plan
		27% of projects deemed ecologically successful
		Potential for ecological success in 63% (with remedial action)
Turner, Redmond and Zelder 2001	Orange County, CA	80 permits between 1985 - 93: 30 met permit conditions, 19 met some, 6 met none, 13 uncompleted, 2 not attempted.
Robb 2002	Indiana	High rates of non-compliance
Mack and Micacchion 2006; Committee on Mitigating Wetland Losses et al. (2001)	Ohio	Compliance rate of 66.6%; result of poor design, planning and/or inappropriate/insufficient management
Race and Fonseca 1996	Florida	High rates of non-compliance

Studies have also discussed why such a shortfall in ecological criteria may have occurred, supported by a number of reviews of early wetland mitigation in the United States (Table 4.1) (Gardner and Radwan 2005). McElfish and Nicholson (1996) contribute three possible reasons for failure. Firstly, the projects are improperly designed or constructed due to ill-informed decisions particularly surrounding soils, hydrology, plant selection, or offsite effects. Secondly, regulating agencies did not enforce or monitor to an adequate standard due to resources or leverage capacities (Hallwood 2007). Thirdly, damage sometimes occurred after the project was established; a result of human error (unintentional or intentional), or natural causes.

Optimism is possible however. Successful examples have largely been attributed to many of the reasons favouring the offset banking approach: economies of scale and the consolidation of scientific, planning, management resources (Mack and Micacchion 2006). Importantly, some of this early evidence is based on examples independent of a truly free-market banking framework. If made possible, third-party bankers can assist mitigating risks identified in early failures. It is suggested they introduce more defined liability, easing enforcement and more stringent regulation of management plans. This allows earlier intervention where planned actions are poorly designed or ill-informed (Redmond et al., 1996). Comparative analyses have investigated the risk of bank failure in relation to failure within alternative offsetting approaches (Spieles 2005; Roberston and Hayden 2008; Mack and Micacchion 2006). Such research supports the opinion that while demonstrated risks are present in offset banking, it offers notable benefits and reduced risk of negative outcomes when analysed this way.

4.0.2 Controllable and uncontrollable risk

When considering the biology-related components to the risk within an offset banking system, a primary issue is the broad concern that the biological values (i.e. the biodiversity) continue to be lost over the course of the schemes' operation. There are many reasons why the biological components may fail in this way. Therefore there are also many measures possible to try and avert this failure and mitigate this risk. When considering a multitude of risks and responding measures it is valuable to distinguish between controllable and uncontrollable risks, so that the most appropriate and effective mechanisms are applied (Shabman, Scodari and King 1996).

Controllable risks are those for which the margin of error is known[51]. The exact outcome may not be initially predicted with any more certainty, but the range of values it may take may be confidently estimated, supported by previous observation and/or empirical testing. Alternatively, in situations with limited information, such as when new approaches are being trailed, such parameters are unlikely to be known and the associated risk of failure may be considered uncontrollable. In these situations, not only is the final outcome uncertain, but there is limited knowledge regarding what the possible outcomes may be, the factors that influence the outcomes, or the relative likelihood of outcomes expected.

Knowing the factors and likelihood related to different outcomes has direct implications for a decision-maker's capacity to implement risk mitigation measures. Offset banking decisions may include how many seedlings to plant, or how large an area to manage to achieve a desired biodiversity outcome. If information is available, risks are controllable and it may be possible to determine the number of seedlings or area of management large enough to reduce the risk where should realistic seedling or management failure occur, this can occur without significantly jeopardising biodiversity values overall. However, without information supporting calculations of expected failure, risks are deemed uncontrollable and it is not possible to calculate the increase in seedlings or area that effectively reduces the risk. Arguably, without appropriate knowledge, arbitrarily increasing seedlings or managed area actually increases risk, as there are more values that may be lost. It is possible to apply a similar analogy to decisions relating to financial and social aspects of biodiversity management, such as contract and employment selection, or expenditure and investment decisions.

---

[51] Note the distinction made by Daly and Farley (2004) where: "Risk: the known probability (relative frequency) of occurrences of an event. Risk is insurable. See Uncertainty…a situation in which we may know the range of possible outcomes but do not know the probability distribution of outcomes. Uncertainty is uninsurable. See risk [Glossary, pg. 439 and 44]" (2004).

With adequate information and controllable risks, risk-mitigation techniques are available. In the absence of appropriate information, alternatives must be applied. Broadly, controllable risks may be mitigated through application of margins (such as number of seedlings planted, or units of area managed) that accommodates risk within the system to a level no longer threatening the broader aims. Uncontrollable risk may be mitigated by enforcement of rules or parameters, or interventionist approaches, such as seedling fertilisation or adaptive management and monitoring of the managed area. It is important to recognise these different manifestations of risk and corresponding responses, as the application of an inappropriate mechanisms is likely to be ineffective, or at worse, counter-productive.

Risks relating to previous failure and underlying uncertainties are exemplified here in relation to biological, financial and social concerns. The variety techniques for risk mitigation necessarily part of system design and operation address one but sometimes several of these components. Discussed bellow is risk and risk mitigation in relation to biological issues within offset banking.

4.1 Biological risk: the risk of loss

4.1.1 The No-Net-Loss paradigm

No Net Loss (NNL) is one of the most important concepts in offset banking as it is the primary way that risk of increased biodiversity loss is addressed (Bendor 2009). It draws on the assumption that achieving a NNL policy will minimise the risk of biodiversity loss. In many cases NNL is a scheme's overarching goal (Crowe and ten Kate 2010). In some contexts intended outcomes extend to a net positive balance, or increase in biodiversity; terms net-gain, *ecological lift* or *additionality* are also used (Robertson 2004; Crowe and ten Kate 2010). Under NNL, biodiversity lost due to negative development impacts are replaced through offset banking in a manner that ensures the overall balance of biodiversity is not reduced. While being the central tenet of the biodiversity offsetting and banking, the concept of NNL is also the most widely debated (Thom, Williams and Diefenderfer 2005; Fleischer and Fox 2008; Moilanen et al., 2008; Bendor 2009). Various principles, approaches and mechanisms have been developed and applied as a result. These are summarily described bellow as their proper application requires a competent understanding of how they work so potential misapplication and undesired outcomes can be avoided.

4.1.1.1 *No Net Loss in space: the importance of scale*

To understanding how the NNL concept is applied, it is necessary to consider the spatial scale at which losses or gains are occurring. NNL may be considered on numerous levels of biodiversity such as: an individual member of a species, an individual impact, an individual offset banking site, the dynamics of a species' population or metapopulation, at the level of the viability of the species or ecosystem over a landscape or more widely, or over an entire distribution (Bruggeman et al., 2009; Hartig and Drechsler 2009).

As offset banking facilitates the replacement of one patch of biodiversity by another in a differing location within a landscape, there is risk that although the values themselves will be inadequately replaced between sites, the landscape level processes and values will be altered, facilitating broader-scale biodiversity loss and frustrating the NNL objective (Bruggeman et al., 2008; Palmer and Filoso 2009; eftec, IEEP et al., 2010; Hillman and Instone 2010). Landcape-level processes such as fragmentation and connectivity; edge, buffer and matrix effects; heterogeneity, patch dynamics and dispersal have significant influence when considering the viability and existence of species (Huxel and Hastings 1999; Laurance et al., 2002; Sanderson et al., 2002; Burgman, Lindermayer and Mayer 2005; Burgman et al., 2009; Hartig and Drechsler 2009; Samways Bazelet and Pryke 2010; Watts and Handley 2010). Consideration of NNL at one scale does not assure comprehensive NNL at another, so mitigation of risk though NNL principles is advised to consider multiple spatial scales (Robertson and Hayden 2008; BBOP 2009f; Bendor 2009).

System dynamics modelling (Bendor, 2009) such as assessing NNL after aggregating multiple offsets across a landscape, has demonstrated how broader-scale perspectives more appropriately reflects whether NNL is being achieved. This analysis concluded that despite NNL occurring within individual projects, even small levels of loss can result in significant biodiversity losses when accumulated on aggregated scales (Bendor 2009).

Offset banking encourages the consideration of NNL from broader cumulative and landscape levels, compared to non-banking offset approaches[52]. It holds potential as a mechanism to effectively mitigate risk of broad-scale biodiversity loss by providing superior economies of scale both biologically and economically (eftec, IEEP et al., 2010). Offset banking supports forward planning and coordinated decision-making with the aggregation of biodiversity so that important landscape-level processes, such as connectivity, larger patch sizes and optimal spatial configurations can be accommodated and maintained to the benefit of the biology and economics concerned (Huxel and Hastings 1999; Laurance et al., 2002; White 2008; eftec, IEEP et al., 2010). Design of an offset banking system offers an approach to reduce risks posed by the multiple scales of ecology within biological systems.

4.1.1.2 *No Net Loss in time: temporal lags*

Risk of disparity between values banked and those they are designed to replace may also be viewed from a temporal perspective (Kiesecker et al. 2009; Hillman and Instone 2010). If the conservation actions are undertaken prior to or concurrently with the development's impact on biodiversity, time lags may represent a significant risk (Robertson and Hayden 2008; Bedward et al. 2009; Bendor 2009[53]). Generally, a development project destroys certain biodiversity values completely, almost instantaneously. Actions to offset this loss are initiated, yet mitigation involving restoration or re-creation of biodiversity values will take time to produce replacement values because of the time required for biological process, such as translocation, dispersal, individual and population establishment, growth and reproduction to occur (Bendor 2009). It is not possible to reverse the damage of the impact if it is discovered some time later that the conditions of the mitigation project (bank or offset) have changed and no longer represent the values destroyed (Bekessy et al., 2010). A temporal gap introduces risk that some or all replacement values may be lost, or fail to be recreated due to chance, unpredicted elements or catastrophic disruptions (EDO 2008b; Robertson and Hayden 2008; Bedward et al. 2009; Bendor 2009; Hammond-Deakin 2009; Bekessy et al., 2010). The risks posed by temporal gaps may be addressed within an offset banking system when credits are only available to offset impacts when the values meet appropriate levels and standards (Bendor 2009). Importantly, there also are circumstances in both case-study systems when credits may be issued prior to the conclusive establishment of these values[54].

[53] Bendor 2009 summarizes temporal risk as three components: Temporal loss is comprised of three things 1) time gap between actions; 2) time taken to restore; 3) risk that the site fails.

[54] While it is biologically desirable to demonstrate the existence of values prior to credit issuance and trade, there are some circumstances in which it is advantageous to issue and trade credits prior to fully replacement of values. This is an important aspect of risk mitigation, both biologically and financially and is discussed in section 5.6.3.1, Chapter 5.

4.1.1.3 *No Net Loss in the landscape: the cumulative outcomes*

Whether NNL loss is achieved across various spatial and temporal scales is the focus of much debate. Critics of offsetting and offset banking actions to date suggest that NNL policies currently in place around the world may not deliver NNL at macro scales, such as over multiple years, or entire landscapes (Bonnie and Wilcove 2008; Hillman and Instone 2010). BBOP (2009e) raises concerns as to whether NNL will continue to be achieved over time and whole landscapes, as it depends on the policies and mechanisms that are used to achieve NNL.

As offset banking occurs over time and depending on the approaches employed, space within a landscape may be occupied either by patches of development (representing biodiversity removal) or the bank-site offsetting the impacts. Whether or not the final outcome achieves NNL once all space in a landscape is occupied by either land-use, depends on the actions employed under offset banking. Should each area unit of development be offset with one unit of area of biodiversity protection, the 'end game' landscape will be a composite of 50% development patches and 50% biodiversity patches; effectively only 50% of the biodiversity remains and consequently NNL is not achieved. Alternatively, if a unit of impact is offset with a unit of biodiversity that was not there previously (i.e. via restoration, enhancement or re-creation), BBOP argue that, within the bounds of ecological restoration and re-creation science, a net balance of 0% habitat loss is possible through active restoration, not preservation alone (BBOP 2009e; Bekessy et al., 2010). Therefore debate concerning how to achieve NNL must consider a range of actions potentially included under offset banking (Bekessy et al., 2010).

While the above argument may be based on NNL of habitat or biodiversity in unit area, it is possible to consider a situation where net area is reduced, but alternative conservation gains are made that produce an overall net increase more broadly in biodiversity values. This is of particular relevance in highly degraded areas, such as areas and ecosystems within New Zealand. Knowledge and understanding of the multiple scales of biology and biodiversity, and the importance of landscape level influences mean that increased species and habitat viability through improved gene-flow, increased breeding populations and other increases in fitness may be achieved through offset banking, and supporting NNL in biodiversity values despite a net loss of spatial area (Fleischer and Fox 2008).

4.1.1.4 *Choice of action to achieve NNL*

Conservation actions potentially applied under biodiversity offsetting such as preservation, protection, restoration, rehabilitation, enhancement, *re-establishment*, creation and recreation of biodiversity are debated in literature (Agius 2001; Spieles 2005; Spieles, Coneybeer and Horn 2006; Bonnie and Wilcove 2008; BBOP ODH 2009e; Bekessy et al., 2010). Given the differing potential of each to achieve NNL, prioritising these approaches in an offset banking system is of particular concern; also that specific conservation actions (e.g. tree-planting) be clarified according to these categories above (e.g. restoration versus rehabilitation).

Kiesecker et al., (2009a) suggests that where development pressure threatens to increase removal of vegetation or draining of wetlands or other environmental degradation, it is very important to ensure that existing values do not succumb to these pressures. This accentuates the potential role for preservation such as increasing legal protection that reduces future development and risks posed by such impacts (Bonnie and Wilcove 2008; Kiesecker et al., 2009a).

Walker, Price and Stephenson's (2008) Index of Risk in New Zealand supported this conclusion with models demonstrating that the legal protection of land has a significant impact on the long-term existence of biodiversity values. Values located on private land under limited legal protection exhibit high levels of clearance and degradation so increasing the protection of such values is a pertinent focus. Preservation may not always be appropriate for achieving NNL however. If values concerned are under no threat of clearance or degradation, then protection and preservation may not achieve NNL (Fleischer and Fox, 2008). In the absence of the threat of destruction, preservation may still be relevant to consider where there is risk of degradation. Bonnie and Wilcove (2008) highlight that even under legislation restricting negative impacts to biodiversity there may be no impetus for landowners to prevent gradual decline. NNL in a landscape may be jeopardised by gradual decline of both protected and unprotected values, so appropriate steps must be taken to address this.

Literature comparing the importance of preservation or restoration of biodiversity values suggests that optimally, conservation of biodiversity and avoidance of net loss at the landscape level ideally accommodates elements of both preservation and active restoration (Agius 2001; Bonnie and Wilcove 2008; Maron et al., 2010). This parallels recognition that achievement of banking objectives should not be assessed based on area alone (Turner, Redmond and Zedler 2001; Spieles 2005; Bendor 2009; Crowe and ten Kate 2010). Many aspects of the success or failure of early mitigation attempts in the United States are assessed and discussed in literature, most importantly recognising that the consideration of NNL based exclusively on area lost versus area gained or preserved is inappropriate when the overall aim of offset banking is NNL of biodiversity values overall (Bendor 2009; Turner, Redmond and Zedler 2001; Spiele 2005; Crowe and ten Kate 2010).

4.1.1.5 *Mitigating risks via NNL policy: international applications*

How does New South Wales' policy address NNL?

The NNL approach is widely adopted in international policies, such as California and New South Wales. The 'improve or maintain' test (IMT) within the Native Vegetation Act (2003) is introduced as the mechanism to achieve NNL in New South Wales, and requires the test to be satisfied (i.e. proposals to be considered 'improving' or 'maintaining' values) to allow development activities (Farrier, Kelly and London 2007; Hammond-Deakin 2009). Under this jurisdiction the improvement of the status quo is required in the first instance, with maintenance of values being the minimum acceptable standard (*c.f.* DEWR 2007).

Section 3 states: "The objects of this Act are:
(a) to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and
(b) to prevent broadscale clearing unless it improves or maintains environmental outcomes, and
(c) to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and
(d) to improve the condition of existing native vegetation, particularly where it has high conservation value, and
(e) to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation,
in accordance with the principles of ecologically sustainable development."
p. 2 NVA (2003)

The Scheme's Biodiversity Assessmen Methodology (*BAM*) prescribes the calculations to determine whether actions proposed meet the IMT. It specifies how to quantify the values concerned and how to calculate the number and type of credits that need to be traded (between project proponent and Biobank credit owner) for the IMT to be satisfied (EDO 2007b; Farrier Kelly and Langdon 2007). A

Biobanking Statement can only be issued, and development impacts be offset by purchasing credits, once this has occurred (Hammond-Deakin 2009). Whether satisfying this test achieves NNL and risk mitigation as intended depends on how BAM's design calculates test outcomes. Should the methodology's design or application fail to reflect actual improve or maintain realities, then it is unlikely to truly reflect NNL of values (EDO 2007b). In this way the BAM is the primary risk-mitigation mechanism in the New South Wales system, and a powerful determinate of whether NNL is achieved and risk of biodiversity loss is mitigated.

How does California policy address NNL?

Bendor (2009) describes NNL with policies in The United States:

"In 1987, the U.S. Environmental Protection Agency (EPA) convened the National Wetlands Policy Forum (NWPF), a wide array of stakeholders whose goal was to 'address major policy concerns about how the nation should protect and manage its valuable wetlands resources (National Wetlands Policy Forum, 1988, p. vii).' The forum attempted to refocus United States wetland regulation towards a policy of 'no net loss,' recommending that:

'...the nation establish a national wetlands protection policy to achieve no overall net loss of the nation's remaining wet- land base, as defined by acreage and function, and to restore and create wetlands, where feasible, to increase the quality and quantity of the nation's wetland resource base (National Wetlands Policy Forum, 1988, p. 3).'

Since the NWPF, the policy goal of 'no net loss' of wetlands has become a driving force behind wetlands management throughout the United States (Hansen, 2006) … In 1990, the Corps and EPA formally endorsed no net loss…(Corps and EPA, 1990)."

The 1990 Memorandum of Agreement between the Department of the Army and the Environmental Protection Agency recognises that it may not be possible to achieve this at the scale of all individual projects, but instead focuses on achieving this on a nation wide, 'wetland base' scale (MOA 1990). This document states that the most appropriate way of establishing or measuring NNL is through the use of professional judgement of the environmental lost or gain resulting from considered projects, owing to the complexity and high variability of wetland values across the country. Based on this information, regulatory agencies then make the decision as to whether NNL has been satisfied (This is in contrast to the prescribed, standardised approach of the NSW BAM).

Rather than requiring NNL, conservation banking system focuses on improving the conservation outcomes of listed species, through

"…the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." p. 2 ESA (1973)

Transactions must further the conservation goals of the species and not place the species' continued existence in jeopardy through loss or reduction in the species' chances of survival, instead of being concerned with area, extent or quality (ESA USFWS 1973). Threats posed to the species' existence under a given development proposal should be considered in relation to the species' specific conservation needs such as corridors or breeding habitat requirements. This is in line with other non-area based perspectives, which suggest that a measure of biodiversity values may not be directly proportional to the unit area of land occupied by said values (Bonnie and Wilcove 2008; Fleischer and Fox 2008).

4.1.2 Mechanisms for achieving NNL: the Mitigation Hierarchy

To achieve NNL in light of previous failures, a range of mechanisms concerned with the ecological components of the process and outcomes have been put in place in offset banking systems around the world. Some mechanisms attempt to circumvent potential losses before they occur. Others seek to account for biological risks within decision-making and design so that the potential for failure causes minimal jeopardy to overall NNL. A primary mechanism is adherence to the *Mitigation Hierarchy*, widely promoted within industry, and strongly supported in literature (Robb 2002; BBOP 2009a; BBOP 2009f; 2010; Darbi et al., 2009; Bekessy et al 2010 PcW 2010; Christensen and Burge 2010). As with other NNL policies, the assumption underlying the Mitigation Hierarchy is that strict adherence to this policy will greatly reduce the risk of overall biodiversity loss.

The importance of this concept is represented in BBOP's offsetting principles[55]; point 3 of 10 states:

"Adherence to the mitigation hierarchy: A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimization and on-site rehabilitation measures have been taken according to the mitigation hierarchy."

p 9, BBOP (2009f)

[55] See APPENDIX ONE: The Principles of Biodiversity Offsetting as described by various sources

The mitigation hierarchy represents a way to limit the risk of spatial loss of biodiversity values (as discussed in section 4.1.1. NNL in space: the importance of scale) (PwC 2010; Naumann, Vorerk and Brauer 2008). The hierarchy stipulates that only residual, unavoidable losses to biodiversity are addressed through banking. Optimally, the least amount of destruction of values at the impact site will prevent a geographic area achieving NNL or net gain at the expense of another region. Maintaining as many values in situ as possible attempts to minimise spatial reorientation (as per section 4.1.3) that may detrimentally disrupt important landscape processes, and risking biodiversity loss and failure of NNL (Palmer and Filoso 2009).

The hierarchy has been described by numerous different publications, with varying terminology and through a range of interpretations (US FWS MOA 1990; Brown and Lant 1999; Koppel and Peters 2004; EIL 2007; Moilanen et al., 2008; Naumann, Vorwerk and Brauer 2008; BBOP 2009a; Darbi et al., 2009; eftec, IEEP et al., 2010). The Convention on Biological Diversity also recognises the significance of the mitigation hierarchy. Parties must include an unambiguous requirement for application of the mitigation hierarchy to achieve NNL and to be guided by the best practice established by BBOP (UNEP 2010).

As an example of one approach, BBOP 2009a[56] considers that:

"The mitigation hierarchy is defined as:

(a) Avoidance: measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity. This results in a change to a 'business as usual' approach.

(b) Minimisation: measures taken to reduce the duration, intensity and / or extent of impacts that cannot be completely avoided, as far as is practically feasible.

(c) Rehabilitation / restoration: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and / or minimised.

(d) Offset: measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve no net loss or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity."

[56] Note additional hierarchies in eftec, IEEP et al., 2010; PwC 2010; Darbi et al., 2009; Naumann, Vorwerk and Brauer 2008

The term mitigation may be used to refer to the whole sequence of actions that are conducted within the hierarchy, or specifically related to particular step(s) (compare PwC 2010; BBOP 2009; Darbi et al., 2009). European perspectives most commonly consider mitigation to be the first two steps of avoidance and minimisation (Moilanen et al., 2008; see BBOP 2009 a, f; eftec, IEEP 2010). It is the final 'mitigation' step that offset banking is considered. In the North American context the term mitigation commonly refers specifically to the third step of offsetting and offset banking[57] (MOA 1990; Robertson and Hayden 2008; Darbi et al., 2009; Moilanen et al., 2008; eftec, IEEP 2010).

Notwithstanding different approaches to the mitigation hierarchy, a unifying characteristic is that offset banking should only be concerned with residual impacts remaining after the first two steps have been completed (EDO 2006a; Burgin 2008; Kiesecker et al. 2008; BBOP 2009a; Bekessy et al. 2010). It is incompatible with principles of NNL to consider offset banking as an isolated mechanism to address negative environmental impacts from development, without addressing avoidance and minimisation measures (BBOP 2009a; Darbi et al., 2009; Kiesecker et al., 2009; BAM DECC 2008).

4.1.2.1 *Applying the Mitigation Hierarchy to minimise risk: making decisions to prioritise and progress.*

To apply the mitigation hierarchy to best effect there must be definition of how to progress through the steps. Decisions must be made about which of the range of avoidance, minimisation and mitigation actions to take (Christensen and Burge 2010). Actions considered need to be definitively attributed to a step in the hierarchy, so priorities may be established. Whether conservation actions such as land-contouring, tree-planting or soil conservation are considered avoidance, minimisation or mitigation directly determines the priority actions should be conducted in. Prioritising actions incorrectly may mean the mitigation hierarchy is not properly applied, rendering NNL and risk-mitigation unsuccessful.

Debate also surrounds how to clarify when it is appropriate to progress to the next step of the Mitigation Hierarchy, e.g. how is it established that an acceptable level of avoidance has occurred and minimisation should be then be addressed (Kisecker et al., 2008; Christensen and Burge 2010; PwC 2010). Some perspectives support decision-making based on maximum benefit to a species or habitat where all possible actions should be taken at each step before proceeding to the next based on the assumption this represents the lowest risk and best possible outcome for biodiversity. At the extreme

[57] See APPENDIX FIVE: Table comparing and distinguishing variation in definition of associated terms, across regions, and GLOSSARY for more on use of terms such as compensation.

of this perspective is complete avoidance by refraining from the development entirely (Christensen and Burge 2010). This is not in line with the additional sustainable development objectives however and forgoing some on-site measures of avoidance and minimisation in favour of offset banking may represent superior conservation gain when improved economies of scale, aggregation of ecological benefits, or the conservation of more valuable biodiversity is possible (White 2008; Kiesecker et al., 2008; eftec, IEEP et al., 2010).

Actions within the hierarchy carry different costs and represent varying biodiversity gains. Choice of actions impact how much conservation gain is made for how much cost. Some perspectives support decisions based on economic efficiency: maximum gain possible for a given resources and financial input (MOA 1990; Kiesecker et al., 2008; Christensen and Burge 2010; see also DECCW). Alternatively, the degree to which impacts should be avoided may depend on the irreplaceably of the values concerned: highly irreplaceable values require higher prioritisation of avoidance measures (Kiesecker et al., 2008). Decision-making best occurs under the guidance of a strategic conservation plan (Kiesecker et al., 2008). Categorising a landscape based on development and conservation land-uses guided by prioritisation and broad-scale goals helps to identify areas where each step of the hierarchy (avoidance, minimisation and mitigation) can be optimally applied. Cumulative impacts may then be properly considered and offset options can be more flexible. Proponents argue this can increase assurances that decisions within the mitigation hierarchy can achieve NNL (Kiesecker et al., 2008).

4.1.2.2 *The Mitigation Hierarchy in case studies*

How is the Mitigation Hierarchy applied in case study examples?

New South Wales

Operation within the step-wise mitigation hierarchy framework is an integral component of the Californian and New South Wales systems[58]. New South Wales' legislation requires adherence to a sequential process of mitigation and is an important component of the scheme's success (EDO 2008b; see also DECCW).

The BAM (DECC 2008) states:

"The applicant for a Biobanking Statement is required to demonstrate that all cost-effective non-site measures to minimise any negative impacts of the development on biodiversity values are being, or will

be carried out (section 127ZL (4)(d) of the TSA Act). This includes both on-site and off-site (indirect) impacts. Before issuing a Biobanking Statement, the Director General must be satisfied that the applicant has demonstrated that all cost-effective on-site measures to minimise any negative impact of the development on on-site or off-site (indirect) biodiversity values are being or will be carried out. These measures may be included as conditions on a Biobanking Statement issued in respect of the development." p. 7 BAM DECC (2008)

Section 127ZK of the Threatened Species Act (1995), Section 127ZK, states:

"(3) An application for a biobanking statement must be accompanied by…
(b) a statement of any onsite measures that are proposed to be taken in connection with the development to minimise the impact of the development on biodiversity values" p. 89

Additionally, under Section 127ZL of the same act:

"In addition, the Director-General may refuse an application for the issue of a biobanking statement: … (d) if, in the opinion of the Director-General, the applicant has not demonstrated that all cost effective onsite measures to minimise any negative impact of the development on biodiversity values are being or will be carried out" p. 90

Requirement to demonstrate prior minimisation measures is also included in provisions relating to red-flag alternation[59] and deferred retirement of credits[60] (DECC 2008) however the first step of the hierarchy is not as extensively considered in New South Wales' legislation.

California

In the United States, official documents require the following of a process identifiable as the mitigation hierarchy (USFSW 2003; MOA 1990; US Federal Register 60(228) 1995), termed '*sequencing'* (Brown and Lant 1999). This is established under the CWA administering the wetland mitigation banking program (US Federal Register 60(228) 1995; MOA 1990; USFSW 2003):

Part II (c) 1. " Avoidance. Section 230.10(a) allows permit issuance for only the least environmentally damaging practicable alternative. The thrust of this section on alternatives is

[59] For explanation of this term see Chapter 6, Section 6.2.3

[60] This allows developers to purchase credits, but sell them on if they do not need them. This may occur if certain impacts were predicted at the initiation of the development, but did not come to pass. This may be a result of the nature of the development (inherent unpredictability) or operate as a mechanism to promote maximum on-site conservation measures by the development proponents. The more impact their development has, the more credits they will need to retire, the less they will be able to retain for re-sale and therefore return profit on. (DECC 2008).

avoidance of impacts. Section 230.10(a) requires that no discharge shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact to the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. In addition, Section 230.10(a)(3) sets forth rebuttable presumptions that 1) alternatives for non-water dependent activities that do not involve special aquatic sites are available and 2) alternatives that do not involve special aquatic sites have less adverse impact on the aquatic environment. Compensatory mitigation may not be used as a method to reduce environmental impacts in the evaluation of the least environmentally damaging practicable alternatives for the purposes of requirements under Section 230.10(a).

2. Minimization. Section 230.10(d) states that appropriate and practicable steps to minimize the adverse impacts will be required through project modifications and permit conditions. Subpart H of the Guidelines describes several (but not all) means of minimizing impacts of an activity.

Compensatory Mitigation. Appropriate and practicable compensatory mitigation is required for unavoidable adverse impacts which remain after all appropriate and practicable minimization has been required. Compensatory actions (e.g., restoration of existing degraded wetlands or creation of man-made wetlands) should be undertaken when practicable, in areas adjacent or continuous to the discharge site (on-site compensatory mitigation). If on-site compensatory mitigation is not practicable, off-site compensatory mitigation should be undertaken in the same geographic area if practicable (i.e., in close proximity and, to the extent possible, the same watershed). In determining compensatory mitigation, the functional values lost by the resource to be impacted must be considered. Generally, in-kind compensatory mitigation is preferable to out-of-kind. There is continued uncertainty regarding the success of wetland creation or other habitat development. Therefore, in determining the nature and extent of habitat development of this type, careful consideration should be given to its likelihood of success."

In the 1990 Memorandum of agreement between The Department of the Army and the Environmental Protection Agency states that in evaluating standard section 404 permit applications:

"… information on all facets of a project, including potential mitigation, is typically gathered and reviewed at the same time. The Corps, except as indicated below, first makes a determination that potential impact have been avoided to the maximum extent practicable; remaining unavoidable impacts

will then be mitigated to the extent appropriate and practicable by requiring steps to minimize impacts, and, finally, compensate for aquatic resource values" Part II (c)

This document also provides guidance as to how to determine when to progress through the steps, determining how much avoidance and minimisation is required prior to mitigation and banking based on the cost of the actions involved, the ability of current technology and logistics to deliver such actions.

In the USFWS 2003 Memorandum on the guidance for the Establishment, Use and Operation of Conservation Banks, there is no reciprocal mention of the requirement for avoidance or minimisation within the conservation banking system (USFWS 2003 Memo. Guidance). Wetland mitigation aims for direct commensurate replacement whereas conservation banking aims more broadly to offset adverse impacts to species long-term conservation outcomes. USFWS (2003) recognition of this produces different policy goals and may explain the hierarchy's absence.

Notably, USFWS publications stipulate that conservation banking is not intended to be in place of avoiding and minimising effects on species onsite (USFWS 2009). They stipulate that banking is only approved for projects that would otherwise be approved (as they have satisfied other environmental and non-environmental criteria) but the on-site mitigation, if required, would be less ecologically advantageous compared to participation in conservation banking. Therefore, it is intended that banking may not be required if all possible avoidance and minimisation has already occurred (USFWS 2009).

4.1.3 Approaches to achieving NNL: restrictions placed on trades via mitigation ratios

When values are exchanged through offset banking credit trading, NNL may or may not occur. Rules governing such trades have commonly been put in place to mitigate this risk. In response to concerns detailed above regarding spatial re-arrangement and the balance of biodiversity values between regions, spatial limits have been placed on trading transactions within both the Californian and NSW systems.

In California, each credit issued is accompanied by a description of its geographic trading area. Credits may only be sold to offset impacts occurring within this area. The area is defined by the regulatory agencies and is influenced by the ecology of the values concerned such as species ranges, landscape-level processes such as watersheds or formally recognised hydrological units, regional context and administrative or geopolitical considerations.

In NSW, a credit profile accompanies each credit issued. This defines the nature of the credit, the specific ecosystem or species it relates to. Trading rules within the system stipulate that only matching credit-profiles may be traded. In some cases, exchanges can be made that offset an impact with a more valued or threatened credit type. It is intended that given the geographic nature of the parameters determining distribution of species and ecosystems, this will restrict the area over which trades are possible, without specifically defining geographic limitations.

Other limits to spatial re-arrangement may be placed on credit trading via the use of ratios and these are widely used in biodiversity offsetting (Roberston and Hayden 2008; Bonnie and Wilcove 2008). Ratios have been calculated by dividing the present conservation values of a development site by the expected future conservation values of the banking area. For example, for one unit of lost biodiversity at the impact site, two units or more may be conserved through offset banking. This would be a 1:2 mitigation ratio. (Robb 2002; Bonnie and Wilcove 2008Moilanen et al., 2008; Curnow and Fitz-Gerald, 2006). Many different ratios have been developed, based on numerous policies, and are one way schemes differ in how they opperate and outcomes they produce. Consequently, ratios are at the centre of much of the debate surrounding offset banking (Brown and Lant 1999; Robb 2002; Walker et al. 2009; Bonnie and Wilcove 2008).

Ratios address risk mititgation through ensuring that if some element of bank is lost or unsuccessful, more values remain conserved than were destroyed at the impact site. The additional values included as a result of applying the trading ratio acts as a buffer, maintaining a satisfactory level of conservation for mitigation, despite loosing (or not acheiving) some banked values (Shabman, Scodari and King 1996; Walker et al., 2009). Therefore, the ratio used ideally relates directly to the level of risk present (ESFWS 2003; Turner 2005; Roberston and Hayden 2008; see also Toyon Environmental Consutants *undated*;). If there is a 50% risk of mitigation failure, then it is appropriate to conduct 50% additional mitigation to account for this, and apply a 1:2 ratio. However, significant prior knowledge is required to establish the risk of failure and derive the appropriate ratio (see Roberston and Hayden 2008).

4.1.3.1 *Observation, experience and conservation action choice regarding ratios*

One way of using prior information is via the application of ratios to account for failure of banks to meet compliance standards. Harper and Quigley (2006b) observed rates of mitigation [compliance] failure within Canadian Fisheries and calculated the ratio at which mitigation should be required so that overall outcomes for mitigation were likely. Their study identified significant rates of non-compliance and failure to mitigate, and calculated that to overcome the observed rates of failure, a 2.5:1 ratio of compensation was appropriate (see also Robb 2002).

Observation from experience and/or research is important for selecting different ratios which may be applied to address other forms and levels of risk (Robb 2002; USFWS 2003; Roberston and Hayden 2008; Toyon Environmental Consultants *undated*). Prior to creation, it can be extremely difficult to predict the likelihood that a particular mitigation bank fails, and how certain or uncertain such predictions are (Moilanen et al., 2009). The various actions that offset banking may carry different levels of uncertainty and risk of failure. This is because some actions (e.g. restorative, rehabilitative, enhancing or preservative actions) are more complex or technically difficult to conduct (Brown and Lant 1999; ELI 2007; Palmer and Filoso 2009; Toyon Environmental Consultants *undated*).

Additionally, where there is knowledge and prior experience more is known about correct techniques and approaches, making positive outcomes far more likely than when applying untested approaches (McElfish and Nicholas 1996). This relates to controllable and uncontrollable risk where the various actions required will likely carry varying levels of risk, and have varying levels of certainty attached to such risks. If aspects of conservation techniques are untested, this form of uncertainty may mean that it may not be possible to estimate satisfactory ratios, so approaches other than trading ratios may be required (Walker et al., 2009).

4.1.3.2 *Ratios as mitigation of temporal risk*

It has previously been common practice to apply ratios to account for temporal lags, as discussed above (Robb 2002; Roberston and Hayden 2008; Bendor 2009; Walker et al., 2009). The extent of this temporal gap depends on the actions involved with mitigation, so different ratios are often applied according to mitigation type. Preservation actions present limited temporal risk as the values concerned exist at time zero with any accompanying management actions being arguably less speculative and unlikely to reduce values from current levels. Restoration, rehabilitating or enhancement activities present a greater level of risk, as there may be some temporal gap while actions effectively create biodiversity values commensurate with impacts (Toyon Environmental Consultants undated; Morris et al., 2006). When mitigation involves creating values not present at a given location, the temporal lag may be extensive. As there are no values currently present to assist establishment and creation, and none will exist if proposed actions are unsuccessful, this mitigation option represents the greatest level of risk (Morris et al. 2006; Walker et al. 2009).

The presence of temporal risk often operates in addition to other forms of risk or uncertainty and so ratios may be additive. When combining multiple forms of risk within a trading ratio, it must be considered that preservation presents reduced temporal risk as values are already present in the landscape prior to impact and mitigation. Preservation also offers less risk reduction when biodiversity is lost, as preservation does not actively 'add' values to the landscape. Comparatively, restoration carries increased temporal risk, but equates to increased risk reduction as biodiversity values are actively increased, offering a superior balance to negative impacts. The complex way in which multiple forms of risk are expressed in mitigation ratios means that arriving at an appropriate mitigation ratio for a given setting is challenging and often debated (Brown and Lant 1999; Stein, Tabatabai and Ambrose 2000; Robb 2002; Bonnie and Wilcove 2008; Walker et al., 2009).

4.1.3.3 *Multiplying, discounting and weighting*

Ratios may also be applied in response to concerns that the values being traded between impact and offset sites are not commensurate (Nelson and Sharman 2007; Bendor 2009; Moilanen et al., 2009). The magnitude or nature of the gains made through mitigation may be deemed less valuable than the complete loss of values occurring at the impact site. Alternatively, policy alone may dictate that any loss of values must be considered to be more significant compared to any proposed gains (Bendor 2009). In this case, ratios may be adjusted through multipliers, discounting or weighting (Nelson and Sharman 2007). These terms may be broadly defined as methods to adjust a given ratio up or down to account for increases or decreases in a range of risk types (for examples see, Nelson and Sharman 2007; BBOP 2009d, e, f; Bendor 2009; Moilanen et al. 2009; Bekessy et al. 2010; EDO 2010b). These additional adjustments may significantly increase the complexity of determining ratios, but increase flexibility, more effectively responding to diverse contexts.

4.1.3.4 *Ratios and trades based on area-units: for example, in California*

Once ratios have been determined, the next step is to equate a unit of trade. Many trading units are suggested, with differing capacity to represent NNL of biodiversity. A common approach is to trade a unit of area such as feet, acres or hectares (Brown and Lant 1999; Stein, Tabatabati and Ambrose 2000; Bonnie and Wilcove 2008; Bendor 2009; Toyon Environmental Consultants *undated*). Brown and Lant (1999) describe early mitigation banking arrangements where ratios were applied in lieu of adequate ecosystem assessment techniques and therefore based on area of wetland trade with ratios of 2:1 for restoration and up to 10:1 for preservation-only projects.

California and the United States use a process of best professional judgement, along with an area-basis model, to determine ratios (USFWS 2003; Bonnie and Wilcove 2008). Mitigation ratios based on area are used at the Wildlands Mitigation Bank in Placer County, California (Toyon Environmental Consultants, *undated*). The bank comprises three phases of establishment, a total of 323 acres and a combination of restoration and creation of marsh, vernal pool and woodland ecosystems and multiple species. The regulating agencies, USACE and CDFG, stipulated that for newly created or less significant values a higher ratio was to be applied with more acres conserved per credit. As values were established and conservation outcomes became assured ratios were adjusted from 2 or 3 acres per credit, to 1:1 (Toyon Environmental Consultants, *undated*).

Increasing the size of the bank area compared to the area of impact is an appropriate mechanism to address the temporal lags and associated risks. This is based on the prediction that increase in wetland size (area) directly increases wetland function. Assuming a logarithmic relationship, over time a large area of wetland will increases functionality at a faster rate than a smaller one (Bendor 2009; see also Turner 2005).

4.1.3.5 *Alternatives to area-based ratios and trades: an example from NSW*

Particularly when applied to non-wetland ecosystems, equating greater area with greater conservation value has underlain criticism of area-based trading and ratios, based on suggestions the area-based approach is less scientifically defensible and problematic regarding consistency, replication and transparency. Focus should instead be turned to functional assessment of values (Brown and Lant, 1999; Stein, Tabatabai and Ambrose 2000; Morris et al., 2006; Bonnie and Wilcove 2008; Burggeman and Jones, 2008; Moilanen et al., 2008; Robertson and Hayden, 2008).

Breeding pairs of animals or specific habitat attributes, such as enough area for an individual burrow or territory, have been used as an alternative unit of trade (Bonnie and Wilcove 2008). The 220-acre gopher tortoise bank in Alabama sold over 60 credits by 2001, with credits issued based on how many individuals the proposed bank could support, and purchaser requirements based on how many gopher tortoises a proposed development would impact (Bonnie and Wilcove 2008). Similar arrangements have been put in place for Prairie dog and Red Cockaded Woodpecker banks (Bonnie and Wilcove, 2008).

Bonnie and Wilcove (2008) further suggest that in the presence of appropriate scientific knowledge, assessment may be optimally based upon survivability of the species and Population Viability Analysis (PVA), but note the high resource and financial costs involved with developing supporting information for this approach. Alternatively, measurement techniques such as the Integrated Functional Index can be combined with units of area to produce an 'effective area' unit and ratio for trade.

What credit trading ratios are used in NSW?

Credits are traded through the NSW scheme at a 1:1 ratio (see Chapter 3 for a description of the scheme). Credits relate to ecosystem or species values rather than unit area although the presence of exchange means that it is possible to make area-based calculations of ratios, as demonstrated in Box 4.1. A location with biodiversity values may be assessed from the perspective of generating credits as a Biobank but may also be assessed to determine how many credits would be debited if the site were developed and the values removed. Two different credit calculations may potentially result. Comparing credit calculations on both sides of the trade in this way (credits to sell and to buy), and combining this with the physical area (unit size) of a specific unit of land, it is possible to observe a credit trading ratio for a given circumstance (see example Box 4.1).

Box 4.1 Credit trading and possible ratio calculation under the New South Wales Scheme
Example A: One hectare of land contains a set of biodiversity values. It is assessed using the Credit Calculator and Assessment Methodology under a development proposal (creating a negative biodiversity impact). It is also assessed under a proposal to create a Biobank. As assessed, the development proposal requires the purchase of 100 credits under current policy and mitigation calculation processes. Alternatively, the same site and values equate to 10 credits if the site were established as a Biobank. Based on this, pursuing the one-hectare development and purchasing 100 credits required for impact mitigation would equate to the need to purchase 10 hectares for mitigation as when one hectare of the same biodiversity values is used as mitigation it has been calculated to generate only 10 credits for mitigation. To generate 100 credits in total, 10 hectares would therefore be needed (10 credits x 10 Hectares = 100 credits). Based on assessment of equivalent values, each hectare impacted upon requires ten equivalent hectares to be employed in mitigation: establishing to a 10:1 mitigation ratio as a result of assessment and trading protocols.

Therefore even without using explicitly stating ratios to guide the credit creation and trading process, ratios are still involved. It is therefore necessary to consider ratios within a system and those that best achieve desired NNL outcomes.

4.2 Risk and the role of scientific uncertainty

Risks present within offset banking can also result from uncertainty in the underlying science (EDO 2007c; Burgin 2008; Palmer and Filoso 2009). Uncertainty and associated risk will remain an irremovable reality within offset banking system (BBOP 2009d). Continued attempts to reach a state with no risk of biodiversity loss may obscure the effectiveness of existing approaches. This is particularly pertinent given the race against time required.

Restoration, creation and enhancement of ecosystems are the principle ways biodiversity values are increased in a landscape; the basis on which it is possible to strive for NNL alongside increasing development[61] (Dobson et al., 1997; BBOP 2009d). It is suggested that to achieve NNL, levels of biodiversity must not only be conserved but also actively increased to properly account for extensive past damage to biodiversity and continued human population and resource consumption (Hilderbrand, Watts and Randle 2005; BBOP, 2009d). Ecological understanding is the basis on which offset banking is possible, however uncertainty and knowledge gaps associated with this field generates much of the risk of offset banking. As comparatively newer disciplines, ecology, conservation biology and restoration ecology have had a shorter time frame to make observations, develop understanding and test theories (Wallington, Hobbs and Lister 1997; Hobbs and Morton 1999; O'Riordan and Stoll-Keehmann 2002; Moore 2005; Turner 2005; Burgman et al., 2009).

As scientific disciplines, ecology is focused on testing hypotheses and generating assumptions to produce models and predictions for real-world applications (Lister 1997; Dayton and Sala 2001; Hilderbrand, Watts and Randle, 2005; Burgman, Lindenmayer and Elith 2005; Turner 2005; Moore et al., 2009). Accuracy and understanding is increasing through this process yet the intrinsic absence of complete knowledge creates uncertainty, translated to offset banking (Dobson et al., 1997; Burgin 2008). Uncertainty in offset banking may come from measurement error or bias, natural variation, uncertainty within modeling and subjective interpretation (Burgman, Lindenmayer and Elith 2005; BBOP 2009d). Both the existence and degree of uncertainty represent important yet distinctive challenges, although this is often poorly considered or communicated (Burgman, Lindenmayer and Elith 2005; Hilderbrand, Watts and Randle 2005; Burgman et al., 2009). Risk mitigation is at best challenging, at worst improbable when levels of uncertainty are unknown (Hilderbrand, Watts and Randle 2005).

Parma (1998) comments:

"… worse than uncertainty itself is the fact that we tend to underestimate uncertainty."

p. 16 Parma (1998)

Burgman, Lindenmayer and Elith (2005) emphasise this, saying:

"This topic [uncertainty] is important because unacknowledged uncertainty leads to optimistic expectations that cannot be satisfied, to the misdirection of scarce conservation resources, and to actions that are blind to substantial qualitative and quantitative uncertainties that, if they were apparent, would lead to different decisions."

p. 2008 Burgman, Lindenmayer and Elith (2005)

Biological uncertainty is particularly relevant when viewed in comparison to the certainty of human processes, such as development. Projects that produce negative biodiversity impacts represent future projections that are considerably more fixed and certain due to the ability to control the components of the process. In contrast, many possible (both conceivable and inconceivable) future states are possible when considering biological systems (Dobson et al., 1997; Suding et al., 2004; Suding and Hobbs 2008). Future outcomes are uncertain when interacting with biological systems such as via conservation actions, (Hobbs and Morton 1999; Andreasen et al., 2001; Nelson and Sharman 2007;

Hilderbrand et al. (2005) in Burgin, 2008; Bendor 2009; also see EDO 2007c). Relevant processes, systems and functions are unlikely to be fully understood with the same level of comprehension possible when considering human-created systems (Hilderbrand, Watts and Randle 2005). Offset banking brings these two systems into close connection, emphasising this gap and potential biological losses.

4.2.1 Ecology and restoration sciences as systems of functions, processes and interactions

Mechanisms are required to manage the risks resulting from uncertainty surrounding the biology that underpins offset banking. Appropriate recognition must be given to the underlying knowledge base with greater attention given to the importance and implications of any inadequacies. The ecological sciences have progressed from describing species, communities and ecosystems to the importance of underlying systems and processes and internal levels of hierarchy and complexity, with a desire for predictive capacity (Lister 1997; Hobbs and Morton 1999; Andreasen et al. 2001; Moore et al. 2005; Wallington, Hobbs and Moore 2005; Burgman et al. 2009).

Biological interactions have developed as an important ecological theme highly relevant to offset banking as the active conservation involved requires directly intervening in interactions ([see Table 4.3] Hobbs and Morton 1999; Chapin III et al., 2000; Andreasen et al., 2001; Fortin and Agrawal 2005). To achieve desired outcomes, management actions predominantly involve enhancing positive interactions such as the interaction between a species and habitat vegetation, or decreasing negative ones such as weeds or animal pests (Burgman, Lindenmayer and Elith 2005; Dobson et al., 2007).

Accurate understanding of biological interactions is essential to successful offset banking. Interactions introduce additional complexity, making understanding systems more challenging (Moore et al., 2009). As such, the disciplines' increase in knowledge and understanding to date has served to highlight science's uncertainty regarding the ecological world (Agius 2001; Turner 2005). Uncertainty resulting from limited knowledge may lead to failure, as has been suggested in the past (see Hilberbrand, Watts and Randle 2005). The resulting over-simplification of complex systems produces inappropriate concepts in turn supporting ineffective decisions, actions and consequently detrimental environmental outcomes (Burgman, Lindenmayer and Elith 2005).

What contributions can developments in scientific principles offer?

Advancing ecological knowledge is instrumental to offset banking, reducing knowledge gaps, highlighting uncertainty and improving understanding. Better understanding promotes superior decision-making in turn reducing or better accommodating uncertainty. More importantly it may support improved conservation techniques able to deliver superior, more certain outcomes. Examples of such relevant developments in ecological understanding are summarised in Tables 4.3 and 4.4.

Table 4.3: "Issues of central concern in current ecological thinking". Such concepts represent the most up to date perspectives of how ecosystems work, so may indicate the most accurate and effective way to address ecosystem management and conservation. Taken from Moore et al., 2009. Page 20

Issue	Description
1. Stability, disturbance, and multiple stable states	Ecosystems are dynamic, open systems existing in a constant state of flux, usually without long-term stability. Disturbance constantly pushes ecosystems in alternative directions, and multiple stable states may exist concurrently.
2. Nonlinear development and uncertainty	Ecosystems are (cyclic) systems that are often subject to sudden, unpredictable change. Therefore, uncertainty is normal, and predictable end points to successional processes are rare.
3. Openness, contingency, and heterogeneity	Ecological systems are open, heterogeneous systems. Their structure and function are variable across multiple spatial and temporal scales and levels of organisation. The successional development of ecosystems is historically contingent depending on particular biophysical conditions.
4. Levels of organisation	Insights into the dynamic nature of ecological systems have meant a shift in emphasis from structure, and an emphasis on species, to the processes that maintain structure. Biodiversity must be considered beyond species to include a number of hierarchical levels (individual organisms, populations, communities, ecosystems, landscapes).
5. Spatial scale and hierarchy theory	Dominant ecosystem processes change with scale. However, the structure and overall behavior of ecosystems can be understood in terms of a few dominant processes. For example, biotic factors (e.g., individual species) are of central interest at intermediate spatial scales, rather than primary functions (e.g., transfers of energy, nutrients).
6. Patchiness and landscape ecology	Issues of variability across space and time, fragmentation, and natural resource problems at

	large spatial and temporal scales suggest greater attention to landscape ecology. When ecological systems are recognised as open and heterogeneous, landscape-level patchiness has strong potential as a guiding conservation principle.
7. Species richness and ecosystem function	The maintenance of functional ecosystems is essential to sustain high species diversity, whereas the contribution of such diversity to ecosystem function is less clear. However, given the high societal value afforded biodiversity, increased efforts should be made to maintain the ecosystem processes on which it depends.
8. Functional diversity and environmental change	The attention to temporal variability in nonequilibrium ecology suggests an emphasis on species' responses to environmental change. This approach unites the focus on particular biotic elements with one on the functional types of species present. The role of species with similar ecosystem effects but different responses may be one of the most important mechanisms for sustaining functional ecosystems in the long term.
9. "Pristine" versus human-modified systems	Human disturbances are now amongst the most important factors shaping ecosystem change. Therefore, biodiversity conservation must recognise the role of humans as primary agents of flux in ecosystems and as an integral component in ecological, evolutionary, and environmental processes.

Hilderbrand, Watts and Randle (2005) suggest that assumptions created as a result of imperfect knowledge and unquantified uncertainty have created five principles or 'myths'. To achieve more successful outcomes in offset banking these principles need to be addressed.

Table 4.4 "The Myth of restoration and their core issues" Taken from Hilderbrand, Watts and Randle 2005, page 3 of 11

Restoration myth	Core Issues	Ways to address this via Offset banking
Carbon Copy	Community assembly predictable; a single endpoint exists	Existing biodiversity is conserved, avoiding expectation of specific endpoints or assemblages
Field of Dreams	Sole focus on physio-chemical conditions; systems self-organise	Increased focus on good management of a range of biotic and abiotic components
Fast Forward	Succession and ecosystem development can be accelerated	Long-term time frames concerned allow for natural time-scales
Cook Book	Methodology overused and not sufficiently validated	Provides strategies for review and refinement of methodology based on practice (note NSW)

Command and Control: Sisyphus Complex	Nature is controllable; treating symptoms will fix the problem.	Directly addresses underlying issues of biodiversity reduction caused by development impacts

4.2.2 The significance of underlying scientific data and the knowledge base and associated risk management tools

Recognition of the potential issues introduced by underlying data is developing. Walker, Price and Stephens (2008) note that an inadequacy of supportive, comprehensive and robust biological datasets is an important issue in designing biodiversity conservation mechanisms in New Zealand. In NSW, current knowledge is the basis for the predictive models of spatio-temporal distribution of biodiversity values that produce the Threatened Species database, used for credit calculation (EDO 2007b; DECC 2009j; Gibbons et al., 2009). The completeness and accuracy of this framework is a source of concern as this also underpins biodiversity valuation for Biobanking credits (EDO 2007b; Crowe and ten Kate 2010). Parkes, Newell and Cheal (2003) also emphasise that the apparent capabilities of the Biobanking scheme are dependent on availability and incorporation of local, historical and other ecological information.

To remain effective for valuing biodiversity for trading, underlying data must be actively refined and improved, as it is integral to the operation of the system (Parks, Newell and Cheal 2003; McCarthy et al., 2004; EDO 2007b; Crowe and ten Kate 2001). Underlying assumptions and theories must be actively tested, and transparent mechanisms to accommodate increases in knowledge and science must exist and be translated through to assessment methodologies used (EDO 2007b; Crowe and ten Kate 2010).

4.2.3 Biodiversity and ecosystem assessment: the 'how' and 'what' of measuring values for tradable credits

Accurate measurement and assessment of biodiversity at a site is fundamental to assigning trading credits for offset banking (Hallwood 2007; Aguis 2001; Robertson 2004; Crowe and ten Kate 2010). Achieving NNL though market-based trading means the nature of the credits traded is pivotally important. For successful conservation, credits must accurately represent biodiversity values so that values traded pertain to those actually lost and created (McCarthy et al., (2004) Walker et al., 2009;

Naumann, Vorwerk and Brauer 2008). In the interests of trade, credits also need to be fungible, so attributes must be chosen which best represent this (BBOP 2009f; eftec, IEEP et al., 2010).

Trading unsuitable credits undermines the achievement of NNL so defining trading credits presents significant risk (Naumann, Vorwerk and Brauer 2008; Crowe and ten Kate 2010; Gorrod and Keith 2010). Risk is present when incorrect decisions are made as to what to measure (the chosen metric) and how to measure it (the assessment protocol) (Gorrod and Keith 2010). Deciding how to measure and what to measure in an ecological system or biodiversity presents a significant challenge (Andreasen et al., 2001; ten Kate, Bishop and Bayon 2004; Robertson 2004; BBOP 2009f; Crowe and ten Kate 2010). Creating accurate, fungible credits relies upon the ability to measure what is present currently, and the capacity to identify its existence elsewhere, in turn relying upon robust quantification processes (Agius 2001; Robertson 2004; Walker et al., 2009).

Ecological assessment is also central to progressing ecological and biological knowledge and understanding the biodiversity of ecosystems (Halwood 2007; Nelson and Sharman, 2007; Bonnie and Wilcove 2008; Gibbon et al., 2009; Walker et al., 2009). Arguably, a fundamental prerequisite of understanding and predicting biological systems relies upon being able to accurately quantify the biodiversity of ecosystems concerned (Andreasen et al., 2001; ten Kate, Bishop and Bayon 2004; Burgin 2008; Naumann, Vorwerk and Brauer 2008; Palmer et al., 2009; Walker et al., 2009). Biodiversity to be represented as a credit must first be defined, and in relation to the nature of biodiversity that best aligns with the scheme's goal: an answer to the 'no-net-loss' of what question (Crowe and ten Kate 2010). Many definitions are used, but biodiversity may broadly be considered a complex collection of interacting and interdependent entities within hierarchical scales. Nowicki (1993 pg. 65) is quoted:

"…diversity does not imply that all components of the system are complex; it only implies that the system [structure, function, composition, interactions etc] itself is complex"

p 126 Lister (1997).

The challenge is therefore to represent both inherent complexities within biodiversity, and the biology of a complex system (Lister 2007; Agius 2001; ten Kate, Bishop and Bayon 2004; Nelson and Sharman 2007; Possingham et al., 2007; Walker et al 2009). In addition to these challenges, assessment within offset banking must also include assurances of transparency, objectivity and replicability to optimally mitigate the broad range of risks that ecosystem measurement represents (Lister 1997; McCarthy 2004; EDO 2007b,c; Nelson and Sharman 2007; Gibbons et al., 2009; DECC

2009j). To ensure the scientific rigour of an assessment approach it is necessary to also assess the certainty of measurements taken via empirical testing and specific investigative assessment (McCarthy et al., 2004; EDO 2007b).

An extensive range of methods to quantify biodiversity present at a given location have been adopted, refined and rejected to date, based on biological and ecological principles to varying degrees (For an overview see BBOP 2009e; also BBOP 2009f; and examples in: Adreasen et al., 2001; EDO 2007a; Limburg and Stainbrook 2007; Lister 2007; Burgin 2008; Fliescher and Fox 2008; BBOP 2009f; Gibbons et al., 2009). Those working to apply ecological understanding to ecosystem assessment for active offset banking markets emphasise how excessively analysing or refining systems can result in methodologies that are hard to understand, reducing their effectiveness and so increasing uncertainty when applied. This balances arguments above supporting complex measurement with the benefit from measurement systems that are easily understood. The absence of a universal, optimal approach may bear testament to attaining such a difficult balance (BBOP 2009c, f).

4.2.3.1 *Use of benchmarks and biodiversity surrogates*

Many measurement and assessment approaches utilise *benchmarks*, *surrogates* and *indicators* to take account of biodiversity values. These approaches are based on assumptions of relationships between limited information available and biodiversity values actually present, relying upon the strength of this information to make correct descriptions and predictions[62] (Carignan and Villard 2002; McCarthy et al., 2008; Grantham et al., 2010; Crowe and ten Kate 2010). It is the reliance upon these assumptions that introduces the risks involved with benchmarks and surrogates. Inaccurate results are produced if assumed relationships are incorrect, oversimplified or the information available does not accurately represent biodiversity values present. As fundamentally scientific principles, these 'assumed representation' approaches are open to contention (Andelman and Fagan 2000).

Benchmarks

A 'benchmark' is a score given to a site to represent its biodiversity value and may be compared to other sites, the same site over time, or the same site under altered conditions resulting from actions

[62] Note McCarthy et al.'s (2004) discussion of the use of the 'large tree' attribute within Habitat Hectares methodology as an estimation or prediction of large hollow trees in an ecosystem and therefore habitat values for tree-hollow inhabiting species.

such as development or management (Parks, Newell and Cheal 2003; McCarthy et al., 2004; BBOP 2009e,f[63];). Benchmarks are established via the identification of biotic and abiotic attributes[64], and are assumed to represent biodiversity at a site (McCarthy et al., 2004; BBOP 2009e,f). Benchmark values are also often used to rank or compare sites, based on a reference benchmark established as the optimum or desired condition (Andreasen 2001). In New South Wales, the reference benchmark has been established as the pre-European condition of that vegetation type, described via the Vegetation Benchmark Database (BAM 2008; Gibbons et al. 2009). The use of more appropriate, local, or scientifically advanced data instead is possible with relevant department approval (BAM 2008). A criticism raised against applying benchmarks is the comparison to reference conditions, where such a 'single' state may represent an ill-chosen example or fail to recognise the intrinsic dynamism characteristic of biodiversity naturally. This has been a particular criticism of NSW's selected reference state (Andreasen et al., 2001; McCarthy et al., 2004; Hilderbrand, Watts and Randle 2005; EDO 2007b).

Importantly, benchmark values indicate what is and is not present at a given site, not conservation status or significance - recognising this difference is instrumental to the appropriate use of benchmarks (Parks, Newell and Cheal, 2003). As such, it may be necessary to combine the benchmark approach with further assessment for optimal application with a conservation system such as offset banking.

Surrogates

Benchmark attributes are used as surrogates, requiring them to be measureable and tangible. BBOP (2009f) defines surrogates (proxies) as:

> *"…a measurable (sometimes quantifiable) and practical parameter that can be used as a substitute for a parameter that is too difficult (sometimes impossible) or expensive to measure directly."*

Surrogates are used in many ecological measurement systems (e.g. Faith and Walker 1996). BBOP (2009f) recognises that surrogates cannot do justice to all components of biodiversity, but represent a practical approach, beneficial as a highly workable assessment method. Table 4.5 demonstrates how the Habitat Hectares Method uses attributes and benchmarks, based on categorisation and scoring

[64] In the Habitat Hectares method, (Parks, Newell and Cheal 2003), the following attributes or components are defined: Large trees, tree (canopy) cover, understory (non-canopy) strata, lack of weeds, recruitment, organic litter, logs, patch size, neighborhood and distance to core area. The final three components represent landscape context, and may be derived through use of maps or other information sources such as GIS techniques.

(Parkes, Newell and Cheal 2003). This example shows how measuring benchmark attributes is the basis of assumptions concerning overall ecosystem condition.

Table 4.5 "Criteria and scores for the number of large trees present". (Benchmark Attribute (Surrogate) = Large Trees) Taken from Parkes, Newell and Cheal (2003) Table 2, Page s32. See Tables 2 - 11 from Parks, Newell and Cheal (2003) for further examples as applicable to other attributes/components. * "Health of large trees assessed by estimating the proportion of expected canopy cover that is missing due to tree death, decline or mistletoe infestation."

Large Trees	Level of Canopy Health (%)*		
	>70%	30-70%	<30%
None present	0	0	0
0 - 20% of the benchmark number of large trees	3	2	1
20 - 40% of the benchmark number of large trees	4	3	2
40 - 70$ of the benchmark number of large trees	6	5	4
70 - 100% of the benchmark number of large trees	8	7	6
≥ the benchmark number of large trees/ha	10	9	8

Because plot and transect data is represented by categorises and scores, extensive natural variability in ecosystem characteristics may be better accommodated, reducing the risk posed by variation from subjective measurement. Yet this approach also carries risk that finer-scale differences and variability important to biodiversity may be obscured (Parks, Newell and Cheal 2003; McCarty et al., 2004). Weighting may be used to place greater importance on some attributes while adjustments for area relationships may also be included (Parks, Newell and Cheal 2003; see also Andreasen et al. 2000; BBOP 2009e).

Presence of species may be used as biodiversity surrogates, yet this potentially over-simplifies relationships as it fails to reflect population size or viability. This potential discrepancy between actual species numbers, potential capacity of a specific habitat, and driven or intrinsic population variability introduces risk through inaccurate measurement (EDO 2007b).

Indicators are another form of surrogates that reflect the importance of biodiversity operating as an integral system (Andreasen et al., 2001; Carignan and Villard 2002 *see also* Fleishman, Noss and Noon 2006; Harding 2006). Determining the integrity of such a system requires sustainability, *resilience* and 'natural-ness' to be evaluated. Exhaustive micro-level measurement may not capture these elements. The broader approach of surrogates and indictors therefore provides information more appropriate to sustaining biological systems and biodiversity (Meurk and Swaffield 2000; *see also* Faith and Walker 1996; Faith and Walker 1996a; Watts and Handley 2010).

Benchmarks, surrogates and indicators aim to reduce risks by improving ecosystem measurement and assessment, yet also introduce their own risks. Techniques rely on robust and comprehensive scientific knowledge and understanding of ecological relationships and interactions such as underlying structure, function and composition of the ecosystem concerned (Carignan and Villard 2002; McCarthy et al., 2008). This means that if the supporting knowledge base is inadequate, inaccurate assessments can occur, as potential inaccuracies within benchmarks, surrogates or indicators are unlikely to be understood and addressed (McCarthy et al., 2004; EDO 2007b; Grantham et al., 2010). Applying such substitutes is therefore a balance between risks posed by inaccurate measurement, with requirement for efficient resource inputs. Given issues surrounding potential knowledge gaps, applying these systems requires additional risk management by giving importance to supporting building knowledge and data capacity.

4.2.4 An example of ecosystem measurement: New South Wales Biobanking and the Biobanking Assessment Methodology.

The capacity to accurately assess biodiversity is a primary mechanism to minimise potential risk of lost biodiversity values and as such, the New South Wales scheme has placed great importance on the BAM. It is a specifically developed, scientifically based, codified protocol to assess ecosystems and attribute credits. Development, application and strength of the Methodology is established via regulation and legislation. BAM is required to identify areas that are of high biodiversity value, quantify the effects of development impacts on biodiversity, and establish biodiversity credits based on management actions both current and future, on proposed Biobanking and development sites (TSR 2008). The BAM was developed with input from scientists, practitioners, stakeholders and a Ministerial Reference Group, to be transparent, objective, operationally-feasible and scientifically-based in achieving the improve or maintain policy (DECC 2009j; Gibbons et al., 2009).

It is based on ecological principles (Gibbons et al., 2009), recognising the importance of biodiversity structure, composition and function at a hierarchy of scales, representativeness in conservation and long-term conservation viability in consideration of resource limitations. The BAM considers seven criteria across a range of scales in assessing a site's biodiversity values:

"1. State and national priorities
2. Regional value
3. 'Landscape Value'

4. 'Site Value'
5. Threatened species
6. Management actions
7. The area (hectares) of the land to be developed (the development site) or managed for biodiversity (the Biobank site)."

p. 8 DECC (2009j)

DECC(W) 2008 describes the process of assessment as:

"At each site, the assessment methodology will prescribe a number of plot surveys within each vegetation type to collect data on defined vegetation characteristics. Each plot survey will require data on prescribed vegetation attributes, including species richness, over-story cover, exotic species cover, hollow-bearing trees, fallen logs, etc. The presence of some threatened flora and fauna species will be predicted using habitat surrogates from the plot surveys, along with the responses to a series of geographic and site-specific questions. Additional surveys may also be needed to determine the presence and abundance of other threatened species not able to be predicted through habitat surrogates. The assessment will also include landscape-level measures to determine the number of credits required. These include the size of vegetation patches and the amount of vegetation cover that surrounds the development or biobank site." p. 1

As described, species are predicted to occur in certain defined habitat and vegetation types (of the 1600 above) and ecosystem credits are issued which represent this. Predictions are based on knowledge of associations with vegetation and other habitat features, and distribution characteristics. This information is contained within the Threatened Species Profile Database and the Vegetation Type Database. In the absence of information for vegetation-based prediction, separate survey work is conducted and specific species credits are issued (DECC 2009j). To equate these measurements to tradable credits requires use of the specifically designed credit calculator. In this final step, the assessment of biodiversity attributes measured by BAM are translated and calculated into credit values (DECC(W) 2009j). BAM approach represents attempts to balance required outcomes of the system (NNL), and constraints posed by costs, supporting data, ease and effectiveness of implementation along with resource and knowledge limits (BBOP 2009e; Possingham et al., 2009).

When applying surrogates, benchmarks and a process of weighting and multiplying (DECCW 2009x), the choice of measurement design to accurately reflect biodiversity values represents a balance between multiple forms of inherent risk. Specific surrogates applied within the system were selected based on desire to spread the risk of surrogacy use across multiple scales, and respond to resource and other constraints identified (EDO 2007b; Gibbons et al., 2009; Possingham et al., 2009). The decision was made not to use species-based metrics due to resource constraints and issues of high temporal variability for a proportion of species (Gibbons et al., 2009). Use of *indicator species* was possible, but a lack of underlying supporting data restricted this. Alternatively, increased focus was given to vegetation structure as indicative of other biodiversity values.

4.2.4.1 *Assessing the success of BAM*

Possingham et al., (2009) discuss how the BAM facilitates the achievement of NNL through trade and offset within Biobanking. One component of success is the robustness of scientific measurement of biodiversity values. The protocol of assessing NNL against multiple, varying criteria is observed as a strength of the methodology, appropriate in light of the multiple components and complexity of interactions (Andreasen et al., 2001). Distinguishing which taxa can and cannot be reliably predicted, particularly from vegetation type, is a positive innovation (BBOP 2009e; Possingham et al., 2009).
While overall the methodology is an improvement in previous assessment methods (EDO 2007b; BBOP 2009e), concerns and suggestions for improvement have been raised; particularly questioning underlying assumptions underpinning assessment decisions. An important component of the measurement capacity of BAM or any assessment approach is how well additional or updated knowledge could be incorporated (Possingham et al., 2009; McCarty et al., 2004). Possingham et al., (2009) also notes the importance of clearly defining what is being measured to enable assessment of how accurate the measurement is. In the NSW case, depending on the process followed, credits may represents a score or an entity, so credits may represent a type *or* an amount. Such ambiguity is not conducive to accurately representing biodiversity values in a unit, and therefore maintaining reliability with the measurement system.

4.2.4.2 *The BAM compared to Californian methodologies*

A single methodology analogous to the BAM of New South Wales Biobanking, is absent from the Californian system. Instead numerous methodologies are used in the banking process, reflecting the different agencies, ecosystems, regions and methods of operation (entrepreneurial, in-lieu-fee, public). By convention expert review, best professional judgement, and case-by-case review of assessments by the relevant agencies and personnel, quantify biodiversity values at a site (Robertson 2004). Methodological approaches to biodiversity assessment are a component of this in some cases and numerous methodologies have been developed and applied across all States in America (BBOP 2009f; Crowe and ten Kate 2010; Madsen, Carroll and Moore Brands 2010). Such variety exists predominantly because methodologies have been designed specifically for clearly defined ecosystems (such as the specific wetland types of earliest banking).

BBOP (2009f) provides a useful summation:

"…the United States is home to perhaps the world's most comprehensive set of methods for assessing projects' impacts and offsets' gains on wetlands, streams and listed endangered species. Many of these assessment methodologies involve rigorous and repeatable framework for analysis of ecosystem functionality that involve, and can demonstrate, consistent application not only at impact and offset sites but across many projects… However, while there is a trend towards the more common use of these more rigorous methods, in the large majority of cases (and the US authorities process some 70,000 to 80,000 decisions on wetland and stream mitigation a year) and particularly for small projects, loss/gain calculations are based on the acres of land impacted, couple with a simple ratio/multiplier and sometimes with an approximate estimate of the acres' condition, based on expert review. This is testimony to the fact that, in practice, detailed ecological assessments are not always possible. The resources required for in depth survey and modelling may be limited or the scale of the proposed project might be such that comprehensive assessments are considered inappropriate. It is not unusual for assessments of 'quality' to be made on the basis of expert opinion."

p 74 BBOP ODH (2009f).

California and New South Wales present contrasting approaches to biodiversity assessment and demonstrate the differences between ecosystem-based and species-based measurement. It has been debated internationally how best to arrive at an appropriate assessment process for offset banking and whether to adopt a species or ecosystem basis or an appropriate combination, as both have notable strengths and weaknesses to consider.

4.2.5 The species-based framework and place of species lists in California and New South Wales

Accurately measuring ecosystem or site biodiversity is fundamental to minimising risk of biodiversity loss and achieving successful offset banking; it is relevant to evaluate using a species-based approach to achieve this. The species-focused approach supported by species listing-practices is central to the Californian system, and a component of New South Wales Biobanking. In New South Wales, the TSA (1995) provides a process of list-creation and establishes the Threatened Species Database. Both are used within the BAM to assess biodiversity values. The database lists species as critically endangered, endangered or vulnerable. It presents a range of information and descriptions pertaining to the species' needs and ecological characteristics such as distribution and habitat requirements, and this information is used in decision-making regarding credit type calculation (BAM 2008).

Bonnie and Wilcove (2008) note that, legally, in California and the United States:

"… the success or failure of a conservation bank is determined by wether it fulfils the requirements for mitigation set forth in the ESA…"

p. 55 Bonnie and Wilcove (2008)

This represents how conservation banking in California is borne from legislation driven by an alternative objective: address public concern over accelerating loss of species icons, such as the bald eagle and the Grizzly bear, and protect and recover individual species (as prioritised on the Endangered Species List created under the same legislation: ESA 1973). Rather than ecosystem or biodiversity health overall, this perspective translates into how values at a bank site are assessed, banks are established, credits are issued, and management and conservation is conducted. Success is typically monitored and evaluated based on the specific requirements of the particular listed species (Lambeck 1997).

Support for a species-based approach may be political, cultural or social. The protection, measurement and management of specific species may also offer significant benefits to other components within a shared ecosystem. This is reflected in concepts such as umbrella, flag-ship, key-stone, key-ecosystem and indicator species: species are identified as having a unique capacity to perform functions and services that provide essential support (through varying mechanisms) to a range of other species (Lambeck 1997; Lister 1997; Hobbs and Morton 1999; Andelman 2000; Carroll 2010; Andreasen et al. 2001; Rubinoff 2001; Burggeman et al., 2009). Management focused upon one such species may offer widespread ecosystem gains, resulting in biodiversity and environmental conservation collectively as broad, expedient and efficient as possible (Faith and Walker 1996; 1996a; Lambeck 1997; Andreasen et al. 2001; Rubinoff 2001; Carignan and Villard 2002).

Species listing supports conservation in many international examples and issues raised against species-focused offset banking mirrors debate surrounding perspectives for or against these species listing processes and the conservation that results (Mace and Lande 1991; O'Brien and Mayr 1991; Keith 1998; Lamoreux et al., 2003; Gippoliti and Amori 2007; Vie et al., 2009). Such arguments raise issues pertinent when considering species-based approaches to offset banking, so relevant aspects are therefore are discussed bellow (O'Brien and Mayr 1991; Freitag, Jaarsveld and Biggs 1997; Nicholopoulos 1999; Possingham et al., 2002; Roemer and Wayne 2003; Andelman Groves and Regan 2004; Early and Thomas 2007; Environmental Law Institute 2007; Zhang and Zang 2007; Vie et al., 2009; Brito et al. 2010).

4.2.5.1 *Discussing species lists: some relevant critiques*

While relevant to conserving species diversity, individual species or groups of species are increasingly being considered as only a subset of values deserving conservation (Bestelmeyer, Miller and Wiens 2003; Bruggeman et al., 2009). Lists based on risk to individual species are argued to oversimplify biodiversity by excluding too many important biological and ecological components for effective conservation. Correlation between species diversity and other common measurement variables such as richness, abundance or distribution may significantly over-simplify actual relationships. Assumptions of community and ecosystem representativeness are likely erroneous as a result, consequently frustrating comprehensive biodiversity conservation (HurlbertBurg 1971; Conroy and Noon 1996; Chapin III et al., 2000; Gotelli and Colwell 2001; Fleishman, Noss and Noon 2006; Bruggeman et al. 2009).

Focus solely on limited species, units or taxa (via lists of threatened, indicator capacity or other categorisations) also fails to recognise and account for the context of conservation risks, status, and the interaction between threats and significantly limiting capacity for efficient mitigation as a result (Roemer and Wayne 2003; Moore et al., 2009; Burgman et al., 2009). As a component of this, scales of species-focused actions typically do not align with the intermediate and wider landscape scales optimal for overall biodiversity (*see also* Lambeck 1997).

Potential bias in the listing process is likely transferred into conservation actions and priorities (Gemmell 2001Possingham et al., 2002; Gippoliti and Amori, 2007; Burgman et al., 2009; Mace and Lande 1991). Burgman et al., (2009) describes this:

> *"The lists are uncertain, largely a consequence of a lack of knowledge regarding the conservation status of species. The lists do not reflect many of the real threats to biota, leaving non-descript taxa relatively poorly protected, and the risk of extinction does not account for varying difficulty in how species may be conserved or rehabilitated. Uncertainty leads to entities going unprotected until information can be gathered, creating a conservative bias in the composition of lists."*
>
> p. 6 Burgman et al., 2009

Finally, the process may divert significant time and money, inappropriately narrow the focus of conservation efforts, and involve high operational costs and challenges. All this reduces efficiency and can lead to counterintuitive decisions and outcomes that detract from overall environmental conservation (Roemer and Wayne 2003; Fleischer and Fox 2008; *for example also see* Mace and Lande 1991; Possingham et al., 2002; Gippoliti and Amori 2007; Burgman et al. 2009; Vie et al. 2009).

How does the species-based approach interact with offset banking?

Species-focused measures have significant shortcomings when representing biodiversity broadly; when adopted within offset banking these issues are also introduced. Poor representation of biodiversity in offset banking can be expected to result in poor biodiversity conservation in the system. Fleischer and Fox (2008) suggest that the single-species focus present as a result of the application of ESA legislation in United States' and Californian conservation banking, has led to management practices that have been narrowly focused (Hooper et al. 2005). As a result, management focused on achieving conservation gains for a specific species may involve practices potentially detrimental to other species themselves important to overall biodiversity, yet not otherwise recognised under a species-centric paradigm.

Fleisher and Fox (2008) quote Carol Witham[65] who states:

"Most of the management plans I have seen don't focus on individual actions into [consideration of] ecosystem integrity and function. If you manage for one species you can get cascading disasters where you react to one management mistake with another mistake."

p. 47 Fleischer and Fox (2008).

With contentious issues surrounding the species-based approach, developments have been made in pplications to better achieve desired conservation outcomes (Vie et al. 2009). For eample:

"Increasing research on dynamic representation measure for species and on species 'occupancy' or 'persistence' models which can provide a stronger evidence base for design and delivers of offsets to meet policy targets. These approaches reflect the fact that the greater the proportion of habitable area already lost, the more an additional hectare lost or gained matters. Similarly, the resilience of species' population depends on whether they are in a healthy functioning state, or in a declining condition. Thus

[65] Private consultant and former President of the California Native Plant Society

a large reduction in population abundance from near carrying capacity might result in a small loss of persistence probability, but a similar (large) reduction to an already reduced population would cause a much greater loss of persistence probability."

p. 71 BBOP ODH (2009f)

These and other developments are moving towards recognising species' interactions and dynamic representation within a wider ecosystem, aligning with trends towards increasingly ecosystem-based approaches (Atkinson 1999; Naeem 2002; Possingham et al., 2002; Bol'shakov, Lushchekina and Neronov 2009). Incorporating improved species-based management into offset banking may offer better ways to conserve biodiversity, reducing the risk of undesirable biological outcomes.

4.2.6 An ecosystem approach: the importance of functioning and stability

In the face of continued biodiversity loss, inadequacies of the species-listing approach have added to impetus for additional and alternative conservation approaches (Haeuber 1996; Gemmell 2001; Roemer and Wayne 2003). Progress within ecological disciplines has also increasingly directed conservation mechanisms towards units other than specific species (Bedward, Pressey and Keith 1992; Carignan and Villard 2002; Naeem 2002; Burgman, Lindenmayer and Elith 2005; Fleishman Noss and Noon 2006). 'Ecosystem' approaches are increasingly favoured (Moore 2001; Carignan and Villard 2002; Goldman et al., 2008; Bol'shakov, Lushchekina and Neronov 2009,[66]) where conservation and biodiversity management is designed and implemented with scale-appropriate, more ecologically representative management units such as species combinations, communities, ecosystems or landscapes (Haeuber 1996; Lambeck 1997; Sanderson et al. 2002; Geneletii 2003; Burgman, Lindenmayer and Elith 2005; Early and Thomas 2007; Samways, Bazelet and Pryke, 2010).

The Firth Meeting of the Conference of the Parties to CBD (of which New Zealand is a signatory) gave international recognition to the value of the ecosystem approach (Table 4.6). Established as a superior approach to achieve Convention goals, the approach was recognised and adopted in a variety of international contexts, further inceasing potential within offset banking [67] (Bol'shakov, Lushchekina and Neronov, 2009)

[66] Note discussion of the Ecosystem approach in New Zealand, by Atkinson 1999.

[67] See also The adoption of the Ecosystem approach in the Millennium Development Goals of the UN (Elliot, 2009)

Table 4.6 "Principles of the ecosystem approach adopted at the Firth Meeting of the Conference of the Parties to CBD" Taken from Bol'shakov, Lushchekina and Neronov 2009, page 74

#	Principle of the approach
1	The objectives of management of land, water, and living resources are a matter of societal choice
2	Management should be decentralized to the lowest appropriate level
3	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems
4	Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management program should: (a) reduce those market distortions that adversely affect biological diversity; (b) align incentives to promote biodiversity conservation and sustainable use; (c) internalize costs and benefits in the given ecosystem to the greatest extent feasible.
5	Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority tar- get of the ecosystem approach
6	Ecosystems must be managed within the limits of their functioning
7	The ecosystem approach should be undertaken on the appropriate spatial and temporal scales
8	Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term
9	Management must recognize that change is inevitable
10	The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of bio- logical diversity
11	The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations, and practices
12	The ecosystem approach should involve all relevant sectors of society and scientific disciplines

The functional importance of a specific species' presence is being progressively minimised when creating and maintaining biodiversity. This is being replaced by understanding the role ecosystem interactions, functions and processes in addition to specific structural, compositional and spatial attributes (Hobbs and Morton 1999; Chapin 2000; Gunderson 2000; Moore 2001; Slootweg and Kolhoff 2003; Fortin and Agrawal 2005; Hooper et al. 2005; Bruggeman et al. 2009). This directs focus to wider spatial scales in addition to (or replacing) species as units of conservation (Haeuber 1996; Lambeck 1997; Sanderson et al. 2002; Burgman, Lindenmayer and Elith 2005; Early and Thomas 2007; Samways, Bazelet and Pryke 2010).

Landscape management is moving towards ecosystem-scale perspectives following recognition that single-species models fail to account for many of the components of value within a landscape (Haeuber 1996; Lambeck 1997; Burgman, Lindenmayer and Elith 2005; Hartig and Drechsler 2009). Ecological processes at the landscape level are the focus of approaches such as the Landscape Equivalency Analysis (LEA), placing value on habitat patches by incorporating spatial arrangement, fragmentation impacts, and taking account of genetic processes such as migration, genetic drift and variation that have significant impact on species and wider biodiversity sustainability (Burggeman et al., 2009; Hartig and Drechsler 2009). The highly spatially-dependant nature of biodiversity requires dedicated recognition for individual patches in a landscape, and adequate quantification of value in this context (Drechsler and Watzold 2008; Burggeman et al. 2009; Hartig and Drechsler 2009). Assessment for trading under LEA provides superior commensurability between the contribution patches make to recruitment, migration and genetic variability at a landscape scale, and therefore population viability and long-term sustainability of biodiversity where increasing development and habitat fragmentation is of concern (Bruggeman et al., 2009).

Balancing the many conservation and biodiversity sustainability concerns, Lambeck (1997) counters criticisms of single-species approaches suggesting:

"… we cannot ignore the requirements of the species if we wish to define the characteristics of a landscape that will ensure their retention. The challenge then is to find an efficient means of meeting the needs of all species, without studying each one individually."

p. 850 Lambeck (1997)

This is relevant within offset banking schemes such as New South Wales' where both ecosystem and species concerns are arguably represented with the intention of achieving balance between such considerations. Successful application of BAM and the achievement of desired biodiversity conservation of have yet to be observed and may be evident as the system matures.

How can lessons from ecology aid mitigating biological risk in offset banking?

Ecological research is emphasising the links between biodiversity, ecosystem functioning and stability (Lister 1997; Hobbs and Morton 1999; Gunderson 2000; Moore 2001; Hooper et al. 2005). Increased understanding of ecosystems is relevant as a primary step towards improved management of ecosystems, and hence reducing risk within offset banking (Hobbs and Morton 1999; Gunderson 2000; Hooper et al., 2005). Consider the current principles below, providing insight to enable risk mitigation through improved ecology.

- Ecosystem properties are strongly influenced by the functional characteristics of species present via interactions, indicating that relative abundance poorly predicts the ecosystem value of a given species
- Addition or subtraction of species have differing impacts dependant on the nature of the ecosystem concerned

- A greater number of species facilitates increased supply of ecosystem goods and services (Hooper et al., 2005).

It also seems highly likely that combinations of species, rather than specific species, offer stabilisation and *resistance* to disturbance. When dealing with the larger spatial and temporal scales concerned in offset banking, this is even more important if risk of loss over time is to be minimised. With a greater number of species present, management options are suggested to remain far more open to address risks that become apparent over time. Such options may be restricted if early decisions prioritise only those species immediately relevant (Hooper et al., 2005).

Management under offset banking may take much from the ecosystem approach with design based on ecosystems being unified, interacting and interdependent entities, rather than managing aspects of a specific population (Haeuber 1996). From greater ecological understanding, optimal offset banking management will actively incorporate combinations of multiple species, biotic and non-biotic factors cross varying scales, habitat for species, other structural and compositional elements and functional and process parameters (Hobbs and Morton 1999; Moore 2001; Fortin and Agrawal 2005; Haeuber 1996; Hartig and Drechsler 2009).

4.2.6.1 *Choosing the best approach: comparing species and ecosystem-based approaches with a summary critique of the ecosystem approach*

In selecting the applicable approach of offset banking to best address risk of biodiversity loss, the comparative advantages and disadvantages of the species and ecosystem approach must be taken into consideration. Table 4.7 summarises one such comparison, describing different measurement approaches according to wether a species or ecosystem approach is taken. As discussed regarding the species-based approach, there are advantages and disadvantages to an ecosystem-based approach that must be considered if management of biodiversity under offset banking is to represent minimal risk of lost values.

Table 4.7 "Some examples of what to measure and consider for species and for communities or habitats in order to achieve no net loss." Taken from The Offset Design Handbook, BBOP 2009f p. 71

For Species	For communities/assemblages or for habitat types:
Which will be affected	Which will be affected
Structure of populations/metapopulations for key taxa affected	Area (extent), distribution, 'health' or 'quality' (composition, structure, function).
Balance of recruitment/mortality for affected populations	Condition, as indicated by key structural and functional relationships such as height of vegetation, wetland hydrology, predator-prey relationships, etc.
Distribution, abundance and levels of occupancy in landscape	Strategic and functional context in the wider landscape context (e.g. connectivity, continuity).
Scale or location required to maintain or enhance viability or persistence	Scale or location required to maintain or enhance functional representation, viability or persistence

An ecosystem approach may be advantageous as effective conservation occurs when threats are adequately addressed (Burgman et al., 2009; see also Gunningham and Young 1997). Threats occur as processes and systems, commonly with many interacting together at an ecosystem or landscape level. Focus should therefore be broadened beyond single species because some involved in threatening processes may not be listed. They are likely excluded from management and this 'patchiness' or unequal conservation makes conserving a resilient landscape of biodiversity and minimising risk of loss less possible (Burgman et al., 2009).

Kiesecker et al., (2009a) discuss an ecosystem-based approach to establishing biodiversity targets, as an alternative to highly challenging complete biodiversity assessment. The 'Coarse Filter' approach is suggested based upon ecosystems and mapped units of vegetation. A subsequent 'fine filter' approach may be applied to respond to the needs of specific species with specific requirements, extremely endemic or specialized species, or those of notable or listed conservation focus. An example of this dual approach in application is seen in the New South Wales system (as discussed below).

Ecosystem approaches also have potential disadvantages[68]. Firstly, ecosystem-type definitions can be more ambiguous compared to species classifications as their definition or delineation is open to higher levels of subjectivity (Haeuber 1996). This therefore introduces the risk that the wrong classification is made, so the wrong management occurs (McIntyre and others, 2002 in Moore et al. 2009). Secondly, increased understanding of ecosystems and their processes, and the translation of this into more complex and specific metrics may be disadvantageous to a trading system (Ring 2010). Should this be

[68] For additional issues not covered here see Haeuber 1996

the case, mitigating risk by improving ecosystem assessment may be contrasted by introduction of more risk to the trading aspect of offset banking. More comprehensive and scientifically accurate ecosystem measurement makes it increasingly clear that the specificities of ecosystems and the increasing spatial contextually of specific sites means two site are less likely to be commensurate, especially with increasing distance. Another trade-off therefore occurs between increasing scientific accuracy and specificity and the fungibility needed for economic credit trade (Robertson 2004; Ring 2010; Crowe and ten Kate 2010).

"… the need to consider human behavior in metrics for market-based instruments is characterized by a trade-off: Ecological accuracy calls for a metric that is complex enough to capture all details of the relevant ecological processes, but socio-economic reality may suggest compromises towards more practical and robust metrics."

p. 280 Hartig and Drechsler (2009)

Finally, critics caution applying ecosystem-based perspectives too broadly or exclusively without proper regard to the further work known to be required in the field. Uncertainty in current principles exists, and calls are made for further research (Lister 1997; Hooper et al., 2005). A focus on ecological attributes such as vegetation density or biogeochemical processes may be improved upon by increasing consideration instead, on 'ecological capital', connectivity and variability (Hilderbrand, Watts and Randle 2005). This contributes to resistance, resilience and processes of disturbance in systems as a path to improved conservation outcomes, in particular where restoration is concerned; suggestions that may offer a more biologically robust system, and reduced risk in offset banking.

4.2.6.2 *Case study: what relevance does the ecosystem approach have in species-focused California?*

The Californian system is species-focused. Banks and the associated credits issued to them are species credits - for example 'fairy shrimp' or 'elderberry longhorn beetle' credits. Bank sites therefore aim to establish habitat optimal for that specific species, as do long-term management plans, credit release criteria and monitoring programmes. Conservation actions taken under this program are likely to have positive flow-on effects to other species and aspects of the ecosystem. As the ESA is focused upon the recovery of species, a habitat may be focus of conservation e.g. the fairy shrimp and Vernal Pools in the Central Valley of California. Generally, species can be supported or recovered only with the active support of overall *ecosystem functions* and processes. In some cases however, a species may exist adequately (in terms of credit requirements) without particular ecosystem functions and processes, or at very limited levels. Active management for overall ecosystem health and functioning is far less likely or beneficial to the bank so auxiliary non-target biodiversity values may suffer as a consequence. Species-specific management is frequently more intensive and targeted than that in the best interests of long-term, sustainable management of an ecosystem. Potential for margins of error, scientific uncertainty, constantly changing environments and catastrophic and unexpected natural events, increases these concerns. Ecosystem complexity and interdependency means failure to provide ecosystem components above in lieu of the needs of target species may significantly reduce biodiversity overall; individual species' gains are unlikely to balance this out.

Species-based conservation banking continues to be practiced with increasing activity in California yet movement and opinion within the industry is turning towards broadening the narrow, species-centric approach and moving towards more ecosystem approaches. While not observed over a long time frame, the New South Wales more ecosystem-based metric is attracting favour as a model for mitigation under both the CWA and the ESA. Current problems aligning the specific, contrasting objectives and origins of the acts would likely be better resolved under a similar, broader approach and echo previously mentioned challenges applying the ESA and CWA not originally designed for banking purposes.

California and New South Wales highlight how species or ecosystem-based paradigms reflect overarching objectives of banking systems. The range of advantages and disadvantages each approach offers is best debated under consideration of specific offset banking contexts. Discussing both the species-focused and ecosystem-focused paradigms is central to understanding how an offset banking system may be designed and developed to address desired biodiversity outcomes variable across contexts, regions and countries.

4.2.7 Transparency and subjectivity within measurement approaches: bias

Finally, biologically and ecologically accurate measurement and assessment systems must limit bias. Bias may result through lack of transparency or introduction of subjectivity, potentially from many sources. Subjectivity and variation in values derived from estimates, measurements or observations are recognised as a form of risk (Gorrod and Keith 2008; McCarthy et al., 2004). Responding to subjectivity risk requires a highly transparent, reliable and objective assessment protocol (Lister 1997; McCarthy et al., 2004; EDO 2008b, 2007b; Gorrod and Keith 2010). Subjectivity may occur through applying processes, representing variation in value judgements. This impacts the outcome as valuations are weighted differently each time assessment is conducted (Parks, Newell and Cheal 2003; McCarthy et al., 2004; EDO 2007b; Burgin 2008). This can produce unpredicted and unpredictable outcomes, as subjects' numerous different decisions balance in unique ways (McCarthy et al., 2004; Burgin 2008).

Offset banking requires an equivalent outcome to be produced from independent measurements and credit calculations. It is essential to achieving NNL that appropriately stable level of value equivalency is maintained across multiple transactions (Robertson 2004; Nelson and Sharman 2007). If the equivalence of one transaction greatly exceeds the equivalence of another transaction, achievement of NNL will be highly variable, jeopardising the balance achieved over the whole scheme.

Independent of the uncertainty surrounding the metrics, there is variability in how different practitioners collect data for the calculations and apply the methodology, which introduces a degree of subjectivity. The Australian Centre of Excellence for Risk Analysis (ACERA) conducted a study investigating

*"Uncertainty in assessments of vegetation condition due to observer error in field estimates of vegetation attributes…[*concluding that*] … The results indicate that uncertainty in field estimates of site attributes may cause vegetation condition to be under- or over-estimated on all but highly degraded sites. The primary cause of observer variation in total vegetation condition scores was random error in raw estimates of vegetation attributes"*

p. 8, Gorrod and Keith (2010)

Given the human component of implementing the measurement system, these requirements necessarily call for minimal complexity (Possingham et al., 2007; Parks, Newell and Cheal 2003; Hartig and Drechsler 2009). The more decisions and calculations humans are required to make, the more subjectivity may be incorporated, and the more room for human error. A biologically accurate and transparent, objective system is tested through implementation. If it fails to be implemented correctly, then the benefits of its biologically robust design are not realised (Andreasen 2001; Parks, Newell and Cheal 2003; McCarthy et al., 2004; Gibbons et al., 2009; Possingham et al., 2009).

4.3 Long-term management and long-term management plans

Proper long-term management is a fundamental mechanism for addressing the variety of risks that threaten bank failure and jeopardize offset banking success (Marsh, Porter and Salvesen 1996; Redmond et al, 1996; Studt and Sokolove, 1996; Crowe and ten Kate 2010). The following describes the components of long-term management requiring consideration for successful long-term management: adaptive management, monitoring, contingencies for catastrophic events and adoption of the *precautionary principle*.

Knowledge uncertainties and the possibility of multiple restoration outcomes necessitate continuous input to make the management adjustments likely required to achieve desired outcomes (Hilderbrand, Watts and Randle, 2005). Biologically robust Management Plans are needed to ensure adequate long-term management[69]. Relevant components include describing biotic and abiotic baseline conditions; stipulating management actions; specific objectives of the bank site, and administrative requirements relating to funding, monitoring and reporting to meet regulatory, contractual and conservation requirements (Hill 2008). For example:

"Biological management includes such activities as weed abatement through manual removal, spraying or fire; thatch reduction and weed abatement through grazing management; providing strategically located water troughs for livestock to reduce impacts to wetlands; and invasive species control methods such as draining stock ponds annually to reduce the impact of exotic bullfrogs. This section should be written by an experienced biologist who understands the ecology of the local area, and the needs of the species being provided for by the management."

p 103 Hill 2008

In comparison, within the New South Wales Biobanking scheme, 'standard' and 'additional' management actions are stipulated in the BAM (DECCW 2008):

"Standard management actions are: manage grazing for conservation, weed control, manage fire for conservation, manage human disturbance, retain regrowth and remnant native vegetation, replant/supplementary planting, retain dead timber, nutrient control, erosion control, retention of rocks…Additional management actions include control of feral, and/or overabundant native

[69] Note that a significant component of a successful and well-regarded long-term management plan is the provision for long-term financial support for the management actions. This is discussed in Section 5.1.2, and as such, the following discussion concerns the aspects of the management plan that pertain directly to biological values.

herbivores; 2) vertebrate pest management (pig foxes and other feral species); 3) nutrient control; 4) control of exotic species; 5) maintenance, or, reduction of natural flow regimes (where possible)"

p 28 2009 Seminar, DECCW.

For banks containing species credits:

"Control of feral and/or overabundant native herbivores; vertebrate pest management - pigs; vertebrate pest management - foxes and/or miscellaneous species; nutrient control; control of exotic fish species; maintenance or reintroduction of natural flow regimes (where possible)"

p 13 BAM 2008

4.3.1 Adaptive Management

Adaptable offset management plans may offer superior conservation outcomes (Marsh, Sokolove and Rhodes 1996; Parma 1998; Gibbons and Lindenmayer 2007; Hilderbrand, Watts and Randle 2005; Fleischer and Fox 2008; Hill 2008). Under adaptive management, outcomes from current management actions inform future decisions and management directions (e.g. Parma 1998; McDonald-Madden et al. 2010). This introduces capacity for learning, giving land managers the ability to change management to achieve better conservation (Parma 1998; Fleischer and Fox 2008; Teresa 2008; McDonald-Madden et al. 2010).

Adaptive management approaches may be passive or active (Parma 1998; McDonald-Madden et al. 2010). Passive adaptive management refers to a management program whereby the outcomes of past management actions are assessed within the process of designing future management programs, as a point of protocol/policy (Parma 1998; McDonald-Madden 2010). Active adaptive management represents the combination of experimental science and conservation management. Building on the passive approach it involves specifically designing management actions so that outcomes provide answers to specific questions, testing existing assumptions. (Parma 1998; Hilderbrand, Watts and Randle 2005; Bonnie and Wilcove 2008) At the conclusion of a pre-defined management period, more specific and useful conclusions are possible than via passive observation alone. Investigation of cost-effectiveness of may be included, as the various benefits may be directly comparable under a suitable design (Hilderbrand, Watts and Randle 2005).

One criticism of previous failures has been the inability of management approaches to alter management practices (Parma 1998). A framework based on static objectives or specific biodiversity outcomes may be counter-productive to broader, actual conservation gains (Lister 1997; Gunderson 2000; Fleischer and Fox 2008). Hilderbrand, Watts and Randle (2005) critique previous non-adaptive or 'command-and-control' approaches that assume the given management approach is appropriate and optimal, potentially 'forcing' an ecosystem in a desired direction via intensive and specific management. Not only is this held to be ineffective but introduces risk that the ecosystem may consequently develop in undesired ways (*see also* Gunderson 2000):

> *"Ignoring uncertainty often results in surprise and failure, because we have not created a system capable of adapting or responding to future drivers or chance events, and we are unable to exert ultimate control over the system. An alternative approach would be designing for resilience by planning for surprise. Although we cannot anticipate all future events, we can manage and restore in ways that allow for uncertainty. Planning for resilience should allow systems a greater ability to deal with and recover from surprise and future change by focusing on a diversity of approaches, functions, and taxa."*
>
> p 7 of 11 Hilderbrand, Watts and Randle 2005

An advantage of adaptive management may be in capacity to better support resistance and resilience of ecosystems and biodiversity values which is fundamental long-term ecosystem existence and so providing perpetual mitigation (O'Riordan and Stoll-Kleemann 2002; Andreasen et al. 2001; Hooper et al. 2005). This is increasingly reflected in management decisions that consider approaches fostering resistance and resilience. Adaptive management is most importantly a component of conservation where on-going pest management is required. This is the case in New Zealand where invasive mammals require perpetual control, therefore most successful when allowed to adapt to the specific responses of the local pests.

Uptake of adaptive management is restricted as a result of potentially costly balance between resources required and the inconsistency of remunerative outcomes, compared to more traditional approaches (Parma 1998; Teresa 2008). A careful balance must be struck between optimal actions based on current (limited) knowledge and risks associated with testing new or alternative approaches (McCarthy and Possingham 2006; McDonald-Madden et al. 2010). Additional design requirements to facilitate hypothesis-testing and conclusive outcomes, and the necessary supporting assessment all increase costs (Hilderbrand, Watts and Randle 2005). If results can be directly translated into superior conservation outcomes then costs may be recouped. If conclusions fail to significantly change management practices then the increased certainty of action is unlikely to balance the non-trivial expenditure (Parma 1998). The benefits of bearing the costs of active adaptive management are much greater if knowledge is limited. When uncertainty is minimal the risks are lesser and a passive approach may be more cost-effective, and therefore favoured.

4.3.2 Monitoring

Long and short term monitoring is an integral component of adaptive management (Turner, Redmond and Zedler 2001; Spieles 2005; Spieles, Coneybeer and Horn 2006; Bonnie and Wilcove 2008; Hill 2008). In the process of bank establishment, short term monitoring is required to ensure necessary standards are met in relation to credits issued and may demonstrate the passing of thresholds or satisfying of criteria required. Long term monitoring aids in assuring continual maintenance of mitigation standards, and identifies problems or failure in a time frame that enables losses to be minimized. Should problems become apparent, more frequent monitoring should be temporarily re-instated (Hill 2008).

Commentators suggest that offset banking management should monitor biological indicators, completion of management actions, and management outcomes. Ideally, underlying assumptions of management decisions are considered given adaptive management above (Parma 1998; Bonnie and Wilcove 2008; Watts and Handley 2010). Indicators and surrogates may also be used in monitoring, endorsed in the CBD (Faith and Walker 1996; Watts and Handley 2010). As an example:

"I used three metrics that should be common goals for all: the establishment of hydrophytic vegetation, the prevalence of non-native species, and the number of species per unit area. I suggest that these fundamental measures can be used to evaluate mitigation banks across eco-regions, mitigation methods, and geomorphic settings, and given the variability in performance standards and monitoring methods, these may be among the only measures common enough for a broad comparison."

p. 11 Spieles (2005)

It is suggested that both management inputs and outputs should be measured as part of a monitoring program, reflecting both the outcome from the impact but also the processes associated (BBOP 2009d). For example, the World Bank's1998 'Guidelines for Monitoring and Evaluation for Biodiversity Projects' (as cited by BBOP 2009d) recommends:

"A clear set of objectives or goals, including clearly stated questions on how these objectives could be reached; a clear set of indicators to measure progress towards project objectives; specific details on how and when monitoring and evaluation will take place, and who will undertake specific activities; identification of any training, capacity-building or financial resources that will be needed to ensure necessary activities are adequately carried out; identification of the intended audiences that will receive the results of an M&E plan; specific details on how information and results from M&E activities will feed back into project management decisions; identification of clear 'decision points' when negative trends lead to corrective actions in project implementation (World Bank 1998)."

p. 86 BBOP (2009d)

Choice of monitoring metric connects with debate regarding ecosystem measurement more broadly[70]. Monitoring metrics must be appropriate for a wide range of locations to maintain equity across sites and values in the system for NNL. Conversely, location-specific or permittee-responsible offsetting is usually designed to monitor specific values in relation to specific development impacts. Credit trading requires an alternative approach. A fungible, tradable credit needs monitoring that is also fungible, so performance of offset sites can be compared, assuring that credit standards are maintained. This is instead of comparing offsets against impact sites per se (as this has already been quantified through the credit trade). Monitoring for a credit trading system must focus on demonstrating commensurate standards between offset sites to make exchanging credits through trade reliable. At the same time, monitoring must also respond to specifics, being able to adequately accommodate the different species, structure and processes at different sites. Balancing both these requirements is difficult however, as metrics optimally situated to one location may be inappropriate or ineffective in another, requiring complex and challenging decisions to be made (Andreasen et al., 2001).

4.3.3 Contingencies for catastrophic events

Catastrophic events cannot be prevented; having a clear stance and protocol to address their occurrence offers the most efficient path to minimizing damage risks. Adequate provision for catastrophic events is an important part of management plans and overall offset design. Damage caused by catastrophic events risk the long-term success of a bank site and a common cause for

[70] Metrics for monitoring may potentially have direct relation to the metric used to assess and measure the biodiversity values in the initiation of the banking process. Note BBOP's (2009d) use of their 'Key Biodiversity Components' within the 'Key Biodiversity Components Matrix', initially introduced within design applications, as appropriate inclusions in a monitoring and evaluation process.

concern (Marsh et al. 1996; Goldman-Carter and McCallie 1996). Any event occurring outside 'normal' or expected parameters might be considered catastrophic, with variable environmental outcomes possible. Such events may be naturally caused [71] such as floods, hurricanes, droughts, tornadoes, lighting strikes, temperature extremes, or non-climatic such as disease and pest outbreaks and geomorphic, tectonic or seismic occurrences. Human-derived events may include pollution, vandalism, accidental damage, fire and arson, and general error in judgment or negligence in preventing unwanted events[72].

Mitigating risk posed by catastrophic events concerns the assignment of liability (both causative and remedial), processes of *remediation*, and mechanisms of prevention. Liability may be ascribed on efficiency, effectiveness and implementation, or on enforcement capacity. The lack of predictability regarding the frequency and magnitude of natural events makes effective prediction and prevention extremely challenging, so planning for remedial action may be the best strategy. Limited predictive capacity may exist where there is data, such as records of flood frequency in a region. This raises further questions over whether to plan for the 100 or 1000-year flood, and what is a reasonable cost for preventative measures where technological limitations mean benefits are outweighed by significant costs (Goldman-Carter and McCallie, 1996).

Difficulty assigning direct causative responsibility for natural events generates debate over who should pay for and conduct remedial actions. Assigning liability based on rationales other than causation has proved challenging and contentious. Impacts from catastrophic events may therefore be excluded from long-term management plans, for reasons of practicality, expediency or ecology. Some jurisdictions have chosen to treat catastrophic events as a natural part of the biological system, arguing that any negative impacts were equally likely to damage values irrespective of offset banking occurring, and so it is not a component of NNL to ameliorate such damage. If the bank site is established in perpetuity, it is reasonable to expect that time exists for damage from natural events to repair un-aided and maintaining long-term NNL.

---

[71] The author recognizes that in cases such as global warning and climate change this distinction is markedly less defined, and in many cases synergistic interactions are present between natural and human-derived causes.

[72] Human-derived events not discussed in more detail here as they are considered generally more manageable as they occur in a less random manner so may be predicted based on factors such as the location and design of the bank or physical barriers or protection in place. Additionally, this capacity for prevention increases with experience over time. A similar assumption cannot be made for the prevention of natural events, such as hurricanes or lightning. Where human error is involved, the management plan is a pivotal tool for defining liability, making remedial action more expedient, and increasing the incentive for active prevention. The role of human error is discussed more in Chapter 6

4.3.4 The precautionary principle to address risk

In the presence of uncertainty, there is risk that decision-making process may be delayed, or not occur at all and result in continued loss of value. This is a relevant concern in relation to offset site management decisions (Goldman-Carter and McCallie 1996; Young et al., 1996; Burgin 2008; Smith *n.d.;* Elliot 2009). Under the precautionary principle, absence of unequivocal evidence should not delay management; management should instead continue, guided by principles of prevention and precaution (Harding 2006).

"Full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment." p. 3 Smith (n.d.)

In NSW, Justice Stein (Hon) has stated:

"[the precautionary principle] is directed towards the prevention of serious or irreversible harm to the environment in situations of scientific uncertainty. Its premise is that where uncertainty exists concerning the nature or scope of environmental harm (whether this follows from politics, decisions or activities), decision makers should be cautious." p 3 Smith (n.d.)

Use of the precautionary principle to guide risk mitigation via mechanisms such as long-term management, planning and monitoring is widely promoted internationally as being in line with sustainable development and offers risk mitigation in systems such as offset banking (Harding 2006; Nelson and Sharman 2007; Burgin 2008). Under the precautionary principle, management actions and policy decisions are made with the intention to avoid unwanted or unintended situations. Decisions should be made with regard to certainty of outcome, and irreversibility of potential negative effects. This may reflect increased conservatism: stronger emphasis on avoidance, larger ratios, longer time frames and more stringently conservative guidelines and standards (Harding 2006). Internationally, this is supported in the Rio Declaration (1992) (Elliot 2009):

"*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation* (Principle 15, Rio Declaration)"

4.4 Summary: Biological Risk, Scientific Uncertainty and Ecosystem Measurement

No offset banking system can ever hope to eliminate biological risk from the system. The biological diversity within offset banking represents together both the most important goal of the system, (achieving no net loss of biodiversity), and the largest source of risk that jeopardizes this: sciences' limited knowledge of biodiversity. Of many steps, the most important is accurate measurement and representation of biological values within offset banking. This in itself presents many challenges, yet with support by other mechanisms seen in Californian and New South Wales' examples, significant progress is being made.

Addressing risk through a multi-faceted framework is important. The most fundamental risk in offset banking originates because of the combination of environment, economy and society under sustainable development. While this chapter has discussed the risks associated with the biological components, these operate in tight combination with economic and social risks. Risk threatening the strength of one places significant threat on another. It is therefore dangerous to address risks, biological or otherwise, in isolation.

The need for multiple components is an idea reflected in a portfolio approach. Practically, this occurs by spreading risk across a collection of banks, reflecting that to prevent increased loss conservation needs to occur across the landscape (eftec, IEEP et al., 2010). Cost and responsibility is also spread across a number of development projects. In operation, the risk that this approach does not work is addressed by a collection, or portfolio, of mechanisms and measures. It is in a portfolio context that these measures should be viewed. They do not represent perfect solutions in themselves and it would be inappropriate to place the burden of mitigation with one approach; this in turn presents more risk. Measures discussed here instead contribute to a portfolio necessary to mitigate risk in an inherently inter-dependent and risky system.

CHAPTER FIVE
FINANCIAL RISK AND ENSURING FUNDING FOR CONSERVATION

The risk posed by financial failure of the offset banking system is as fundamental a concern as that posed by biological failure. Proper financial underpinning of offset banking is integral under sustainable development principles. To achieve NNL, the system must generate adequate money for biodiversity conservation; it must also balance the economic costs of biodiversity loss with the environmental (and by extension, social) costs and encourage biodiversity conservation while discouraging biodiversity destruction. The finance and economis of the system are critical to ensuring this occurs, and are a source of risk that must be mitigated. In this chapter I will discuss the process of identifying financial risks present within offset banking as a precursor to the various mechanisms available to mitigate and minimise such risk. Given this understanding, risks associated with the finance and economics of offset banking may be managed so these do not jeopardise, but instead enhance, the biological and social benefits available through offset banking.

5.1 Generating adequate money for conservation by ensuring financial success of individual banks

5.1.1 Credit Transactions

The first stage of ensuring that adequate financing is available to support an individual bank is ensuring a robust credit[73] transaction. A credit's primary financial function is to generate money to support the biodiversity conservation of the bank; this requires credits be sold and for an appropriate price. In turn, this requires the identification of a buyer, establishing an appropriate price and generating revenue via credit exchange. It then must be ensured that this money achieves conservation as intended. The correct credit price achieves little without available and willing purchasers yet an under-priced transaction is also undesirable. The economic free-market's purpose is to balance such competition concerns. A system of multiple buyers and sellers efficiently addressing these issues is fundamental to offset banking and the market-based approach, so is the subject discussed below.

Credit sales must be unambiguous and explicit to ensure the money exchanged makes the intended conservation gains (Teresa 2008). Transactions that are poorly regulated introduce risk that banks and credits may be over-sold, where credits are sold for values that do not exist (Naumann, Vorwerk and Brauer 2008). A bank owner may overstate credits available, or the same credit may be sold to more than one party, mitigating more than one impact. Upon the second sale, the impact is considered mitigated, but the values have already been used in mitigation and so theoretically, these values no longer exist. In these cases, money is generated that does not contribute to conservation. Robust and enforced accounting processes, at the bank and higher administrative levels are required. A comprehensive and up-to-date credit-trading registry (with compulsory registration) is also necessary. Both efficiently manage risks to an individual bank site posed through by inappropriate credit transactions (Teresa 2008).

5.1.2 Long-term funding: endowment funds

The second stage of financial risk management is to ensure long-term financial success of individual bank sites. With increased awareness of this importance, and more stringent requirements by governing bodies, effective mechanisms have been developed. Current best practice is an endowment *fund, increasingly becoming an essential component:*

"Endowment funding is, in most cases the most efficient, cost-effective and pragmatic way to assure long-term management of a conservation bank. Properly structured, endowment funding can relieve the bankers of ongoing risks and long-term management responsibility for conservation banks."

p. 142, Teresa (2008)

5.1.3 Management costs and the initial deposit

Money in an endowment fund is managed to ensure it produces perpetual revenue, while maintaining the capital base. The interest generated from an initial deposit returns income to sustain the offset bank, without the initial deposit itself being used. This fund addresses the risk posed by stochastic or unguaranteed funding for management as it provides an assured level of income over the long-term.

A successful endowment fund requires both a correct initial deposit and correct financial management thereafter. Present-day judgements and predictions this requires may only be proved correct over longer future time-spans, making errors harder to remedy and these challenging speculations. Best practice has developed to establish necessary requirements, costs, and final budgets:

"It is possible to reduce the long-term costs of conservation land management to a single value - a financial calculation, in today's dollars - which is the present value of all future costs associated with a project..."

p. 135, Teresa (2008)

The schedule of management actions are the basis for calculating the deposit required. Accurate projections are increasingly achievable with direction given from defined outcomes and experience. Potential risks remain however, requiring significant knowledge and planning to specify the management actions needed over extended future timeframes. The projected costs of these must also be estimated, with proper consideration of potential changes in technology, labour requirements, site conditions, or management best practice. Even with prior experience, the highly location-specific nature of management and associated costs mean final requirements are likely to vary considerably across locations, making generalised assumptions rare (Teresa 2008). Such considerations are particularly relevant where adaptive management is applied, and it is recognised these increase management costs (Teresa 2008).

Management costs are a direct product of the intensity, frequency and expense of management actions, so the years immediately following bank establishment will require a higher income stream. During this period management is likely most intensive and frequent while values are established, particularly where restoration, recreation, enhancement or establishment is involved. A step-wise reduction in costs following an initially expensive phase may be appropriate. This is incorporated through the established management requirements being extrapolated over time, preceding calculations of the final deposit amount.

5.1.4 Achieving proper investing and spending

Unfortunately, initial perception of simplicity in this process has resulted in examples of serious error[74]. Wide-ranging and varying costs have proved challenging to accurately estimate as many are not obviously related to specific management actions, such as indirect costs from labour-related levies,

[74] See for example the case of The Environment Trust discussed in Fleischer and Fox 2008, and The Ecosystems Land Mitigation Bank Corporation discussed in Gardner and Radwan 2005.

benefits and taxes, overheads for office and administration including legal, accountancy and secretarial work, and insurances and taxes (Teresa 2008). In addition, there will be costs associated with managing the invested capital including expert fees and transaction costs. Oversight of these can have a significant impact on the amounts required (Teresa 2008).

Funding problems have also arisen when management outside of the established plan is required and which the endowment fund is unable to support. This occurs because of inaccurate management predictions or failure to account for unpredictable events. Two responses are possible: drawing additional funding from the capital base or reducing management actions to match current income risking both short and long term biodiversity decline (Teresa 2008). Multiple withdrawals from the capital base decrease its interest-earning capacity and the unsustainable income will be reduced to a point where management stops completely, risking decline of all values.

With increasing focus on the perpetuity of values, the proper functioning of endowments over longer time frames has received more attention. The greater time-span income covers, the more critical capital maintenance required. This is because of the impact of interest, inflation and depreciation in the system and how these compound over time. Because the endowment process relies on the ability of the initial deposit to earn interest over time, calculation of the initial deposit is a function of the total management and operational costs, adjusted for the effects of interest rates (Teresa 2008). Accurate projection of future interest rates is an uncertain and highly technical process, as rates vary over time and investment portfolios.

Different estimates and predictions may be used and the compounding nature of interest means that this variation has a significant effect on the amount required for the initial deposit. Applying incorrect rates can jeopardise the ability of the endowment to meet expectations, and respond to unexpected future conditions. Previous rates have in some cases been overestimated and the endowment has been unable to withstand market fluctuations that reduce interest rates too far or frequently below the predicted rate. The specific needs of endowments for conservation have demonstrated this to be a highly specific area of knowledge and highlighted the role for specialised *endowment holders* (Teresa 2008).

A policy directing income expenditure is also required[75]. The amount available for annual spending is a function of the expected interest earned based on predicted rates. Earlier endowments assumed that total interest represented available spending income and failed to consider inflation and depreciation that reduce capital buying power over time and the capacity for the initial deposit to generate enough income to meet inflating costs. It is now best practice to allocate only a portion of the interest accrued each year for spending, with a designated portion being reinvested to maintain the capital. Establishing a non-wasting endowment manages the risk that inflation will reduce any money set aside now, for future conservation purposes.

5.1.5 Operating the endowment

Following endowment design, the timing of the initial deposit must be considered. For maximum risk-mitigation, the deposit should be secured prior to credits being sold (Teresa 2008). This is frequently challenging due to the substantial money concerned, and so the risk involved. Should the credits sell slowly or not at all, lost opportunity cost of the endowment fund is significant. This may have the potential to render the economic balance of the project untenable. However, if funds are deposited only after credits are sold, then the time between bank establishment, credit sales and endowment funding may be substantial enough that values decline because management is not funded (Teresa 2008). The timing of the endowment deposit (before, concurrently or after credit sales) must adequately mitigate risks to biodiversity values, without placing counter-productive and uneconomic burden on the bank owner.

Responsibility for management and investment is most ideally externally assigned, preferably to a specialised, non-profit entity that invests the money on behalf of the steward, can take advantage of a more favourable tax status, and ensure transparency and impartiality in distributing the payments. Their independence allows an additional enforcement mechanism if management payments are made only when criteria are met by the bank site and bank owner.

State and government entities or specialist private firms may take this role. The legal and fiscal implications of this are discussed below, noting contrasts between New South Wales and California. Social concerns may favour allocating to a private, non-profit entity. The provision of income for biodiversity conservation is expected to be seen as an incentive to private landowners, however it has

[75] For example, CNLM adopts a 4.5% or less spending rate - based on collected data.

been suggested that the involvement of government in a landowners income may be perceived to introduce more, rather than less, risk to the private land-owner. It may detract from its perception as a free-market scheme and cause it to suffer some of the limited participation issues restricting current rebate and grant programs and potentially jeopardising essential scheme uptake.

5.1.6 Long-term funding in Case Studies

New South Wales and California

Table 5.1 (p. 139 - 141) compares differences and similarities within the long-term funding frameworks of California and New South Wales, reflecting the best practice becoming established. New South Wales' Biobanking Trust Fund is a recent application of non-wasting endowments supporting long-term conservation, from practices long established in the United States. A non-wasting endowment fund is established as a requirement of establishing a conservation or mitigation bank in California. Improvements in design and professional expertise in this area has been fundamental to California's success.

The Centre for Natural Lands Management (CNLM) in Southern California is a highly regarded non-profit, specialist bank *stewardship* organisation established in 1990. CNLM has contributed significantly to endowment practices across that state, in particular through systems developed for long-term management plans and costing. The demonstrated success of their business model makes a valuable template for illustrating how to manage long-term financial risk within offset banking, discussed bellow.

Property Analysis Record (PAR)

The Property Analysis Record, or PAR, is software developed for CNLM's Endowment and Stewardship operations, now offered under licence by CNLM. The Model calculates a financial value for the long-term biological and protection requirements of a bank project:

> "…first by establishing the long-term needs of the project by comparing a set of management possibilities against the actual condition and circumstances of the project…Second, PAR asks what can be done in the design or documentation of the project to reduce these…Third the PAR asks what tasks are necessary to offset the remaining threats to the project over time…With these assumptions,

the PAR prepares a task-based budget suitable for presentation as an annual cost, an average perpetual cost and as an endowment."

p. 136 Founder, Teresa (2008)

The model recognises two time periods: 'Initial and Capital' and 'Long-term On-going' periods. The Initial and Capital period corresponds to the period of bank establishment, including any restoration, creation or other value-adding activities. The CNLM uses a 4-5 year time frame for this period, depending on the project. This may include land-acquisition costs, credit marketing and transaction fees and one-off labour costs. These costs are not included in the endowment calculations. Separate Initial and Capital (I&C) payment is required, preferably before the CNLM accepts stewardship. It may be paid over a schedule of instalments if appropriate adjustment is made for loss of earning and inflation over the repayment period. The PAR produces an annual budget and includes for the provision of three to five years of ongoing expenses to be included as a buffer for potential volatility of earnings. The PAR also includes a 10% allocation of all direct, indirect, overhead and insurance costs as a contingency allowance. It also adjusts all costs for inflation and discounts them for time.

The PAR is a foundational component of the success of CNLM, which has established a laudable reputation and offers a range of ecosystem management and other services to augment the conservation/species banking industry. The PAR model is a proven approach to the long-term management of both management and financial requirements of a biodiversity bank, and is therefore an appropriate approach for application more widely in other schemes.

Table 5.1 Summary and comparison of features of the NSW and Californian long-term funding frameworks. See GLOSSARY for definition of terms.

Endowment features	**Term used**			
	California Endowment Fund		New South Wales BioBanking Trust Fund	
Requirement established	The Memorandum of Guidance for the Establishment, Use and Operation of Conservation Banks in California (2003) (*within others also*)		TSA 1995, Section 127ZW, X,Y; TSA Biobanking Regulation 2008 Part 7 Section 29; individual bank requirements are in the Biobanking Agreement	
Parties with relationship to the endowment	Stewart	Receives payments from the endowment to fund management actions required of it.	The Minister	The State Government Minister who administers the TSA Act and appoints the Trust Fund Manager
	Endowment Holder	The organisation managing, investing and distributing the endowment deposit and any earnings. May hold any other bank role and may be a non-profit/NGO or less commonly State agency.	The Trust Fund Manager	The person charged with investing and managing the Biobanking Trust Fund. May or may not be state entity.
	Easement Holder	Could potentially gain access to endowment payments in order to fulfil the obligations of the easement.	Bank- owner	As a condition of receiving credits, is responsible for the initial deposit into the Trust Fund.
	Credit-seller	Is responsible for funding the initial deposit of the endowment as a condition of being issued credits. May also be responsible for management until such time as the endowment is operational (i.e. fully funded and producing income to support management of the bank as required)	Bank manager	Receives annual payments from the Trust Fund that enable the long-term management required. Submits annual reports required in order to receive such payments.

Table 5.1 (Cont.) Summary and comparison of features of the NSW and Californian long-term funding frameworks. See GLOSSARY for definition of terms

Funds held as (Collective/separate)	Held as individual funds, or as private collections, or as collections within private companies, or invested by the state	Held as a collection of all funds from all banks in the State
Initial deposit paid (when)	On or before a date specified in Bank Agreement or in accordance with agency specifications. Commonly a sequential process aligned with credit sales.	As Credits are transferred i.e. sold or retired. Must be made before the transaction is registered.
Fund held by	One of many entities, private or public, with the authority to do so.	Funds held by the State in the Biobanking Trust Fund
Managed by	A person appointed by the endowment-holding entity (an employee or member).	The Ministerially appointed Trust Fund Manager [1], Can also be the Environmental Trust as established under the The Environmental Trust Act 1998
Payments made by	Annual payments, from endowment entity to Bank Steward as per specific arrangements	Annual payments made by the Trust Fund Manager; upon receipt of annual report; schedule specified in the Biobanking Agreement
Management costs calculated by (who and how)	Various methods applied based on entity responsible. For example, see PAR and CNLM (in text). Management and endowment procedures specified in Bank Agreement Documents, written by bank-owner representatives and approved by multi-agency bodies.	Landowner submits a completed Management Actions and Management Plan Template with the application for a Biobanking Agreement; Accredited Assessor Submits Credit Calculation report including management actions required for proposed credits. Final Agreement issued by DECC, states Management Plan, Schedule of payments and initial Trust Fund Deposit.
Total Fund Deposit calculated by (who and how)	Government and State entities governed by finance and investment law that applies to conservation easements, which limits their investment options and returns possible as state funds. Private entities are not restricted by these regulations.	Determined by the Director-General of the Department administering the Act

Table 5.1 (Cont.) Summary and comparison of features of the NSW and Californian long-term funding frameworks. See GLOSSARY for definition of terms

Invested guided by (rules)/ notable restrictions?	Operate Credit Trading registry; stipulate the endowment fund must be paid; may be third party beneficiary to endowment; signatory to Banking Agreement detailing the Endowment.	The TSA (1995) states that investments should be made in the same manner as under the Tustee Act 1925, and in regard to the Biobanking Regulation (TSA 2008)
Role of State (and State agencies)	If a third party beneficiary to an endowment and easement, an assigned government agency such as USFWS can directly manage or allocate the management of the endowment under certain eventualities	Specify/approve management actions, plans, schedule of payments, initial Trust Fund Deposit via issue of Biobanking Agreement; appoint Trust Fund Manager - if state-filled (as currently) then also includes the duties of the Trust Fund Manager.
Provision for amelioration access	Best-practice requires the re-investment of the excess, to buffer future volatility	Annual payments can be suspended by DECC. DECC can claim damages. Director-General may direct the Trust Fund Manager to use funds in a specified manner - potentially for amelioration.
Provision for returns in excess of those required/expected	Fund must be self-sustaining. Additional requirements not specified in regulatory documents.	Where there is an operational surplus in excess of 30% (of all scheduled management payments), the bit above 30% may be paid to the bank site owner. (TSA Reg. 2008)
Cost recovery	Some bankers have chosen to re-invest more interest that required in agreements and have grown the endowment fund to be larger than minimum requirements from a desire to be better prepared to accommodate future economic uncertainty, or to expand management options and potential for the future.	Participants in the scheme may be required to pay the Minister costs associated with operating the Fund, such as ensuring compliance and administration.

[1] During the initial phase of the Biobanking Scheme, this role is filled within the State Government, however provision is available for this to be taken over by a private entity at a later date. This change in operations has non-trivial implications for the scheme as a whole, and is discussed in relation to California subsequently.

5.1.7 Endowments and long-term protection

In addition to the framework outlined in Table 5.1, there are some other key features of the California scheme worth noting. These provide context for the differences between the two systems. An endowment may be invested and managed in many ways. Different investment profiles present varying levels of risk with varying levels of return. In California, state and federal laws regulate the fiscal and investment rights of local and state government agencies. They restrict allocation of money and structure investments to certain forms of low-risk investment. This limits returns possible when investing money such as endowment funds, in many cases to below what is reasonably necessary to sustain a banking operation (Teresa 2008).

A private firm is less encumbered by restrictions than public bodies and is able to access investments and investment structures offering a significantly higher rate of return. Private firms are in a far better position to secure a higher income stream from the endowment deposit. Therefore, it is most common for endowments to be held in private, non-profit, specialist firms that may hold similar roles for foundations, charities, hospitals, universities or other such non-profit philanthropic organisations[76].
This presents a very different mode of operation compared to New South Wales where the endowment is government managed. In the absence of such limitations imposed upon government or agency investment and fiscal management, there is little impetus for many private firms to take on this role. This may be one reason that such a difference exists between the two examples.

5.1.7.1 *Easements*

In a chapter concerning financial risk, the discussion of the permanent protection of the bank site for conservation purposes may seem misplaced. However Californian land-rights structures, utilising easements, are an effective mechanism of managing financial risks associated with long-term funding of bank sites. The structure establishes a unique relationship between the bank, land and credit owners, the perpetual protection of the bank site and the perpetual management funding because it allows the severance of these multiple rights from the land-title holder (McElfish and Nicholas 1996; Carroll Fox and Bayon, Appendix II 2008; Gardner 2008). Rights to resources such as minerals or water are divided through the same approach. Banking credits may be analogously severed and sold

[76] Note Commonfund www.commonfund.org and The Investment Fund for Foundations www.tiff.org

by a party other than the landowner or fee-title holder. Table 5.2 summarises how such rights may be distributed to a number of parties within a banking framework.

Table 5.2: Parties and rights with potential involvement with the structure of conservation easements and endowments in California, under the conservation and mitigation banking system. 'Banking documents' refer to legal documents required for bank establishment (BEI/MOA/CBA). See GLOSSARY for abbreviations and definition of terms.

Entity	Role may be filled by	Concurrent roles allowed/restrictions on roles	Rights held
Regulating agency	The state and/or federal agency(s) that approve the bank	Agencies may concurrently be *endowment* or *easement holders*, but more commonly third party beneficiaries. They may hold fee-title to the land if other rights have been severed, but this is not preferred.	Jurisdiction as per legislation, regulations and guidance's over the enforcement of banking documents (BEI/CBA/MOA) conditions. Also retains rights to access endowment and land under various mechanisms.
Bank sponsor	Private individual, company, NGO or non-profit	May concurrently hold land fee-title, and *bank management* positions	Liabilities, financial or otherwise, as specified in banking documentation the *bank sponsor* signs.
Credit owner	Private individual, company, NGO or non-profit	*Credits* may be owned by the bank sponsor, land fee-title holder, bank manager or an independent buyer.	Holds the rights to sell the credits issued in the banking documents, for profit. Credits may only be purchased once if used for mitigation.
Fee-Title holder/ Land owner	Private individual, company, NGO or non-profit or a state agency.	May concurrently own credits as the bank sponsor, and/or be the bank manager.	Rights are highly specific, based on jurisdiction, easement conditions and conditions within banking documents, and other severance of rights relating to the land.
Easement Holder	Private entity, NGO, non-profit or State agency.	May not be held in conjunction with any other role, except the in a position of bank manager. An entity may also be a third-party beneficiary to the easement typically a government agency or private non-profit organisation that can step in if the primary holder defaults.	Rights necessary to uphold the conditions of the easement (such as rights to water and access etc.). Also the right to enforce the conservation easement against violation, e.g. trespass or vandalism (the right to enforcement may also be acquired through being third-party beneficiary).
Bank Manager	Private individual or company, NGO or non-profit.	Role may be held concurrently with bank sponsor, land fee-title holder, easement holder, but	Rights under contract of employment if an independent entity.

		not the endowment holder.	
Endowment Holder	An organisation or entity approved to hold endowments by the regulating agency (most commonly private, non-profit, but may be a state agency).	Must be an independent entity i.e. cannot hold any other role, but may be concurrent with land *stewardship*/management.	The right to hold, manage, invest and allocate the monies of the endowment fund for the purposes established in banking documents. Rights to access the fund may also be acquired by a third party beneficiary to the endowment

This structure can also include severance of access rights and rights to enforce certain conditions (both restrictive and prescriptive) on the land, through the use of an easement placed with an additional, separate entity. Within California, the structure commonly places credits with the *bank sponsor* while the fee title is transferred to a non-profit organisation or state agency. In addition, an easement is granted to a separate party. Distinct from a covenant, an easement grants the *easement holder* both rights and responsibilities: the right to enforce the conditions of the easement in return for accepting liability for values specified within the conditions.

Both a Management Plan and the Conservation Easement are signed as part of the legally binding Bank Agreement. A structure of state legislature, conservation easements go beyond traditional easements that allow restrictions on specific degrading land uses, grant rights to inspect and monitor the property in line with the easement's conditions and objectives (Gardner 2008). As applied in conservation and mitigation banking in California, easement holders are further required to actively uphold these rights (i.e. rights cannot be waivered). These conservation easements stipulate the maintenance of the species or wetland values banked, and so the easement holder accepts liability to ensure these values in perpetuity. If the values are not maintained a specified third-party such as a government agency can direct the easement holder to do so under threat of withholding federal tax benefits or the right to hold future easements[77] (Gardiner 2008).

This easement structure minimises risk by enabling proper funding and long-term management because it places these responsibilities with entities most capable of fulfilling these specialised roles. It also minimises conflicting interest that may increase financial risk (see discussion of conflict of interests

[77] In cases of easement violation, the Grantee may bring a legal or equitable case against appropriate parties, to prevent or cease the violation, or to recover the costs of repairing the damage (see Appendix III, Carol, Fox and Bayon 2008). In California, the CFDG, Californian Attorney General or any other third-party to the easement may also take enforcement measures. If a state agency is a third-party beneficiary to the easement and also the endowment fund, they can access the endowment for the purposes of enforcing the easement (i.e. make the management funds available as necessary if the current Steward fails in their obligations) (Teresa 2008).

in Chapter 7, sections 7.5 and 7.3). Further, the perpetual management and protection of the offset bank values may continue uninterrupted irrespective of land tenure, removing the risk that transfer of land ownership will jeopardise the conservation values. Finally, the most important way that this land-rights structure mitigates financial risk is because it allows liability to be not only clearly established, but also severed from those unable to manage it reliably or efficiently.

Clear ascription of liability accompanies clear placement of risk: those with liability take on certain risks. A primary step towards mitigating and addressing risk is assuring that risks lie unambiguously with those with the best capacity to manage them: from here, risk mitigation can be effectively undertaken. For example, the role of the endowment fund: the endowment is a response to ascription of liability and assumption of risk. The credit owner/bank sponsor is released from the liability of long-term management by signing the easement over to a third party easement holder as above. To reflect the benefit of the transfer of liability and risk, a financial cost (i.e. the endowment) must be associated. The endowment fund money represents compensation for the easement holder taking on the liability and risk of the easement, as there is an appropriate mechanism to manage the financial risk of this task - the endowment (McElfish and Nicholas 1996; Teresa, May 2010 Pers. Comm.).

And so risk is mitigated; other parties do not carry long-term management risks as this has been clearly ascribed to the easement holder whereupon these risks are mitigated though the endowment process. Those carrying risk have the tools available to properly minimise them. In other contexts, such as New South Wales and potentially New Zealand, covenants may be used in place of endowments. This process involves similar perpetual protection mechanisms but does not ascribe any liability nor make provision for enforcement in the same manner. This raises questions in both regions as to how specific rights and responsibilities may be ascribed to run perpetually with land transfers while accommodating the needs and risk burdens on landowners. This is ideally conducted in a manner ensuring those with conservation values on their land are able to conserve them though offset banking, rather than owners being discouraged by the perception of high-risk responsibilities (for more discussion regarding entrepreneurship, participation and incentives see Chapter Five, section 5.4.3 - 5.6.3.2)

5.2 Ensuring success of many banks together: functioning in an economic context

The above mechanisms mitigate the financial risk surrounding an individual bank. All banks in a system are additionally exposed, as a collective group, to the risk of the economic system underpinning the scheme failing: the system does not generate the money needed for adequate conservation on a whole-scheme level. The market-based approach is intended to generate an optimum and efficient amount of money. In the context of conservation, where market-based offset banking is a novel paradigm, familiarity and expertise with the principles of the economic base may not be widespread or comprehensive, which challenges their effective implementation. However to create a successful economic market within which offset banking and credit trading is successful, a sound knowledge of economics and economic principles is essential. It is for this reason that important concepts are explained bellow: without these concepts in mind, design of an offset banking is at risk of financial failure as an economic system.

Firstly, a market for trading credits must be established (Crowe and ten Kate 2010). Such an economic market is concerned with the efficient distribution of goods and services (See Chapter 2: Sustainable development and the role of economics). Biodiversity and other offset credits represent some of the many environmental goods and services biodiversity provides. These goods are created legally and conceptually, as detailed previously, thus creating a commodity in an economic sense (Crowe and ten Kate 2010). With a commodity, a trading market may be established to influence and allocate market goods and services. This process requires the following aspects - market and non-markets, private and public goods - to be taken into consideration.

5.2.1 Market and non-market goods

Non-market goods are externalities as they cannot be allocated by market mechanisms, and so are excluded from market distribution (Gilpin 2000). Market goods are defined as resources that are rival and excludable (Table 5.3) (Anton, Fisk and Holstrom, 2000; Daly and Farley 2004; Heal 2000; eftec, IEEP et al., 2010). Redefinition allows previously non-market goods, such as biodiversity goods and services, to be economically allocated establishing the relevance to the economic paradigm.

Goods and services are rival when use by one party reduces use potential use by others, and excludable when someone using the resource prevents use by another party. Physical properties of a particular good or service will determine the degree of rivalness. Certain natural resources cannot be considered rival, such as an aesthetic view, protective capabilities of a health ozone layer or oxygen production by a healthy forest (Anton, Fisk and Holstrom 2000; Daly and Farley 2004).

Table 5.3 Economic definition of types of goods (Adopted from Table 3.1 eftec, IEEP et al., 2010)

	Excludable	**Non-excludable**
Rival	Private goods (Market goods)	Common goods (non-market goods)
Non-Rival	Club goods	Pure Public goods (non-market goods)

Excludability is not a direct result of inherent physical properties. One individual's exclusion from a resource because of another's access does not necessarily occur because all or part of the resource as been directly consumed, but because the individual owner has been given the right to exclude others (Anton, Fisk and Holstrom 2000; Daly and Farley 2004; Heal 2000). This right is created through human institutions such as law and law enforcement and is introduced through property rights (Hanna and Munasinghe 1995; Gilpin 2000; eftec IEEP et al., 2011). For example, a company may obtain rights to access land, to mine for minerals. This mining company is now able to exclude other mining companies, and other entities circumstantially, from accessing and using these minerals, even if the company does not consume or use all of the minerals themselves.

5.2.2 Public and private goods

Goods are public if access is freely available to all (Table 5.3) (Heal 2000; Gilpin 2000; Daly and Farley 2004; eftec, IEEP et al., 2010). While intrinsic properties of specific goods dictate their classification, human institutions influence this. Government taxes, subsidies and laws can make previously private goods publically provided, or previously public goods privately owned (Heal 2000; Gilpin 2000; eftec, IEEP et al., 2010). Some may be relevant to possible classifications of biodiversity.

Locke's early Labour Theory suggested that, in relation to natural resources specifically, the individual contributing the labour or input that resulted in those resources being turned into some useable good should therefore be the sole owner of that good or resource - a case of reaping what you sow (Anton 2000). Technological advancement and innovation contributes to a society's ability to make goods public or private. Improvements in television technology allow broadcasters to make television signals readable with certain privately-owned decoding equipment, turning previously public broadcasts into private goods for sale in the market (Anton 2000; Heal 2000; Daly and Farley 2004). Such an example illustrates how complex this distinction may be. The information content of the broadcast, the money financing it, the equipment and labour that created the broadcast may be publically or privately owned and also may be viewed as potentially having public benefits and costs, even if the elements are privately owned (Daly and Farley 2004). This may be compared with biodiversity, where specific components may (or may not) be made rival and excludable, requiring differing property rights to respond.

Property rights and exclusion are a design component of offset banking, through regulation and legislation (Hanna and Munasinghe 1995; Gilpin 2000; Drechsler and Watzold 2008; eftec, IEEP et al., 2010). These components of an economic market - goods being market or non-market, public or private - directly relate to managing financial risk in an offset banking system because if these concepts are not understood and properly accommodated though the design of an offset banking system, then proper economic functioning is unlikely and the overall objectives of offset banking will be jeopardised. The case-studies of New South Wales and California here illustrate how these concepts form an integral part of an effective offset banking system, and financial risk is minimised because proper economic functioning is possible.

5.2.3 Case Studies

Legislation may control exclusion and access to, interaction with and use of biodiversity and related resources. This is administered by the appropriate legal body and, as needed for offset banking, may include specific guidelines requiring permission prior to access. This enables banking in both California and New South Wales (Bruggeman et al., 2009).

How is this achieved in California?

While conservation banking is not a specific inclusion of the ESA, legislation creating exclusion enabling conservation banking is present (ESA 1973).

> "With respect to any endangered species of fish or wildlife listed pursuant to the section of this Act, it is unlawful for any person subject to the jurisdiction of the United States to … (B) Take any such

species with the United States of the terrestrial sea of the United States…with respect to any endangered species of plant listed pursuant to section 4 of this Act, it is unlawful for any person subject to the jurisdiction of the United States to - …(B) Remove and reduction to possession any such species from areas under Federal jurisdiction; maliciously damage or destroy any such species on any such area; or remove, cut, dig up, or damage or destroy any such species*…"*

Pg. 25 ESA 1973

This means that public and private landowners planning to utilise development rights on private, state, tribal or federal land are excluded from actions in the manner described in the act, namely:

*"The term 'Take' [*of an listed species*] means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct."*

p. 3 ESA 1(973)

The ESA has two sections pertaining to 'take'. Section 7 pertains to Federal, state, local or tribal government projects, or activities on their behalf. Section 10 applies to private landowners and development on their property. In this way, the ESA specifies exclusion of specific parties, from specific land uses (Bruggeman et al., 2009).

How is this achieved in New South Wales?

In New South Wales, exclusion occurs through several Acts, namely the Environmental Planning and Assessment Act (EPA) (1979) and the National Parks and Wildlife Act (1974), which include specific restrictions regarding development of land, and interactions with endangered, threatened or critical flora and fauna. The Threatened Species Conservation Act (TSA) 1995 creates exclusion by prohibiting development based on resulting impacts on threatened, critically endangered, endangered, presumed extinct or vulnerable species, communities or habitats. Division One, Part 2 and 3 specify what the exclusion applies to by stating the process of defining the species and habitats. The Act further details how consent for development may be granted through Biobanking. The legal system and supporting police forces of the respective States provide necessary enforcement, as this exclusion is created through instruments of law (Feeny et al., 1990). Actions against these regulations are considered breaching the Act so are legal prosecutable.

In New Zealand, exclusion provisions supporting market creation may be found within the Resource Management Act (1997). Here it is stated that:

"Part 3 Duties and Restrictions under this Act. Land. Sec. 9: Restrictions on use of land (1) No person may use land in a manner that contravenes a national environmental standard unless…(2) No person may use land in a manner that contravenes a regional rule unless… (3) No person may use land in a manner that contravenes a district rule..." p. 67

New Zealand therefore has some exclusion necessary for the creation of commodity and an offset banking credit-trading market.

5.2.4 Trading credits: creating supply and demand

Optimally, financial trading of commodities occurs by the forces of supply and demand (in offset banking see eftec, IEEP et al., 2010). In offset banking it is argued that demand creates supply. Provided there is a reason for someone to purchase a credit, there is therefore a reason for someone to create one (mitigating factors to this are discussed below). Demand exists when purchasers receive actual benefit from buying offset banking credits, such as satisfying regulations and consent for a profitable development project. Recall that legislation and regulation in California and New South Wales creates excludability; benefits are consequently ascribed to the holder of the rights (the credit purchaser), generating demand and supply (Shabman, Scodari and King 1996; Palmer and Filoso 2009; Wissel and Watzold 2010; Mead 2008; Hill 2008; Carroll, Fox and Bayon 2008).

In California, multiple Federal and state agencies have issued documents to this effect. The Memorandum on the Guidance for the Establishment, Use and Operation of Conservation Banks by the Department of the Interior, Fish and Wildlife Service, Washington DC, (May 2nd 2003) states that, in relation to mitigation required under Section 10(a)(1)(B) of the ESA:

"Mitigation may include off-site protection of the listed species and its habitat and may take the form of purchasing credits in an approved conservation bank"

It re-enforces that, as per an executive order of the State of California from the California Natural Resources Agency, policy implemented by the CDFG states (April 7th 1995):

"A conservation bank is privately or publicly owned land managed for its natural resource values. For example, in order to satisfy the legal requirement for mitigation of environmental impacts from a development, a landowner can buy credits from a conservation bank, or in the case of wetlands, a mitigation bank. Conservation banking legally links the owner of the bank and resource agencies, such as the Department of Fish and Game or the U .S. Fish and Wildlife Service."

The TSA (1995; TSR 2008) creating the New South Wales scheme represents a more streamline approach, stating in Section 127A (p. 66):

"Establishment of biobanking scheme:

(1) There is established by this Part a biodiversity banking and offsets scheme (the *biobanking scheme*).

(2) The biobanking scheme has the following key elements:

(a) The establishment of biobank sites on land by means of biobanking agreements entered into between the Minister and the owners of the lands concerned,

(b) The creation of biodiversity credits in respect of management actions carried out or proposed to be carried out on or in respect of biobank sites that improve biodiversity values,

(c) A system that enables those biodiversity credits, once created and registered, to be traded (including by being purchased by developers) and used as an offset against the impact of proposed development on biodiversity values,

(d) The establishment of a biobanking assessment methodology, by order of the Minister published in the Gazette, for the purpose of determining both the number of biodiversity credits that may be created in respect of management actions or proposed management actions and the number of biodiversity credits that must be retired in connection with a development to offset the impact of the development and ensure that it improves or maintains biodiversity values."

These regulations create a demand - a reason for individuals to buy and sell credits. This facilitates participation such as in the entrepreneurial banking industry in California (Shabman, Scodari and King 1996; Ten Kate, Bishop and Bayon 2004). In the case of NSW, regulations specify the nature of production, supply, purchase and trade. Together with exclusivity, regulations create necessary supply and demand (Shabman, Scodari and King 1996; Palmer and Filoso 2009).

5.2.5 Designing the commodity for trade: privatisation

In line with ensuring the success of many banks together through mitigating the risk of improper economic functioning, the commodity traded must be designed in a way minimises this risk and supports desired financial and economic outcomes. Through understanding the implications of design choices upon these outcomes, decisions may be made to best mitigate risks present.

Given the influence of regulation and legislation as described above, many alternate commodities and markets may be created, each with distinct outcomes and implications (Ostrom et al., 2003; Tietenberg 2003; Crowe and ten Kate 2010; Hickie 2010). Much discussion occurs in literature and in society regarding privatisation and how private the commodities of biodiversity and the wider environment may be (Robertson 2004). Debate suggests that the degree of privatisation that occurs has direct implications for society's ability to provide all the outcomes and end-points desired, not only the economic ones (Ostrom et al., 2003; Tietenberg 2003). A highly privatised market may allocate goods and services by the most efficient allocation possible under robust economics, but may fail to provide the justice, equitable distribution and social welfare that are also priorities (Ekins, Hillman and Hutchison 1992 a; b). As sustainable development requires adequate provision for society's needs also, this consideration is relevant.

According to the design and choice of parameters of credit trading under offset banking potentially allows for different levels of privatisation. The level of private ownership in comparison to the extent of state ownership or control determines the level of privatisation the credits represents. As such, to varying degrees a balance of power is established between the economic forces of the market, and social provision through government control. The first way this may occur through the consideration of the nature of the values being privatised. In New South Wales, Dickie (2010 un pub.) argues that credits created under the TSA (1995; TSR 2008) are based on the management of the biodiversity values and this is the commodity created and traded in the system[78].

In New South Wales a credit recognises contractual obligations between the Minister and the bank owner relating to development rights and management requirements. The agreement binds the landowner to management that secures and potentially improves specific biodiversity values at the

[78] Credits are awarded based on specified management actions within the Biobanking Agreement which are predicted to equate to a given level of biodiversity gain (DECCW 2008c; Currnow and Fitz-Gerald 2006)

bank site, restricts any actions that cause damage, and records the agreement on the land-title to ensure perpetuity of the arrangement (TSA 2005; 2008; DECC(W) 2009a, g, i). Hickie argues that due to this structure, it is not the ecological community or threatened species being privatised, but the development rights and management actions (Hickie 2010 un pub.). Tietenberg (and Rose) (2003) support this, as they assert that tradable permit establishment is not privatisation of the resource *per* say in a traditional sense, rather the privatization of access to the resource.

"The theoretical extension of this legal structure is that the Minister is obtaining a right to performance of management actions and not a transferal of native vegetation or species assets"
p 34 Dickie (2010 un pub.)

In this case, social values such as landscape and recreational enjoyment, provision for future generations, maintenance of genetic diversity for utilitarian and insurance reasons, and the intrinsic, non-use values of flora and fauna are not being privatised and the benefit to society is not being restricted to a single owner. Certain management obligations and costs, and the cost of destruction instead are considered privatised under Biobanking. It may be wholly appropriate for such costs and obligations in the context of negative development impacts to be assumed by specific entities rather than society in general. Hickie (2010 un pub.) therefore argues that privatisation under Biobanking may not interfere with social provision of the benefits of biodiversity, and should not be reason to refrain from further developing a credit-trading system.

How privatised the credit is impacts upon the value potential traders give to the commodity, and consequently how it is traded. The greater restrictions and lesser freedom the state imparts, the less of the commodity that is privately controlled and the less value a private owner may see in obtaining it through trade. Market forces act on traders' desires for goods and services, so with reduced desire for commodities less trading will occur. In this case the government may take an active role to support trade and allocate the goods and services as required (see also Hanley and Splash 1993; Gilpin 2000; Martin and ver Beek 2006; Harris 2007). This is achieved through an extensive range of mechanisms such as rebates, taxes, levies, funds and programs with the potential for additional ones only limited by current creation (Gunningham and Young 1997).

Alternatively, if the credit is highly privatised, demand is likely higher, allowing trade to be driven by market-forces and less by centralised direction. The government may still retain oversight and influence through imposing regulation. Hickie (2010 un pub.) also discusses how the level of commodification and privatisation of a credit is dependant on the rights to compensation and rights to transfer. In the New South Wales Scheme, the Minister who issued the credit may cancel it under certain circumstances. Crucially, should this come to pass, no compensation is to be paid to the landowner[79] meaning the credits are not 'indefeasible' (Smith *undated (a)*; TSA 1995; 2008), restricting the rights of private ownership that are conferred in the Biobanking credit.

Rights of the credit-holder are further restricted though Ministerial rights of enforcement, extending to provisions that allow the Minister to seize the land should repeat non-compliance occur (TSA 1995; TSR 2008). The existence of third party standing rights is another aspect that impacts the rights of the owner. The provision of third party standing rights, makes it possible for a third party (anyone other than the Minister or the credit holder) to bring a claim of Agreement Breach to be settled in the Land and Environment Court (EDO 2009). This may also remove the right to privity of contract assumed in other circumstances, but has yet to be tested in New South Wales (Hickie 2010 un pub.).

In summary, the New South Wales system offers an example of how taking into account many considerations and economic principles enables a trading commodity to be designed, supporting market mechanisms and ensuring adequate money is available for biodiversity conservation by Biobanking.

5.3 Mandatory versus voluntary approaches to participating in offset banking

A market may deliver outcomes only with suitable participation in an adequate volume of trades. Irrespective of robust commodity and trade design, the desire of people to participate by supplying and demanding credits is essential. Insufficient participation underpins the risk there will be insufficient money directed to biodiversity conservation through offset banking. The issues of adequate participation are multi-faceted. Whether a system is mandatory or voluntary is the first consideration[80].

---

[79] But note that this is not the case whereby the credit is cancelled because of the issuance of a petroleum title, or mining activities.

[80] A voluntary or mandatory system is distinguished by whether participation in biobanking is enforced or optional. This is established in regulation or legislation whereby defining if all development projects are required to purchase Biobanking credits. The scheme may be established voluntarily if all development projects must assess for mitigation, as is required by some projects, and other avenues for mitigation and/or impact assessment are available in addition to Biobanking.

5.3.1 Participation in New South Wales

Participation in the New South Wales scheme is voluntary. Developments requiring impact mitigation and satisfaction of the IMT (see Chapter 4, also the GLOSSARY) under the EPA (1979) may choose to take either the Threatened Species Assessment Procedure including a Species Impact Statement (SIS) under the TSA (1995)[81], or participate in the Biobanking Scheme under the same act (DECC 2008a). Once a Biobanking statement has been issued however, credit purchase (i.e. participation) becomes mandatory.

For landowners with biodiversity values, participation in Biobanking is voluntary. There are various options for landowners wanting to conserve biodiversity values. The most relevant option is the Property Vegetation Plan (PVP) under the Native Vegetation Act (NVA) (2003). The landowner establishes a PVP to conserve biodiversity values, potentially accessing grants and other financial assistance. It is a legally binding agreement between the landowner and the *Catchment Management Authority* (CMA; local government body). A Clearing PVP may also be enacted to enable the landowner to clear some land and establish commercial activities, keeping some of the land in an agreed upon conservation-based state to offset this (EDO 2010). Landowners may not purchase Biobanking credits in lieu of doing a PVP to satisfy NVA (2003) obligations.

Some commentators criticize the current framework, advocating instead that rural landowners be able to purchase Biobanking credits to satisfy the NVA (2003) offset requirements either as an alternative to, or replacement of, the PVP process. They argue this would increase participation in the scheme and uptake in the rural sector, enabling the benefits of the Biobanking scheme to be better realized. Alternative positions suggest that the established robustness of the current NVA (2003) and PVP process achieves current conservation goals as intended and should not be modified.

5.3.2 Participation in California

In California, while mitigation or compensation of development impacts is mandatory, the purchase of both conservation and mitigation bank credits for this purpose is essentially voluntary. Alternative mitigation options are available for both species and wetland impacts as recognized by varying legislation[82]. The agencies who finalize whether the proposed form of mitigation satisfies requirements are guided by the latest documentation, (Federal Register/Vol. 73, No. 70/Thursday, April 10, 2008/Rules and Regulations) which recognizes the continued role for all three forms of mitigation, but establishes a firm preference for purchasing bank credits (Gardner and Radwan 2005). Furthermore, other guidance and regulations provide the parameters for how decisions may be made, including situations where alternative options are not appropriate. While alternatives to mitigation banking exist, the discretion available to make these choices limits the extent to which participation is voluntary.

5.3.3 Considering whether systems should be mandatory or voluntary

What are the implications if participation is mandatory?

Voluntary or mandatory frameworks have different outcomes for participation, which in turn has different outcomes for the system's operation as a whole. Two arguments support a mandatory framework. From an economic perspective, without mandatory participation appropriate supply and demand will not be generated as participant may shift their 'supply' or 'demand' to alternative options. Supply and demand may either be inadequate or unbalanced, but either situation fails to deliver economic or conservation objectives.

Environmentally speaking, by making alternatives to offsetting present (such as by not offsetting at all or through alternative offset mechanisms) degradation can be expected when less robust options are available for selection as these options may produce less favorable environmental outcomes and undermines the ultimate goal of biodiversity conservation. Upon consideration, if offset banking offers enough advantages to be adopted then incomplete implementation represents incomplete realisation of its advantages and by extension, preventable biodiversity loss.

What are the implications if participation is voluntary?

Support for a voluntary scheme comes from practical caution regarding widespread adoption of a new approach with undemonstrated outcomes. Other economic arguments are presented, emphasising that it is the presence of choice that optimally incorporates incentives for behaviour (Hartig and Drechsler

[82] See Table A3.1, APPENDIX THREE. Most recent regulation in relation: Department of Defense and Environmental Protection Agency (2008) Compensatory Mitigation for Losses of Aquatic Resources; Final Rule. Federal Register/Vol. 73, No. 70/Thursday, April 10, 2008/Rules and Regulations

2009). Economically, mandatory participation allows less competition. In a system of supply and demand, it is the presence of competition that maintains low market prices, typically close to production cost (Daly and Farley 2004). Within offset banking these are the management costs and an appropriate benchmark for price to ensure mitigation is not inefficiently expensive. The presence of competition within a voluntary system best achieves efficient mitigation pricing. Competition may also be derived from within a mandatory market where a credit purchaser may choose between multiple sellers. The specific nature of credits in both New South Wales and California currently appear not to produce the liquidity required for this to occur, so competition to regulate price must be external.

The presence of choice in a voluntary system is suggested to have other advantages. If a course of action is imposed, the incentive exists to do the minimum possible, even avoidance (Gunningham and Young 1997). If given a choice, it is likely made with the intention of obtaining the best outcome possible. Because of the economics involved with offset banking, this equates to getting the most conservation possible from the money spent, or spending the least money to get the most gain. Less money spent may actually be most desirable. The less that one project absorbs the more remains to allocate elsewhere on other conservation perhaps, or back into the economy to support more banking and so more conservation. These incentives bring entrepreneurship and outside investment into offset banking, proven to critical for California's success. Incentives for optimal choices exist because of opportunities and rewards within the system (or the perception of such) and so regulations still must create conducive conditions, ensuring incentives work in this manner (Gunningham and Young 1997; Agius 2001; Doremus 2003; Hartig and Drechsler 2009).

The desire for maximum outcome is the origin of innovation. Innovation is pivotally important to achieving the financial (and biodiversity) aims of the system (Agius 2001). Innovation may be expected to generate improved systems in technology, ecosystem management, accountancy, market and legal mechanisms and other aspects to biodiversity conservation that could further the gains possible, in a more financially-advantageous manner. The strength of the voluntary system and entrepreneurialism in offset banking therefore offers the opportunity to secure improved conservation outcomes (see Gunningham and Young 1997). This may not however be realized without a voluntary framework encouraging innovation, and the risk of a lost opportunity may be realized.

5.4 A FUNCTIONING OFFSET BANKING MARKET: COMPONENTS OF ACHIEVING AND MAINTAINING DESIRED MARKET FUNCTIONING

With a defined commodity, supply and demand, and a mechanism for trading, a market in biodiversity credits may establish (Crowe and ten Kate 2010). It then becomes necessary to ensure the market operation achieves desired objectives. Banking schemes in California and New South Wales have been adopted as it offers advantages over previous approaches. From a financial perspective success is achieved through offering the same if not better conservation, at a lower price. If, through operation, a market over-, under- or miss- allocates financial resources this creates risk that efficient, effective biodiversity may not occur. Therefore the task remains to ensure the market that has been established operates to achieve this goal. Ensuring optimal credits pricing and scheme participation is fundamental to this.

5.4.1 The price of credits

Supply and demand is balanced through traded commodity prices so proper regard must be given to the price of biodiversity credits. A credit priced too high will inhibit demand, and a price set too low will inhibit supply. A high credit price is counter-productive if the costs imposed to developers do not represent cost-effective biodiversity conservation. If the level of money involved with biodiversity conservation may achieve more gains under a different system, offset banking simply produces more expensive, not better, conservation. Expensive conservation is not aligned with sustainable development irrespective of where they money is generated from (Gunningham and Young 1997).

In many societies, including New Zealand's, reliance upon tax-payer funded government conservation programs is of particular concern, so additional, private income sources for conservation are desirable. However, this burden may fall back to the government and taxpayer if the credit price is too low: those destroying biodiversity values are likely not contributing adequate finances to ensure their long-term management. With concern for equity, those standing to profit from biodiversity destruction (by removing biodiversity values and generating profit from the cleared land) should be charged with greater financial responsibility. Offset banking intends to provide a mechanism to achieve this while also creating incentives to limit biodiversity destruction. Inexpensive impact mitigation via offset banking removes the incentive for developers to minimise impacts in the first place, widely recognised as preferable to mitigation after the fact. This is why offsetting and banking is endorsed only as a final step in the mitigation hierarchy. Inexpensive mitigation undermines this.

A lower and upper credit price is established with regard to these concerns. A cap may be created through regulation or government intervention[83]. Subsidies and taxes are often used in trading markets to maintain a commodity at a price that balances supply and demand in a specifically desired manner (Gunningham and Young 1997). While credits may be augmented with government subsidies and taxes, both California and New South Wales' systems demonstrate that both upper and lower caps may be a product of the system's design and serve this function without the need for subsidies and taxes and the disadvantages they may present (Gunningham and Young 1997)[84].

The lower and upper cap allows for a range of credit prices in the market, so that the forces of competition, supply and demand can achieve the most efficient outcome possible. The parameters set by the caps allow this to occur without jeopardising either the long-term maintenance of biodiversity values, or the judicious use of biodiversity conservation spending.

5.4.1.1 *The lower price cap in case studies*

The design of legal and financial instruments in both California and New South Wales requires a portion of the sales to be dedicated to long-term management. As credit-sellers in both systems are able to charge any price to any buyer, prices will reflect many considerations, primarily long-term management funding (Endowment or Trust Fund, in California and New South Wales respectively). Such requirements mean it is unlikely any bank owner would sell credits at a price lower than the cost of long term management. This ensures the price of credits will not impede long-term biodiversity objectives relating to management. Under pricing of credits in one transaction may be recouped in subsequent sales, maintaining the overall price required. As the lower cap reflects required contributions to long-term funding, decisions at the regulatory level must consider this when designing the regulations around the initial deposit.

---

[83] Note the use of the term 'cap' here does not refer to a fixed cap as is present in a restricted cap and trade system, instead the term cap here refers to a limit or parameter existing as an emergent property of the design of a system.
[84] Reference is made to the role of taxes and subsidies in the following; Theeuwes 1991; Rietvled and Van Wissen 1991; in't Veld and Kraan 1991; Gale Barg and Gillies 1997; Gilpin 2001; Daly and Farley 2004; Harris 2007.

5.4.1.2 *The level of the lower cap*

There are many possible levels for the lower price cap; the level determines whether the market can function as desired to support long-term management of values but also meet requirements of credit suppliers. As one of numerous influences, regulations may directly and indirectly affect cap level, so must be considered in the system's design. A credit seller is likely to desire to recoup costs incurred during bank establishment such as application and processing fees, charges from biological assessors or legal professionals, and direct costs incurred from restoration or protection of biodiversity values during bank establishment. Cost parameters are set by policy and regulation that may define how assessments are done or the structure of application and processing fees.

Other costs sellers seek to recover may reflect opportunity costs from relinquishing all other profitable uses of the bank site, opportunity and interest losses for the money spent to date, and costs associated with the landowner's time and money during the process. Any profit that the bank owner desires to make and that the market may bear (encompassing influences of competition, supply and demand), may be added after these costs are met. Regulation and policy may create a minimum cap, but this level may not represent an adequate incentive for landowners to participate as their interests favour a higher credit price, making this a necessary consideration regarding lower thresholds.

5.4.1.3 *The upper Cap*

Those purchasing credits will favour a lower credit price, so this demand will be decreased if credit prices are too high which introduces the risk that supply and demand becomes unbalanced. A maximum cap is therefore appropriate. From an environmental perspective, a high credit price may appear most advantageous as it generates increased revenue for biodiversity conservation for each project. Expensive mitigation may serve as the most powerful incentive for developers to refrain from negative biodiversity impacts but there are additional, counter-productive outcomes from an over-inflated credit price.

Prices are established after values have been defined so generating more money from a transaction does not directly translate into conserving more values. After long-term management funding requirements and establishment costs are met, additional return from the sale of credits represents higher profit margins only. Undesirably the same level of conservation is being achieved, but at a much higher cost. Where cost does not accurately represent the benefits, the incentive is to look for alternatives such as other mitigation or to circumvent the mitigation process. Both options place the success of offset banking at risk.

As an economy operates as an aggregation of transactions, market outcomes are a product of the system as a whole (the flow of money across all trades) rather than the outcome of an individual trade (flow of money from one trade). The economy favours a greater number of trades and wider participation with a more accessibly priced credit, rather than generating high prices from a limited number of buyers representing only the most profitable development projects. In a market-based system, more conservation of biodiversity values overall will occur when credit prices are not excessively high. Conversely, high credit prices have been observed as a factor deterring development (so reducing impacts and leaving values in tact) if mitigation or compensation requirements increase overall costs of the project beyond economic feasibility. The highlights the balance that credit prices impact and the risks that must be managed in designing a trading commodity and the prices it trades at.

5.4.1.4 *Factors establishing an upper cap*

Various forms of competition are the main factors informing the upper price of credits. Purchasers are unlikely to buy bank credits priced higher than the cost of competing alternatives. Regulations may allow alternatives, also influencing their accessibility and cost (Robertson and Hayden 2008). Developers may choose to mitigate impacts in other ways, or not proceed with the project (or to relocate) to avoid mitigation requirements. Decisions to proceed or terminate will be made based on the economic balance of the project; costs of mitigation will only be acceptable if they are less than the potential profit of the project. A wide range of factors within the wider economy and society influences the economic balance of a development project.

California

In California, upper limit to credit price exists because of alternatives available to developers. While allowing alternatives (as above), regulations in California also direct when alternative mitigation is available, restricting such choice in specific cases. Developers may be required to purchase bank credits only, removing competitive influences. In this case, project economics have greater influence likely raising the price a developer is willing to pay.

Within a free-market, competition between credit sellers also reduces maximum prices possible. Given the choice between multiple credit sellers, a developer is expected to choose based on the lowest price, encouraging vendors to reduce their prices to achieve sales. Regulations may be used to control how much competition one bank or credit imposes on another, such as introducing restrictions by defining trading areas. Through application processing, agencies are able to control the characteristics and number of credits approved and therefore the number of vendors and level of competition in the market at one time.

New South Wales

Too few credit trades have accrued in New South Wales to reliably estimate upper limits to credit prices. Speculation from industry commentators concern the high land prices in the Sydney basin (a result of various social and economic issues) said to generate very high estimates of credit prices. The maximum credit price is an issue that is receiving much attention from observers and potential participants in the New South Wales markets and a clearer perspective on credit prices will only develop as trade volume increases.

The seminal trade for the Sydney Basin region is available for price indication. The Sydney Growth Centres Biodiversity Offset Program purchased credits in a pre-arranged transaction[85]. Because of this specific department-assisted arrangement, many of the expected influences such as profit margins, perceived opportunity costs and competition were not able to impact the price in this case. The Brownlow Hill agreement processed earlier in 2011 is the first transaction to occur independently from the above Sydney Growth Centres Biodiversity Offset Program. Occurring between independent parties the nature of this trade may be more indicative of true market activity.

The emergence of competition within Biobanking in the Sydney Basin is a cause for concern by some commentators. The specific nature of credit types available may leave developers with few remaining examples of the appropriate ecosystem to either purchase as their own mitigation (after following the alternative SIS process), or that have been issued with credits. A potential credit holder may be in a position to take advantage of the buyer's limited position and sell credits in excess of all reasonable establishment costs, charging instead what the (restricted) market will bear. Alternatively, there may be

[85] Information regarding this trade may be found on the Public Biobanking Registries from http://www.environment.nsw.gov.au/bimsprapp/BiobankingPR.aspx accessed 13/06/2011

a very limited number of development projects that require such specific credits, and so sellers will reduce profit margins significantly to secure a sale, selling for a price much closer to the lower cap.

5.4.2 The right price: the importance of cost-effective biodiversity conservation

In California, expensive mitigation has been reason for development projects to be abandoned, postponed or dramatically altered in come cases (Crowe and ten Kate 2010). This may a desirable conservation outcome if a high mitigation price was driven by rarity of values or extremely challenging management requirements, as the decision succeeded in preventing inappropriate loss of biodiversity values. If high prices reflect a lack of competition and inflated profit margins however, then the loss of the transaction may also be a lost opportunity to secure funding for conservation via banking. Such values may go without conservation if another project does not provide this financing. In this case, a lower credit price would have arguably produced desired biodiversity outcomes, along with any social benefits of the development. Hence excessively high credit prices potentially represent inefficient allocation of resources, reduction of biodiversity outcomes and therefore failure of the market to deliver desired outcomes. The appropriate balance represents cost-effective conservation, central to the overall success of credit trading and offset banking (Gunningham and Young 1997; Naumann, Vorwerk and Brauer 2008; Hartig and Drechsler 2009; eftec IEEP et al, 2010; Crowe and ten Kate 2010; see also Chapter 2: Sustainable development and the role of economics)

Competition occurs through adequate participation, so is required to prevent over-inflated credit prices. Competition within mandatory and voluntary systems is discussed above. In the voluntary systems of California and New South Wales notable features of the schemes relate to participation, and mitigating risks if participation and competition is insufficient.

5.4.3 Participation in supply

Participation will be encouraged when offset banking is seen as a valid alternative to other land uses. As landowners most commonly derive their sole income from productive land uses, the commercial viability of the scheme is of greatest importance. If participation is seen as too expensive, landowners will be discouraged. High initial costs increase the financial risk as greater investment represents greater opportunity cost and more significant consequences from an unsuccessful outcome.

This is an issue for participation in New South Wales currently (Hammond-Deakin, EDO 2009). Policy requires credit owners to supply 80% of the Trust Fund before receiving any income. Trust Fund deposits are necessarily large, potentially representing an insurmountable financial burden. Credit sellers therefore ordinarily rely on the sale of credits to achieve this, requiring an appropriate return to satisfy this. The lower the credit prices observed, the greater challenge supplying 80% of the initial deposit would be, and supply will falter. Should credit sales be insufficient to supply the required deposit, policy holds the credit seller accountable for the shortfall, and must assume this undesirable risk.

The way the scheme is designed has a significant impact on the risks present to landowners and their participation in market supply (eftec, IEEP et al., 2010). Altering regulations surrounding the Trust Fund deposit to present less risk to landowners may therefore increase supply. Alternatively, should market prices for credits be demonstrated to be reliably sufficient to achieve the initial fund deposit, then perception is likely to change and participation will increase. Without participation generating supply, price indicators are not present to drive this process and there is some suggestion that this may be provided by government bodies, such as through regulated prices, economic modelling or direct creation and facilitation of examples of credit trading (Hammond-Deakin, 2009).

Achieving adequate and effective participation is achieved via implementing the appropriate financial, economics-based incentives to ensure sustained supply (Hallwood 2007; eftec, IEEP et al., 2007). These require robust system design. Consideration must also be given to sustaining adequate demand, so the financial incentives introduced through alternative offset options are also relevant. If alternative offsetting options are available to developers, there is potential that these may be held to different standards and therefore represent different costs (Gardner and Radwan 2005). This may negatively affect offset banking participation as standards, and consequently costs, are lower so developers are less likely to see the advantages of participating in banking (McElfish and Nicholas 1996; eftec, IEEP et al., 2010). Demand for banking credits may also be reduced where regulations are not clear, or the manner in which they are implemented by agencies is unpredictable, and therefore presents a risk to traders that financial incentives are not guaranteed. Systems' design including clear guidance and codes of practice can significantly reduce such problems (Gardner and Radwan 2005; eftec IEEP et al., 2010).

5.5 ENTREPRENEURSHIP AND INNOVATION

5.5.1 Californian success: the role of entrepreneurialism

Offset banking successfully balancing and managing the various financial risks has a smoothly and successfully operating credit market. It demonstrates ecologically successful impact mitigation, increasing volume of trades, and attracts an increasingly wide range of interests as the system expands. Such success may be observed within modern conservation and mitigation banking in California; the industry is currently buoyant. Having suffered minimally in recent negative global financial conditions with volume of trades, land area under conservation and flow of money through the system continues to expand. The industry shows increasing optimism for the financial future. Financial risks are mitigated adequately and the banking system is working positively.

To understand how such success may be achieved elsewhere, commentators have highlighted the pivotal role the entrepreneurial sector has had in their process of mitigating risks and achieving successful offset banking operation. Their role is lauded by a number of commentators who see them as instrumental to the state's success. Encouraging entrepreneurialism is one way to broaden participation, potentially attracting a wider scope of participants previously not engaged with biodiversity conservation. Further, entrepreneurship operates under a business model typically requiring robust practices in such areas as law, planning, financial accounting and biology. This business approach may offer superior risk mitigation as a product of requirements for expertise in personnel, systems and processes, along with the checks, balances and external scrutiny that is commonly present within a business model. As an example, entrepreneurship in California illustrates how appropriate entrepreneurialism has the potential to mitigate certain financial risks present, so is explored bellow.

5.5.2 The Californian example

The entrepreneurial banking sector is represented by a number of for-profit (and for-profit divisions of non-profit organisations) private companies who generate income from creating and selling mitigation and conservation credits. This is different from the private landowner who generates credits and sells them to create an income from conducting the long-term management. Entrepreneurial companies typically generate income from speculatively purchasing properties (or an interest in properties), completing activities such as restoration, creation and enhancement to generate creditable values, and then selling credits for a profit (Robertson 2004). Companies do not assume long-term management or frequently, land title (these may be transferred to a specific division or association of the company). Therefore once credits are sold the company's interests in the bank ceases and new projects are initiated.

Some companies generate credits then sell them on the open market once a buyer has been found. Others generate credits in response to specific clients with development projects. Some companies operate under a consultancy framework where they create credits by employing the relevant third-party contractors for ecosystem assessment, legal documentation, financial planning and other tasks. Other companies operate a 'full-service' model, conducting all components of the banking process from land purchase, credit creation, sale and long-term management. The most established banking enterprise is Wildlands Inc. Sacramento, established in 1991. It offers a full mitigation banking service, with 28 banks in its current catalogue, selling 12 different credit types. It has established over 50 mitigation projects and conserved over 35,000 acres (~14,160 hectares).

5.5.3 On balance: do entrepreneurs represent more or less risk?

The role of entrepreneurship in offsetting has not received unilateral endorsement. Entrepreneurial banking is an innovative and optimistic conservation approach, as the sector is able to generate enough revenue to sustain commercially successful ventures (Robertson 2004; for example see Lipper and Sagehorn 2007). The Californian industry may represent the most established, independent conservation-based industry, neither government-supported nor non-profit. There is some concern however, that the commercial framework of entrepreneurialism may undermine the objectives of biodiversity conservation. Such perspectives suggest conflict may prove unavoidable as aligning biodiversity priorities with commercial interests may prove impossible with decisions likely benefiting one interest, but not another (Dolsak and Ostrom 2003). This suggests biodiversity conservation will be secondary to financial and business considerations, suffering as a result. As an industry leader, conclusions from California make the most valuable contributions to assessing the validity of these concerns. The observation of a number of advantages from entrepreneurial banking and the promotion of stringent, formalised standards by National Mitigation Banking Association members provides evidence that such predicted conflicts of interest are, in general, not materialising (e.g. Lipper and Sagehorn 2007).

5.5.4 Advantages of the entrepreneurial system

The power of entrepreneurship comes from the incentives created by the potential to generate private, sustainable profit for entrepreneurs. Generation of profit is one of society's strongest driving forces. Active entrepreneurship addresses a fundamental risk within offset banking: limited flow of financial resources. Entrepreneurial incentives increase participation, as the capacity to earn an income attracts a wider group of participants who otherwise could not afford or would not be interested in a biodiversity-based enterprise. Most importantly however, entrepreneurship directly drives innovation, which is essential to biodiversity conservation (Albrecht and Wenzel 1996).

5.6 Innovation

Innovation is critically important to sustainable development and improved management of environmental resources (*see* section 2.0.1, Chapter 2; Gunningham and Young 1997; Statistics New Zealand 2009; Counsell, Evans and Mellsop 2010). Innovation relates closely to risk within offset banking: pursuing offset banking takes a risk that there are other financially superior alternatives for biodiversity conservation. Active innovation mitigates this as it provides a mechanism for such improvements to be discovered and adopted.

Innovation represents new ways of doing things. Innovation in science and technology, use of economic theory and resources, the role of regulation and government, and social movements, attitudes, and changes have driven the development of society to date (Fisher and Freudenburg 2001). A field of study in its own right, Ecological Modernisation (see section 2.0.1 Chapter 2) represent these ideas and emphasises the role such innovation and novel development will have in the conservation of biodiversity and all environmental resources (Mol and Sonnefeld 2000; Editorial 2000; Fisher and Freudenburg 2001). Innovation largely produces new, increased outcomes from the use of the same or fewer resources. Recognising the finite natural resources available, likelihood of increased population growth, and associated pressure on biodiversity globally means future conservation depends on achieving more conservation through more efficient resource use.

Offset banking is an innovative system, intending to achieve previously un-realised objectives regarding sustainable development. It represents innovation in a variety of ways:

- Improved mechanisms for managing money such as endowments for conservation;

- Progress in the ecological sciences such as restoration and ecosystem management producing more certainty in outcomes, involving more efficient resource use, and the ability to expand the capabilities of conservation to values previously too challenging to attempt;
- Technological innovation, for example in ecosystem measurement and monitoring, financial platforms for credit trading or design and operation of databases that register and track all aspects of the market; and
- Innovation within the development sector allows projects to better avoid and reduce impacts on biodiversity and the environment[86].

Actively innovative systems provide better conservation in the face of uncertain processes and outcomes, and in response to changing conditions and states in knowledge. Innovation generates improved approaches, solutions and mechanisms for superior conservation outcomes (Gunningham and Young 1997). Within the extent of current knowledge and the dynamism of the biosphere innovation is critical to sustaining risk-mitigating solutions in continually changing contexts, and continued improvement in biodiversity outcomes. Where current approaches prove incorrect, innovation will likely bring forward necessary improvements to mitigate such new risks (Gunningham and Young 1997).

5.6.1 Innovation in finances: private equity and investment

An entrepreneur-based system drives innovation in a number of important ways. One is through generation of private equity and investment. As above, extremely high credit prices are unlikely to translate into increased biodiversity conservation as this money is generated following the establishment of values. Increased quantity and quality of biodiversity conservation is achieved when more money is available at the stage of selection, establishment and protection of values, at the initiation of the banking process. Increased revenue at this point in the system is necessary and may be generated if private investors are willing to inject equity and capital at this stage. Investors are willing to provide money required during bank establishment if profitable return on their investment is possible. This is the role of entrepreneurial banking.

Offset banking revenue is generated through the development sector yet capacity for conservation could also be extended with revenue from additional sectors such as private investment (Crowe and ten

[86] In reference to these points see Albrecht and Wenzel, 1996; Theeuwes, 1991; Robertson 2004; Saeed, 2004.

Kate 2010). In California and across a number of United States, private investment is showing increasing interest, as investors are able to generate positive returns from investment in entrepreneurial banking. It is attracting a greater number of new potential investors and a funding source for biodiversity conservation potentially greater than ever before (Crowe and ten Kate 2010). Money increasingly available from the private investment sector will allow the banking company to preserve more values over a larger area before locating buyers for the credits that result. Such investment actively supports increased credit supply, strengthening the banking system. It is one of the major successes of the banking industries in California; an infusion of hundreds of millions of private dollars has been invested in conservation.

New businesses

The investment of private equity is also occurring through various auxiliary enterprises and parallel industries established from the entrepreneurial base in California (Crowe and ten Kate 2010). Revenue generated by these companies makes direct and indirect contribution to the flow of money within offset banking and towards biodiversity conservation. Novel business concepts include Mission Markets[87] who provide a platform for industry network development and communication, facilitating the trade of credits on multiple levels from marketing to transaction. Similarly, MarkIt[88] offers third-party credits registering, transfer and tracking support. Ecosystem Marketplace[89] is a market-watchdog providing a portal for information exchange and integration, and monitoring and reporting of trading in *ecosystem services* across the board. All broadly focus on enabling trades and expanding exchanges. They respond to opportunities available for innovative products and services, with the creation of new jobs and income streams occupying slightly different market shares and business profiles. Current and future enterprises rely on increasing participation in banking and other ecosystem trading to support their own growth and success. Private equity within entrepreneurial systems such as California's is pivotal, in addition to the achievement of conservation goals to sustain continued investment. A popular movement towards 'sustainable' or 'green' investment products and services is one driver, but across the board, investments returns cannot be made without successful conservation, so both private and biodiversity interests are aligned in this manner. Company profiles and current marketing provide evidence of this (for example see Lipper and Sagehorn 2007).

---

[87] see www.missionmarkets.com
[88] see www.markit.com
[89] www.ecosystemmarketplace.com

5.6.2 Improvement of conservation methods

Collaboration

Innovative revenue streams generating more money for conservation is one way that the entrepreneurial sector contributes to increased biodiversity conservation. It also has a role facilitating important developments in the field, where superior conservation contributes to mitigating biological risks to conservation values discussed in the previous chapter. An emergent property of the entrepreneurial sector is the collaboration between multiple fields of expertise. Successful entrepreneurial companies in California bring together professional staff from the wide range of fields including the legal, ecological, biological, financial, economic, political, engineering, hydrological, managerial, marketing, administration, information systems technology, geographical, cartographical and business professions (Lipper and Sagehorn 2007). The close interaction and collaboration between these is needed to establish and close a bank. This interdependence between these previously disconnected sectors requires knowledge and ideas to be combined in new ways and innovation to occur. There is likely feedback of this through the sectors themselves, contributing to developments across the board, extending society's knowledge base and contributing significantly to broader sustainable development.

Better ecology

"Mitigation banking is just the mechanism to stimulate scientific progress, for the benefit of people and the environment alike."

p. 87 Albrecht and Wenzel (1996)

Offset banking may further the progress of ecology and drive improvements in the conservation and restoration sciences when innovation can occur at a more direct, practice-based level within ecosystem management. The economics of offset banking create powerful financial incentives. This fosters innovation, as better conservation comes from improving existing systems or adopting new ones. Participants stand to make the largest financial gains by increasing the efficiency, economy and level of conservation they achieve and so requires successful mitigation from competent, effective restoration, enhancement or re-creation of biodiversity.

This may be observed in California where significant understanding of ecosystems has been developed though the sphere of offset banking. The desire to achieve successful mitigation of previously poorly-understood species and ecosystems have necessitated building knowledge of their ecology. Manipulation of ecosystems such as vernal pools and other wetlands has seen vast increases in understanding and management capacity, as has the knowledge of species that banks intend to protect. Uncertainty of relevant biology or ecology makes conservation of threatened or rare species highly challenging. Bankers actively conserving these values feel the level of knowledge regarding these species is far greater than available when companies were first established. For example, banks for species previously challenging to manage such as migratory fish are beginning to be established.
Requirements of measurement, assessment and monitoring of biodiversity variables has increased expertise and skill-sets in related areas such as applied geography though mapping, surveying and GIS work. These auxiliary fields are predicted to experience beneficial flow-on effects in terms of knowledge-based capacity. This is possible as a result of greater experience in banking and incentives for innovation and development, which combines with the involvement of professionals in diverse fields who are seen to be in the best position to achieve maximal outcomes (Saeed 2004). Of these professions, long-term management of ecosystems has developed into an industry in its own right, accompanied by a similar expansion of associated knowledge. The research division of the CNLM demonstrates how increased research into the broad fields of conservation sciences is also enhanced by the presence of a banking industry.

Observations and industry feedback demonstrates that entrepreneurial banking companies find economic and biodiversity objectives appropriately well aligned. The risk of entrepreneurship introducing a conflict of interest that jeopardises biodiversity values appears to have been avoided. The importance of future business opportunities necessitates the optimum conservation possible, for business reputation, market shares, relationships with the regulating bodies and general licence to operate. Good conservation is currently viewed the foundation of a good banking company. Potential remains that participants may choose to sacrifice the quality of biodiversity values if it is more economically advantages to do so, but it appears these opportunities are simply not available, or are not sustainable, and so appear absent in the current market.

5.6.3 In support of entrepreneurship: mechanisms within the system's design

To achieve the risk mitigation entrepreneurial banking contributes, an offset banking system must be established in a manner allowing and supporting entrepreneurial banking success. The degree of entrepreneurial activity in offset banking is a function of the balance between numerous components within a system's design, as discussed above. Additionally, there are some components of the schemes in California and New South Wales that expressly facilitate entrepreneurial involvement by removing some of the barriers within other design options.

5.6.3.1 *Credit release schedule*

A notable feature of Californian conservation and mitigation banking is the credit release schedule (also see section 6.1.1.1, Chapter 6). Biological and conservation rationale favours the issuance and trading of credits after values have been established to an acceptable condition. However, the length of time that this takes may present unsurmountable barriers to entrepreneurial participation. To balance such concerns, a credit release schedule provides for a specified number of credits to be released in a sequential manner over time, once ecological requirements are satisfied. This provides increased surety to bank owners, addressing risk posed by uncertain credit returns with the large time and money inputs required (Crowe and ten Kate 2010). If values are not created adequately, it provides some minimisation of potential loss, as credits have not been prematurely sold for impact mitigation.

In New South Wales, no formal credit release schedule is applied, as all credits are issued when the Banking Agreement is signed. Credits are issued based on current values and those predicted according to the prescribed management plan (see Chapter 3). This has been criticised as, following credit release no incentive exists for bank owners to achieve increased conservation on the site, as it cannot generate additional credits. Once issued, credits may be used for impact mitigation immediately, despite a portion of the credits pertaining to values expected in the future based on management plans yet to implemented or proven. A credit release schedule may respond to some of these concerns (Crowe and ten Kate 2010).

5.6.3.2 *Severance of land rights*

Profit-making potential that attracts entrepreneurship is possible when the risks of participation are deemed to be smaller than the available benefits. Therefore, one way of encouraging entrepreneurship is reduce risks where possible. The ability to sever land rights in California is one important part of this. Bankers may be separate themselves the liabilities of land ownership, long-term management and funding, so can actively manage and minimise the risks these responsibilities entail. Retaining interest in these components represents liability and risk that detract from the benefits entrepreneurs may receive. Removal of such risks makes benefits more accessible. The transfer of liability possible does not detract from the important provision of these aspects, as they may be definitively ascribed to another entity. This does not detract from the scheme's overall robustness, but are extremely important to attracting entrepreneurs.

5.6.3.3 *Attitudes and society*

Societal attitudes are a final barrier to achieving the risk-mitigation benefits available through effective entrepreneurship and innovation. To benefit from risk mitigation through entrepreneurial banking, firstly New Zealanders must see conservation on private land, generating private profits, as an appropriate and desirable mechanism of conservation. To date, the majority of New Zealand's conservation has been done on behalf of and for the benefit of all New Zealanders, through government funded and operated programs and departments (Meurk and Swaffield 2000). Some notable conservation has been achieved through the QEII Land Trust, however government conservation jurisdiction over 1/3 of the land area greatly outweighs the much smaller 1% of New Zealand's land mass being protected under this Trust. Private land has been primarily viewed as a source of economic production, with land not used for urban development primarily occupied for pastoral and other agri-business land uses (Meuk and Swaffield 2000). Entrepreneurial banking necessitates a departure from this dichotomy, representing a significant contrast to the current paradigm and national psyche. Viewing non-government-based conservation as inappropriate, impossible or undesirable will significantly impede the success of entrepreneurial banking. Widespread endorsement of a shift towards conservation occurring on private land with profits directly attributing to private entities must be something New Zealand society as a whole embraces.

"We can collectively decide to integrate indigenous nature into our productive landscapes, or we can allow reinforcement of the historical dichotomy of nature and culture and continue the ambivalence and uneasy sense of displaced identity it brings."

p. 142, Meurk and Swaffield (2000)

5.7 Summary: financial risk and the entrepreneur

The pivotal role of finance and economics in offset banking introduces many additional risks. These directly interact with the well-acknowledged biological risks, but present distinct issues that require specific and informed attention in the design of offset banking systems. Addressing financial risk is a crucial and foundational component of supporting successful biodiversity conservation. Encouragingly, there are a number of approaches that recognise such risks, and mechanisms are developing which provide a significant level of risk mitigation. Common risk-mitigation approaches involve spreading risk. This is relevant to offset banking, as any system adopted will optimally exist in a framework where a portfolio of approaches addresses risks of biodiversity decline and environmental conservation more broadly. Offset banking represents one mechanism available. Encompassing multiple banks, multiple development projects and multiple layers of risk mitigation mechanisms also represent this portfolio approach. Therefore while financial risk is an equally significant component in addition to biological risk, operational experience and concentrated expert attention to such issues is providing valuable and successful risk mitigation. The nature of financial risk present, and mechanisms that increasingly assuring such risks can be overcome, become clearer and more attainable when informed expert attention is directed to these issues.

CHAPTER SIX

THE THIRD RISK: HUMAN AND SOCIAL FACTORS

This thesis distinguishes a third form of risk within offset banking corresponding to the final component of the tripartite sustainable development framework: human society. Individuals within society introduce risk to offset banking. Because of the nature of human behaviour, human actions required in offset banking carry potential error in judgement, negligence or even malice and deceit. It is also through human nature that societies are formed, and it is important that human actions and the outcomes of offset banking they produce appropriately represent their wider society. In effect, this requires offset banking to deliver outcomes that are biologically and financially appropriate as discussed in Chapters 4 and 5, but outcomes that are appropriate for the wider society as well. It is possible to mitigate both these human and social risks: risk that human actions and behaviour jeopardises offset banking outcomes, and risk that wider, socially appropriate outcomes are not achieved. A number of mechanisms are available to address these risks, and are described and analysed in this chapter. Appropriate provision for public participation is emphasised as central to mitigating these risks, and achieving desired biodiversity outcomes.

6.1 Risk posed by human behavior and actions

6.1.0 Misrepresentation and 'cheating'

Concerns have been voiced, and in some situations demonstrated, that individuals may act counter-productively to conservation within offset banking: cheating or miss-representation may occur (Gunningham and Young 1997; Hallwood 2007; Walker et al., 2009). Offset banking relies on individuals completing certain actions to certain standards. If they fail, conservation is jeopardised as has been observed in the past (see discussion in Chapter 4, section 4.0.1). Potential problems include failing to complete, or even attempt, work required; misrepresenting (over-estimating) work conducted; or misrepresenting (exaggerating) the values involved and over-selling credits (Gardner and Radwan 2005; Hallwood 2007; Naumann, Vorwerk and Brauer 2008). Over-selling credits refers to the situation whereby a credit is sold to offset an impact, but at a later date the credit is sold again to another purchaser for another impact, without any additional conservation work carried out; on balance no more mitigation occurs. Over-selling may also occur if more credits are issued to a bank than there are values commensurate at the bank site. This can result from inaccurate measurement and assessment, or deliberately over-stating the values present in order to obtain more credits.

Where offsets are used to make an objectionable development project more attractive to regulators or the wider public, the term 'license to trash' has been coined referring to offset trading being used to gain permission for destructive biodiversity impacts otherwise deemed inappropriate (Redmond et al., 1996; Naumann, Vorwerk and Brauer 2008; Bekessy et al., 2010; Crowe and ten Kate 2010; eftec, IEEP et al., 2010). When used in this way, credit trading fails to produce conservation outcomes, misrepresenting the true achievement of offsetting negative environmental impacts.

Undesirable behavior may be potentially observed in all offset banking parties including regulators where they approve, or fail to intervene in, deficient banks, projects or trades (Hallwood 2007; Walker et al., 2009). Intentional or otherwise, this may be caused by lack of knowledge, ability or other resources. Conflicting interests between present financial or personal incentives may also exsist, potentially outweighing and replacing stringent implementation of the scheme's parameters (Walker et al., 2009; Crowe and ten Kate 2010).

6.1.0.1 *Subjectivity*

Misrepresentation can also unintentionally occur through inherent variation in human behavior; actions by different people potentially produce different outcomes not equally advantageous to conservation. This is primarily introduced during the process of estimating values and applying assessment methodology; measurement processes are suggested to be particularly susceptible (EDO 2008b; 2007b). Some degree of subjectivity can be expected when applying approaches such as indicies and benchmarks where operators are required to form opinions about the state or condition of biological systems and components (*see* Chapter 4, section 4.2.3.1). There may also be subjectivity introduced by operators themselves, based on educational or employment background or other interests they hold.

Subjectivity is raised as a significant concern in New South Wales (EDO 2007b, 2008b). Decision-making processes without defined protocols may also be subjective where the decision rests with an individual's personal or professional assessment. This has been raised in relation to the red-flag variation system in New South Wales (*see* section 6.2.3 below). The Australian Centre of Excellence for

Risk Analysis (ACERA) studied and reported on this subject by investigating how observer error in field estimates of vegetation attributes translates to uncertainty in vegetation condition assessments and concludes that:

"Uncertainty in assessment of vegetation condition may lead to poor decision or unexpected outcomes, including the loss of biodiversity…Observers' estimates varied substantially across multiple scoring categories for all vegetation attributes on almost all sites…The results indicate that uncertainty in field estimates of site attributes may cause vegetation condition to be under or over estimated on all by highly degraded sites... It is recommended that: research is undertaken into methods fro reducing observer error; field observers estimate uncertainty around point estimates of vegetation condition; the sensitivity of index scoring structures to observer error is reviewed; and that decision makers explicitly incorporate uncertainty into the decision making processes and aim for outcomes that are robust to this uncertainty."

p. 8 Gorrod and Keith (2010)

A variety of mechanisms and design elements in New South Wales and California reduce these sources of risk, making the schemes stronger and more successful as a result. Specifically, robust operating rules are requisite to establishing a trading system (Agius 2001; Doremus 2003; Crowe and ten Kate 2010). Four such rules concern the misrepresentation and subjectivity risks above: approval or accreditation of personnel involved; use of bonds, insurance and sureties; mandatory credit registration; and compliance of rules via monitoring, enforcement and auditing processes. These mechanisms are discussed bellow

6.1.0.2 *Personnel accreditation*

Regulations in New South Wales restrict those allowed to operate within the Biobanking system, endeavoring to eliminate individuals intentionally or unintentionally misrepresenting values and jeopardizing outcomes (DECC 2009c). Assessors must be accredited to conduct assessment and measurement of biodiversity values on an impact or biobank site using the BAM and Credit Calculator (DECC 2008c). This person must have a suitable level of field-based and academic/industry experience in the relevant fields of biology and ecology and must also complete a Biobanking Assessors course to gain additional skills. With these criteria fulfilled, application is made to the appropriate Minister and accreditation is issued (s.42B TSA 1995). This process ensures that only those with appropriate knowledge and skills complete potentially subjective biodiversity and ecosystem assessments. It also provides an avenue to identify those with potential to act out of accordance with the scheme, and limiting their involvement and potential risk associated. Secondly, potential bank owners must pass a 'fit and proper person' test prior to bank establishment. This considers of standing of character, honesty and integrity to identify and therefore prevents individuals without the capacity to uphold scheme integrity, due to conflict of interest or potential misrepresentation (TSA 1995; TSA Reg. 2008; DECC 2008c).

In California, no equivalent or similar process regulates who may be involved in wetland or conservation banking. Regulation less formally exists however through the continually developing basis of 'social capital' that has developed, providing a framework that promotes behavioral compliance and defendable scheme execution (*see* Pretty 2003).

6.1.0.3 *Social capital*

Human capital represents capacity required for work: a product of skills, knowledge, physical condition and motivation (Ekins, Hillman and Hutchison 1993; Gilpin 2000) Social capital supports this: bonds and relationships existing within social groups or communities foster trust and reciprocity facilitating successful production (Ekins, Hillman and Hutchison 1993; Gilpin 2000; Pretty 2002; Ballet, Sirven and Requiers-Desjardins 2007). To generate social capital, common rules, norms, and mutually agreed standards drive behavior and help align group with individual interests. The capacity for enforcement also has a significant impact (Feeny et al., 1998; Birner and Wittmer 2003).

> "As [*social capital*] lowers the costs of working together, social capital facilitates cooperation. People have the confidence to invest in collective activities, knowing that others will also do so. They are also less likely to engage in unfettered private actions that result in negative impacts, such as resource degradation. Four central aspects have been identified (Pretty and Ward 2001), namely (i) relations of trust; (ii) reciprocity and exchanges; (iii) common rules, norms and sanctions; (iv) connectedness, networks and groups."
>
> p. 69 Pretty (2002)

Social capital may exist through unions, associations and other co-operative organizations that facilitate group unity and cohesion (Ekins, Hillman and Hutchison 1993; Gilpin 2000; Pretty 2002). This may be observed in the California mitigation banking industry. The National Mitigation Banking Association (NMAB) has been established and holds highly patronized annual conferences, bringing numerous stakeholders with a range of perspectives and interests in the management of biodiversity. Communication and information sharing occurs through social interaction, discussion and collaboration, unified by common goals (the success of the industry and sustaining livelihoods), building trust and reciprocity. This represents linking, boding and bridging, which Pretty et al., (2003) suggest forms social capital. As evidence, stakeholders at the 2010 event voiced strong preference for increased enforcement of rules, high standards of operation, and improved communication between differing parties. A culture of social relations and industry contacts, between regulators and development sector, are held key to industry success. This demonstrates the importance on the social capital within the Mitigation and Conservation Banking industry, suggesting optimism for its continued success:

> "…[social learning] is associated, when it works well, with participation, rapid exchange and transfer of information when trust is good ... Social learning leads to greater innovation as well as increased likelihood that social processes producing new practices will persist."
>
> p. 75, Pretty (2002)

To ensure individuals adhere to required standards of personal action a self-regulating system can develop, facilitating a normative expectation of positive (rather than negative) behavior from parties involved. Notably however the NMBA attendees continually advocate for strong agency oversight and enforcement, emphasizing that social capital is a complementary rather than replacement system to ensure compliance within the industry.

6.1.1 Financial assurance: bonds, insurance and sureties

It is a significant risk within offset banking that necessary conservation work will not be carried out, enhanced by the almost indisputable certainty that the impact will occur. A significant source of mitigation failure has been that work is not completed to an acceptable standard, and in some cases, not initiated at all (Goldman-Carter and McCallie 1996; Brown and Veneman 2001; Gibbons and Lindenmayer 2007; Burgin et al., 2008).

To provide some assurance that work will be completed, the Californian systems employ mechanisms such as bonds, insurances and sureties and require evidence these are in place before credits are issued (Hill 2008; Teresa 2008). These serve the dual purpose of creating an incentive to complete the work, and ease remediation by providing financial support to complete work not done (McElfish and

Nicholas 1996). A variety of financial assurances have been used to date (Redmond et al., 1996), but all designed to ensure *amelioration* if performance standards are not met, or operators default on their obligations by guaranteeing financial backing, or to directly conduct work required.

Where bonds are used, money may be held in an escrow account and released only when performance criteria are met, or a surety cost may be met that provides the bond (McElfish and Nicholas 1996; Redmond et al., 1996; Hallwood 2007; Hill 2008; Teresa 2008). Alternatively, letters of insurance bind a third party to provide amelioration (Redmond et al., 1996; Hill 2008; Teresa 2008). The insurer may charge a fee for assuming liability, over and above cost recovery fees if amelioration work becomes necessary (Teresa 2008). A lending institution may also supply Letters of Credit, guaranteeing the finances required for additional work.

Value of individual financial assurances is determined through negotiation, reflecting the variety of factors generating the specific risks, such as the values concerned. This also includes ‘human’ components such as experience, reputation or background. In California, some larger companies are able to take a consolidated approach whereby insurances and bonds may be taken out for multiple banks at a time, or simply employed on a revolving or transferable basis from one project to another, limiting costs to the company while still providing the necessary protection, and thereby efficiently reducing the overall costs of mitigation (McElfish and Nicholas 1996).

6.1.1.1 *Credit release schedules*

Established within banking documents (CBA/MOA/BEI), *credit release schedules* ensure adequate and timely completion of work and encourage scheme participation (also see section 5.6.3.1, Chapter 5). The schedule stipulates when and how credits will be issued over time. Credits are estimated when the bank is created and as specific criteria are demonstrated, more or less credits may be issued to reflect the values actually established. Designing monitoring indicators, thresholds and criteria for a credit release schedule requires careful consideration (Nevel at al., 2004). They must accurately reflect effective conservation, align with financial assurances provided, while being achievable enough to ensure that overly-stringent criteria do not act as a disincentive, either deterring participation or encouraging cheating[90] (eftec, IEEP et al., 2010).

[90] Also see discussion of monitoring, section 6.1.2 below

Using credit release criteria means the schedule does not provide a guarantee of credits but represents a balance between two main alternative credit issuing processes (Goldman-Carter and McCallie 1996; eftec, IEEP et al., 2010). One option is to issue all credits when the bank is established under the assumption that work will be carried out (as is the case in New South Wales). This involves some risk that even if the work is carried out, the values may not be established as the credits reflect and so mitigation in ultimately inadequate (eftec, IEEP et al., 2010). An alternative approach is to issue credits after establishing and demonstrating values[91], yet requires significant financial input prior to any (uncertain) financial return, i.e. saleable credits. The latter approach may ensure more robust conservation but carries uncertainty and risk for potential bankers unsure of the return on their investment, so is be expected to reduce participation in the scheme (Redmond et al., 1996; Gardner and Radwan 2005). A credit release schedule makes banking more practical for potential bank owners, while providing a mechanism ensuring work is timely and successfully completed (Hallwood 2007).

6.1.1.2 *Assuring work within Biobanking in New South Wales*

Comparable financial assurances and credit release schedules are not required under Biobanking. Instead, incentives and enforcement are used to increase compliance. Issued credits reflect values expected from agreed management actions (Currnow and Fitz-Gerald 2006; DECC 2008c). As part of the Biobanking Agreement, the management plan stipulates how and when this work is conducted. Outcomes are demonstrated via monitoring and annual reports. Management payments from the Trust Fund (i.e. a bank's income) may be suspended if this is not completed; leveraging bank income is expected to be a powerful compliance incentive. In addition, a graduated system of enforcement mechanisms further ensures compliance (see section 6.1.2 bellow).

Again, determining the criteria to meet management obligations is complex. A landowner could conceivably be expected to demonstrate a variety of things. Within Biobanking, landowners must report their completed actions (e.g. maintaining fences, weed-control, or abstinence from certain activities such as firewood harvesting). Arguably these could be adequately met despite only minimal conservation gains. Applying more biological criteria may better highlight actual conservation gains, yet criteria such as vegetation cover, species presence or certain measures of ecosystem functioning may be difficult to achieve despite concerted and well-intentioned management. If landowners expect meeting certain criteria will be excessively onerous, this will reduce their willingness to participate.

[91] A view-point favoured in literature e.g. Goldman-Carter and McCallie 1996; Bekessy et al., 2010

Criteria must therefore balance concerns for biological authenticity and efficacy of implementation (eftec, IEEP et al., 2010).

6.1.1.3 *Credit registry*

A comprehensive registry of credits, debits and trades contributes to offset banking in several crucial ways: most importantly preventing over-selling or misrepresentation (Naumann, Vorwerk and Brauer 2008; Teresa 2008; Crowe and ten Kate 2010). Compulsory credit transaction registration makes potentially over-selling credits to multiple buyers virtually impossible. Third party firms are developing increasingly powerful technology and software, tracing all aspects of banking, providing accurate and accessible credit information in real time, and significantly increasing the robustness of credit trades[92]. Registries also facilitate monitoring and compliance (DECC 2008c; Crowe and ten Kate 2010). Physical inspection of site values may be easily aligned with credits registered, providing a smooth system of identifying and addressing inconsistencies and deterring bankers from over-stating values present. A central credit registry is an integral component of New South Wales Biobanking. In response to industry-wide promotion, a number of credit registries have developed in the USA and California, with the mandatory registration of credits expected.

6.1.2 Compliance: monitoring, enforcement and auditing

Adequately assuring monitoring and enforcement presents complex challenges, yet the majority of current criticisms focus on whether or not compliance-ensuring systems are present at all (e.g. Redmond et al., 1996; Bekessy et al., 2010). Prioritization of enforcement programs, supported by comprehensive monitoring and auditing, is emphasized by many as the foundation of any offset banking system (Albrecht and Wenzel 1996; Goldman-Carter and McCallie 1996; Nelson and Sharman 2007; Gibbons and Lindenmayer 2007; Burgin 2008; Walker et al., 2009; Fleischer and Fox 2008; eftec, IEEP et al., 2010; Bekessy et al., 2010; Crowe and ten Kate 2010).

Monitoring

Previous chapters have addressed the complexities and importance of monitoring the biological components of banking projects. Monitoring criteria require careful and informed selection, clearly

[92] See Mission Markets www.missionmarkets.com and MarkIT www.markit.com

communicating what is being monitored and why (Nevel et al., 2004; EDO 2008b). For example, the requirement for annual management reports under the New South Wales system is a process where individual actions are recorded and monitored, as a proxy for the management of biodiversity at a offset bank site (as above) (DECC 2009c). Within this, it is also necessary to account for human risk, and individuals complying with the rules of the system (Bonnie and Wilcove 2008; EDO 2008b). Biological and conservation criteria may be used as a proxy for indicating whether an individual has completed the work required; if the values are established and maintained then it is assumed the individual complied with requirements. However, it is recognized that both the actions taken, and the outcomes of such actions can be monitored independently (eftec, IEEP et al., 2010). This requires monitoring specifically for compliance with contractual obligations within the bank agreement and easement, if present (Bonnie and Wilcove 2008; Hill 2008).

Enforcement

Monitoring and enforcement must directly interact: it is an important function of comprehensive monitoring that data collected can efficiently support enforcement by providing a link where compliance issues are identified and enforcement can be instigated. Enforcement also complements monitoring: value of monitoring programs is reduced without assurances that inadequacies will be effectively remedied (for example see DECC 2008c). The presence of stringent, clear enforcement procedures is necessary as a deterrent, reducing incentives for intentional non-compliance (Bekessy et al., 2010). Self-monitoring can be an important part of these links (McElfish and Nicholas, 1996):

> "…self monitoring can also make enforcement easier because the enforcing agency uses the permittee's own data to prove non-compliance… can promote self-enforcement."
>
> p. 25, McElfish and Nicholas (1996)

There are also important interactions with civic involvement: publically available monitoring evaluations allow community-based auditing while providing essential facilitation for third-party enforcement of biodiversity outcomes (further discussed in section 6.1.2.1 below) (Goldman-Carter and McCallie 1996; Nelson and Sharman 2007). Enforcement processes in New South Wales and California demonstrate a selection of mechanisms, with programs varying in relation to respective legal environments.

Enforcement in California

Banks are established in California by multi-party contracts (CBA/BEI) (US Army Corps of Engineers Alexandria 1996; Carroll, Fox and Bayon 2008). This establishes signatories and liable parties, including regulatory agencies so any failure to uphold these contractual obligations is addressed in the relevant court. One party retains the right to sue the other for breech of contract, breech of duty of good faith and fair dealing or unjust enrichment (Gardner 2008). Litigation-based enforcement of banking objectives requires notable legal (and consequently, financial) resources such as collecting evidence and legal fees. It is therefore appropriate that state and federal departments retain this right as contractual partners, likely to have superior financial and personnel resources available than other potential signatories. Litigation is favoured also because the regulatory environment makes enforcement via legislation difficult. Predominantly, regulation is issued via guidance, but a statue or regulation must be directly violated for an agency to pursue enforcement non-contractually (Gardner 2008). Easement enforcement is similarly used to achieve compliance in California (Teresa 2008; see Chapter 5, section 5.1.7).

Enforcing compliance in New South Wales

In New South Wales, there is a sequential hierarchy of actions that may be taken against bank owners or *managers* who fail to meet their obligations, escalating according to risk: threat that continued non-compliance poses to biodiversity values; severity of the breech; ecological harm possible; and mitigating factors including intent or otherwise of the bank operator (DECC 2008c; EDO 2008b). The primary point of enforcement is the requirement for annual reports. Should these be absent or inadequate, annual maintenance payment may be withheld (DECC 2008c). As these represent the landowner's income, the financial incentive to increase compliance is strong. Following from this, the minister may direct that action be taken and unsold credits may be suspended or cancelled (Currnow and Fitz-Gerald 2006). The Department may also enter the property to conduct the work, recovering these costs from the bank owner and seeking damages via prosecuting for breech of the Biobanking Agreement. The Department may launch an investigation should such additional enforcement via legal action be required (DECC 2008c). This supports an application to the Land and Environment Court where the land may be transferred to another more appropriate entity.

The Department's Compliance Assurance Strategy (DECCW 2008c) details how scheme infringements are detected and actions taken. It also addresses whether the scheme operates in legislative compliance; is equitable and transparent; the adequacy of education and information provision; and how overall objective are being achieved. This is fundamental to support community confidence in The Department's regulatory capacity. By clearly stating obligations, and options and mechanisms to improve compliance, it aims to reduce un-intentional breaches due to lack of knowledge. The strategy also offers assurance to credit purchasers, protecting their interests by better securing conservation outcomes and therefore strengthening the scheme's operation in a number of ways (DECCW 2008c).

In New South Wales, the wider public can also be involved with monitoring and enforcement. This is a result of the legal environment of the state as, in contrast to the litigation and contract-basis of California, New South Wales' enforcement occurs via legislation because bank owner's obligations are established via contracts under Acts of Government. Infringements are therefore considered a breach of an Act so may be brought to the Land and Environment Court (Currnow and Fitz-Gerald 2006; Nelson and Sharman 2007). This is referred to as the provision of standing rights and is extended to third parties (i.e. third party standing rights) where any member of the public may bring a case before the court. Providing broad, open rights has been seen by some such as the legal advocacy group Environmental Defenders Office New South Wales (EDO NSW) as important to ensure Biobanking meets its objectives (Gunningham and Young 1997; Nelson and Sharman 2007; Smith n.d.). Standing rights exist under the TSA (1995):

> "Section 127L(1) Enforcement of Agreements:
> Any person may bring proceedings in the Land and Environment Court for an order to remedy or restrain a breach of a biobanking agreement, whether or not any right of the person has been or may be infringed by or as a consequence of the breach."
> p. 75 TSA (1995)

Alternatively, members of the public are able to lodge a formal complaint (regarding suspected breaches), for The Department to address (Nelson and Sharman 2007; DECC 2008c).

6.1.2.1 *The role of the contract*

Despite varying legal contexts, contracts creating offset banks (both Biobanking Agreement in New South Wales and Conservation Bank Agreements in California) establish how compliance is assured, by specifying the financial assurances required, processes of monitoring, criteria to demonstrate compliance, and enforcement processes (e.g. TSA 1995; Hill 2008). Multiple signatories are bound in clear agreement, providing support necessary to enforce expectations. They may also specify remedial action, and associated funding, so enforcement may led to any losses being remedied (Marsh, Sokolove and Rhodes 1996).

As a foundation for enforcement and compliance, and a platform for redress as described above, contract design may also create incentives both for or against compliance (Marsh, Sokolove and Rhodes 1996; Curnow and Fitz-Gerald 2006; Hallwood 2007). Hallwood (2007) models the outcomes of contract design by considering 'agents' who takes responsibility for the work required and generates the credits, and 'principles' who oversees credit issuing, requiring the work to be completed[93] (see also Gunningham and Young 1997). The contract stipulates contributions (inputs) required to achieve specified biological outcomes, credits associated, and agreed penalties if failure occurs - e.g. withholding credits until additional remediation occurs (Hallwood 2007). A positive return on the mitigation/conservation investment depends on the difference between cost of inputs and number of credits generated (Robertson 2004), so profit maximization occurs when agents invests the smallest amount possible to gain specified credits.

Contract design therefore determines the incentives for the agent to reduce inputs and investment in work based on whether they expect this "*shirking*[94]" to be detected by the principle, and the costs that result from being detected; a function of the remedial action required in the contract and the likelihood of enforcement (Hallwood 2007). Hallwood (2007)'s model also demonstrates that the more expensive restoration is, and the more investment required, the greater the incentive to 'shirk' if agents believe detection is unlikely (Gunningham and Young 1997). Hallwood (2007) emphasizes contract enforcement is necessary, via site inspections by the principle. Contracts must balance the level of investment required with stipulation for remedial action and penalties for non-compliance, to be effective for enforcement.

6.1.2.2 *Auditing*

Auditing is a final component of ensuring compliance (EDO 2008b; Bekessy et al., 2010; eftec IEEP et al., 2010), occurring at a higher level where offset banking systems and procedures are reviewed and investigated to ensure they are operating as intended. Auditing should be done extremely transparently and impartially, ideally involving a third party (EDO 2008b; Teresa 2008; Bekessy et al.,

---

[93] 'Principles' being agencies such as DECCW in NSW or USFWS or USACE in California; 'Agents' being offset bank owners.
[94] The term is used by Hallwood (2007) to represent cheating in the system - i.e. inadequate investment in conservation work, bellow that which is required of the agent. Page 448.

2010) such as the Commonwealth Government Department for New South Wales (Nelson and Sharman 2007) or the EPA in California.

Auditing may be done of individual banks, specific trades, and the operation of the scheme in general. Desktop audits ensure correct protocols have been followed, such as use of assessment criteria and maintenance of monitoring processes (EDO 2008b; Nelson and Sharman 2007). The finances of the system also require auditing, ensuring that the financial support of the bank remains solid, and financial transactions have occurred in-line with requirements (Fleischer and Fox 2008; Teresa 2008). Compliance auditing in multiple forms, is a component of the NSW Compliance Assurance Strategy addressed in the *'Compliance Audit Handbook'* (DECC 2008c).

More comprehensive auditing including site-visits is also required to assess how successfully processes such as monitoring are being implemented (EDO 2008b; Nelson and Sharman 2007). Whole schemes may also be subject to audits to determine if trades are meeting objectives, consistency is being achieved, and whether intended outcomes are occurring such as cost-effectiveness in implementation and enforcement and alignment with broader government objectives (DECC 2008; Bekessy et al., 2010). For example, in NSW the Minister is obliged to report on the progress and operation of Biobanking and make this publically available (TSA 1995). The entire scheme, including the Assessment Methodology will be reviewed on a regular basis with opportunities for public submissions (DECC 2008c).

6.1.2.3 *Resourcing issues*

Significant resources are required to implement compliance assurance through mechanisms described above; if resources are inadequate, enforcement is sub-standard or unlikely as observed in prior early wetland mitigation (Goldman-Carter and McCallie 1996; Hallwood 2007; Nelson and Sharman 2007; Fleischer and Fox 2008; Walker et al., 2009). Time, money, personnel and expertise must be available and lack of such resources together with low prioritization of enforcement may prove more influential than specific enforcement mechanisms themselves (Hallwood 2007; Fleischer and Fox 2008). Hallwood (2007) emphasizes that contract design for successful enforcement depends on adequate resources, particularly for physical site inspections.

Resourcing for enforcement and compliance must be directly addressed through a scheme's design. Cost-effectiveness is an important factor. Costs for agencies to enforce contracts must be balanced appropriately by the advantages of enforcement: i.e. social benefits from cost-effective, privately funded biodiversity conservation (Hallwood 2007). Both California and New South Wales therefore make provisions to resource enforcement from sources within the scheme itself. Endowments used in California can serve this function so should be large enough to support necessary agency enforcement (Fleischer and Fox 2008; Teresa 2008). When enforcement occurs through the easement, the easement holder must resource this. This may come from the endowment, insurance policies, or if held by an agency, department funding may be called upon if required (Teresa, per. comm. 2010).

Under the Compliance Assurance Strategy in New South Wales, enforcement is primarily the responsibility of The Department (as above), raising resourcing issues. By design, costs associated with non-compliance may be recovered from the Biobanking Trust Fund, at the Direction of the Fund Manager (Currnow and Fitz-Gerald 2006). Monitoring to support enforcement must also be funded through the Trust Fund and associated long-term management plans (Nelson and Sharman 2007). Importantly, the scheme has been operating for a limited time so empirical evidence of success is not available. It is not yet clear whether The Department has adequate time, financial and personnel resources to successfully implement the strategy. Nelson and Sharman (2007) recognise a relevant role for third-party standing rights. Establishing such rights requires monitoring results, offset banking contracts and other relevant information to be publically available to facilitate effective oversight by interested parties within the community. The ability for individuals and groups to bring cases of potential breech to court directly helps to reduce demand on regulatory agencies and represents an additional source of resources for enforcement (Gunningham and Young 1997; Nelson and Sharman 2007)[95].

Achieving compliance through financial assurances, monitoring and enforcement is essential for offset banking, ensuring individuals operate within the system to achieve overall biodiversity conservation goals, and mitigating a significant component of social risk. Additionally, as a collection of individuals and communities, mechanisms are also required to ensure that the outcomes of the offset banking system do not pose a risk to society on the whole. This is the topic of concern in the following section.

[95] The importance of additional, private or non-governmental resourcing for enforcement is considered from the continuous viewpoint that adequate funding from regulatory agencies is unlikely, given the significant political pressure they are exposed to, to retain some flexibility in how robustly specifics of the scheme are upheld, by those with specific interests (Bonnie and Wilcove 2008; Walker et al., 2009)

6.2 The risk posed to society at large, by offset banking: the importance of policy and regulation

One reason offset banking is considered 'risky' is because of the risk offset banking produces unsuitable outcomes when measured by societal concerns, objectives and expectations; comprehensive failure then becomes a self-fulfilling prophecy. How offset banking policy and regulation is designed directly reflects valuation of biodiversity (Wissel and Watzold 2010; Vorhies, 2011). Biodiversity is valued for biological, scientific, and economic contributions. Individuals, communities and societies also derive distinguishable additional benefit, creating distinct goals and desires for biodiversity and conservation, having important implications for offset banking policy and regulation (Dobson 1999; Bishop et al 2011).

One such goal for offset banking is economic efficiency, (established in Chapter 5): conserving biodiversity most cost-efficiently (Farrier, Kelly and Langdon 2007; Counsell, Evans and Mellsop 2010; eftec, IEEP et al., 2010). Additional financial objectives for offset banking include redirecting financial responsibility to those directly degrading biodiversity values (principally development activities) rather than from limited taxpayer resources (Bedward et al. 2009). Explained further by Agius (2001), where society and finances intercept, economic incentives and mechanisms adopted must be in line with community values and objectives and have a high level of community acceptance (see also Gunningham and Young 1997). How economic benefits and burdens are distributed through offset banking raises concerns a societal aspiration for social justice (Dobson 1999).

The 1996 report[96] by the Commonwealth Government of Australia echoes this:

> "…to conserve biodiversity it was necessary to find ways that are consistent with community values while at the same time encouraging ecologically sustainable use…preferences should be given to mixes that motivate communities and industry to conserve biodiversity… seek to reduce underlying [social] causes of threats to biodiversity… as well as the direct [biological] threatening processes."
>
> p. 491 Agius (2001)

[96] *Reimbursing the Future: An evaluation of motivational, voluntary, price-based, property-right and regulatory incentives for the conservation of biodiversity,*

Policy must therefore consider societies' biodiversity objectives and perspectives around biodiversity decline (Dobson 1999; Crowe and ten Kate 2010). As in California and New South Wales, biodiversity conservation in New Zealand occurs within established frameworks of democratic society, making concerns for social justice relevant. This section focuses on how such egalitarian concerns for such equity and justice may be addressed within offset banking design.

6.2.1 Justice, equity and biodiversity

A central social objective of offset bankin is achieving environmental justice, generally understood as

"…the human right to a healthy and safe environment, a fair share of natural resources, the right not to suffer disproportionately from environmental policies, regulations or laws, and reasonable access to environmental information, alongside fair opportunities to participate in environmental decision-making' (Centre for Sustainable Development, University of Westminster and the Law School, University of Strathclyde 2006: 8)."

p. 427 Hillman and Instone (2010)

Issue has been taken with economic approaches operating without concerns for justice, equity and welfare provision in society, as economic efficiency does not intrinsically consider these (Benton 1999; Daly and Farley 2004; Muller 2007). Questions regarding the sustainability of a traditional, economically efficient allocation were raised in Chapter 2; the inherent capacity for equity in allocation is also of concern to some (Ekins, Hillman and Hutchison 1994; Daly and Farley 2004; Dobson 1999; Muller 2007). There is therefore distinct risk that as an economic policy, offset banking may produce socially inequitable outcomes in terms of environmental justice.

An equitable allocation distributes resources fairly to all individuals in society because it is desirable and just to do so. Individuals desire different specific goods and services, but in some cases it is desirable to have a minimum level of equal access to certain goods and services provided to all in society, irrespective of individual want or desire (Fisk 2000). As examples, government healthcare, education and social welfare are provided as public goods, requiring alternative policies than for managing private goods by economic efficiency (Fisk 2000; Muller 2007). Offset banking is implemented because biodiversity is recognised as having some level of public good, requiring socially and environmentally just management. Providing social equity and justice (together with economic efficiency) is therefore an important role for offset banking design and policy.

6.2.1.1 *Generational equity: intergenerational*

Social equity, justice and sustainable management are closely linked (Ekins 1993; Norton 1995; Dobson 1999; Daly and Farley 2004). Intergenerational equity means just distribution is sustained into the future, therefore current management and policy should not reduce the benefits and options available to those in the future (Norton 1995; Dobson 1999). For biodiversity conservation policies to be socially acceptable, they must be seen as equitable: no group, either present or future, is favoured or disadvantaged compared to the other (Agius, 2001). To mitigate such risks of inequity requires that biodiversity resources be managed sustainably, retaining the environment's capacity to continue to produce benefit into the future. This is central to ecological economics (see Chapter 2) (Ekins 1993; Norton 1995; Muller 2007). Offset banking may enable appropriate development to continue so current generations may realise development benefits, yet the conservation components provides biodiversity and associated benefits into future.

The balance between the level of current development against the level of perpetual biodiversity conservation via trading offset banking credits directly reflects to what degree the current generation sacrifices their own needs or wants in order to provide for future generations.

> "…the whole of the sustainability debate can be read, precisely in terms of 'distributing something' across generations, or, in other words, in terms of intergenerational distributive justice."
>
> p. 4 Dobson (1999)

Balancing such risks in a decision-making framework within offset banking trades is challenging given the needs, wants, perspectives and constraints of future generations are highly uncertain (Norton 1995, 1999; Barry 1999). Holland (1999) suggests that achieving intergenerational equity is achieved not by specific outcomes challenging to define, but achieving equity and justice in systems operated by appropriate principles. This establishes a clear role for the policy that guides an offset banking system, in mitigating the risks of intergenerational inequity.

Equity with previous generations is also of concern (Beckerman 1999; Dobson 1999). In the New South Wales context, Agius (2001) considers equity with past generations where earlier landowners have been able to destroy biodiversity and reap all associated economic benefit, largely without the responsibility of environmentally offsetting such loss. Offsetting restrictions imposed on current landowners are a direct response to biodiversity loss caused previously; risking inequitable distribution of benefit and burden that may have bearing on how policies influence participation by current landowners. Despite the lack of clear resolution in literature or practice, New Zealand policy will deserve similar attention given such notable consideration by economists and environmentalists alike (Dobson 1999).

6.2.1.2 *Intragenerational equity*

How biodiversity resources are managed impacts whether society's members may have more or less access to biodiversity benefits, or if some are disproportionately burdened with financial or practical costs of biodiversity loss or amelioration (Naumann, Vorwerk and Brauer 2008; Dobson 1999). This makes intragenerational equity, between members of the same generation, important (Muller 2007).

Biodiversity is spatially explicit; it is valuable because of its location within the landscape. Because offset trading may significantly spatially re-arrange values, important landscape processes may be altered. Depending how exchanges are managed, this can have either positive or negative effects on biodiversity. Similarly, effects on human communities can vary. Biodiversity loss may be greater in some areas, where the negative effects of biodiversity are felt more seriously. Alternatively, less development and greater biodiversity conservation in some locations may also be inequitable. How offset banking exchanges patches of biodiversity across a landscape must be managed with due regard for this distribution of social costs and benefits.

6.2.2 Regional equity and disparity

Regional disparity is a significant equitable concern: trading across wide geographic areas may potentially allow excessive loss of values from one region and excessive conservation in another. This may be a result of variation in the cost of biodiversity conservation across a landscape. Costs directly relate to management requirements, varying based on the type of biodiversity and ecosystems concerned and making some values less expensive to conserve. Regional governance structures (for example, determining labour costs) and varying opportunity costs for conservation land can create wide disparities in the cost-effectiveness of biodiversity conservation between regions. This may overly-concentrate biodiversity in some areas, to the detriment of social equity, and comprehensive, representative conservation for biological integrity.

Communities may be concerned if offset banking replaces important local or social values specific to their area, conservation in another region and causing significant local decline. Alternatively, their region may be supporting other regions' development by providing the biodiversity offsets, so sacrificing their own economic development and associated benefits and becoming somewhat of a 'biodiversity dump'.

In New South Wales, inequitable disparity has been predicted between rural and urban communities regarding how biodiversity is valued, and so conserved, across rural and urban areas (Farrier, Kelly and Langdon, 2007; EDO NSW & TEC 2008b). Current processes of biodiversity assessment and exchange are viewed by some as favouring increased development in urban, coastal areas where pressure for land is higher and conservation is more costly and challenging. Biodiversity conservation may be therefore disproportionately concentrated in rural areas. Farrier, Kelly and Langdon (1997) conclude because Biobanking is not compulsory in New South Wales, but Property Vegetation Planning under the NVA (2003) makes offsetting compulsory in rural areas, there is a potentially conflicting interaction between Biobanking and other environmental legislation. To be equitable, the same restrictions and incentives must apply to all. Strategic, regional planning such as via the Biodiversity Certification[97] process identifies potential spatial inequities timely enough to prevent or ameliorate risk of such negative outcomes (Farrier, Kelly and Langdon 1997).

Other potentially disparities in New South Wales exist between new and existing homebuyers. The TSA (1995) requires new developments such as residential subdivisions to mitigate their impacts. This is an additional cost to developers absent in prior homebuilding. Project developers absorb this cost short term, but eventually pass it to the consumer - the new house or land purchaser. This may be inequitable as buyers of existing homes will not bear this costs (all things being equal) despite previously built houses arguably contributing to biodiversity loss on at least a commensurate level, but without the cost of mitigating the negative impacts. This may also concern intergenerational equity: those making purchases today experience greater costs due to activities and choices of individuals at an earlier time (Agius 2001).

Geographic distribution and reallocation of biodiversity values under offset banking concerns many interests, making establishing trading rules a process of balancing a range of risk mitigation. Conservation of biodiversity values requires distribution to be equitable to communities, while

[97] For more on NSW see http://www.environment.nsw.gov.au/biocertification/index.htm (accessed 18/06/2011); http://www.environment.nsw.gov.au/biocertification/GrowthCentres.htm (accessed 18/06/2011).

maintaining biological integrity, so regulating and restricting trades to minimise risk is challenging, yet pivotal within offset banking design (Agius 2001).

6.2.2.1 *Trading rules: service areas and like for like restrictions*

Trading rules are used to avoid these risks and maintain biological integrity and social equity (Crowe and ten Kate 2010). In California, bank sites are assigned service areas within which credits may be sold to provide mitigation for project impacts. Impacts outside a banks service area are not considered mitigated (under regulations) by purchasing its credits, although may be done philanthropically or speculatively. The specific area is described in the Bank Agreement, according to region, biology and conservation needs of the bank and its values, according to watersheds or hydraulic unit codes (HUC'S), species range, or geo-political contexts. Importantly, larger service areas are likely to facilitate more trades but risk greater spatial rearrangement of values. Smaller areas reduce this risk, yet may exclude some economically or biologically beneficial trades. Service area decisions can appropriately balance these risks.

New South Wales does not specify service areas, instead trades must be between matching credit profiles (see section 4.2.4). With ecosystem credits 'trading-up' is permitted: exchanging lesser-valued credits for higher valued credits (DECC 2007; BAM 2008; Crowe and ten Kate 2010). Geographic limits are not explicit, but it is intended that the spatial distribution of biodiversity values across New South Wales (with values being predominantly region-specific) will necessitate trading within appropriate regions, limit the out-of-region trading possible, and reduce risks of inequitable geographic rearrangement of biodiversity values.

6.2.2.2 *The no-go area*

With areas or values of extremely high value, there is much greater risk of excessive or irreplaceable loss (EDO NSW & TEC 2008b). Offset banking may be inappropriate in this case: a 'no-go area' may be designated (Norton 2009; see also Bekessy et al., 2010). No-go area may be explicitly delineated, or provided for through a specified identification process. Either represents a consensus on the biological and/or importance and significance of certain values such that no benefit from development can outweigh the cost of associated impact and loss, rendering mitigation unachievable.

No-go areas may also be an emergent property of market mechanisms. Certain values are likely prevented from inappropriately trading and irreversible lost from a landscape because, if significant enough to warrant special protection, this is likely because the values are extremely rare or very costly or difficult to conserve. The cost of any credits generated would naturally be extremely high, increasing exponentially with scarcity or rarity. This can be expected to self-limit development projects unable to support such a high mitigation price. If mitigation is too expensive, the development project will not go ahead, so no impact will occur. Development may also be limited if, due to scarcity or extreme cost, there are no offset banks offering such specific biodiversity values. Again, the development will not likely go ahead, negative impacts not occur and a no-go area is effectively established.

This may be insufficient for social equity so risks may remain. The point at which a development project and its impacts are prevented due to scarcity and cost may be misaligned with a level of conservation that is biologically or socially desirable. Values may not be scarce or rare enough to deter development because of mitigation costs, yet may have great social importance to preserve. Furthermore, the point of scarcity at which the mechanism takes effect, biological process may mean conservation can no longer prevent continued decline and eventual extinction. For this reason, additional quantifiers of the 'no-go' area may be required to mitigate this risk, for example, the *red flag* variation system in New South Wales

6.2.3 Red flags in New South Wales

When a site is assessed for potential development, biodiversity present may raise a 'red-flag'[98]. This identifies a no-go area of important biodiversity that cannot easily be replaced, so may be unsuitable for offsetting (BAM 2008; EDO 2008b). Criteria include over-cleared vegetation types, endangered ecological communities or being one of only a limited number of habitat or species populations the removal of which would jeopardize overall survival (DECC 2007). It is not possible to improve or maintain the values of a red flag area through Biobanking so an IMT cannot be passed and development is not permitted.

[98] The Red Flag area is defined as "An area of land at the development site with high biodiversity conservation values where the impact of the development on biodiversity values cannot be offset by the retirement of biodiversity credits in order to improve or maintain biodiversity values, unless the Director General determines that strict avoidance of the red flag area is unnecessary in the circumstances." Page 21 DECC 2009b

Red-flags may, however, be varied (the term used to allow removal) which subsequently allows development and Biobanking applications to proceed. Ministerial discretion may be requested to determine if retaining the red-flag would be unnecessary and unreasonable in the circumstances, according to established protocol (DECC 2007)[99]. Generally, variation is approved based on rational that highly fragmented, degraded patches require such intensive resource inputs and therefore greater biodiversity conservation is likely and rational where resources are directed towards another site - i.e. though a Biobanking trade. This process highlights additional risk: that incorrect decisions regarding no-go areas are made.

The red-flag and accompanying variation process is a most prominent source of debate in New South Wales (Possingham et al., 2007; Angel and Wamsley n.d.; EDO NSW, TEC 2008b; EDO 2007b). Specifically, the methods and metrics used to identify red flags and the process for assessing variation are questioned regarding their alignment with the BAM, the transparency and objectivity of decision-making, and their scientific and ecological validity (Angel and Wamsley n.d.; EDO NSW & TEC 2008b; EDO 2007b). The social value of small urban patches considered non-viable under current criteria (poor condition, size and surrounding land use) may not be properly captured. As it currently stands, they are eligible for red flag variation and clearance, despite having potentially significant value for the immediate community, and risking significant social loss (Angel and Wamsley n.d.).

To finally address risks of inequality, the costs of biodiversity conservation must be distributed equitably. How much of the cost of biodiversity conservation should be borne by the community as compared to those directly impacting via development? If society at large benefits from biodiversity conservation and most development projects also directly or indirectly provide benefit to society, perhaps some of the costs of development, such as biodiversity offsetting, should be absorbed by society? Finding a system that suitably balances these concerns and addresses risk of inequality in biodiversity conservation is extremely challenging. Tradable credits are supported as offering a most equitable, if imperfect, risk-balancing solution (Agius 2001; Rose 2003; Tietenberg 2003; Crowe and ten Kate 2010).

[99] Variation may be approved if all avoidance and minimization mechanisms have been considered, the contribution the patch makes to regional biodiversity must be low and the site's values must be have extremely low or absent viability; a function of size, condition, tenure and surrounding land uses (DECC 2009b; 2007). Other considerations may be considered, such as relationship to any regional plan or any additional environmental compensation offered by the development's proponents (DEC 2007).

6.2.4 The risks of environmental management and Hardin's Thesis

Hardin's Tragedy of the Commons (1968) provides an influential contribution when approaching risks within environmental management: if resources held in common such as biodiversity are used by many without rules and regulation to govern, they will exploit resources the point of degradation. Establishing either government or private property rights addresses this risk (Ostrom 1999; Ostrom, Gardner and Walker, 1994; Burke 2001; Dietz et al., 2002). Property rights (the right to exclude others etc. see Chapter 5, section 5.2.1 - 4), such as established by offset banking, are institutions of rules and regulations restricting use of otherwise common resources to prevent long-term exploitation and degradation.

Property rights may be public, private or a combination, so Kraan and in't Veld (1991) explain it is possible to make environmental policy choices based either on private, individual choices addressed by economics and market operation, or through the public choice via democratic process and associated role of government. Criticism exists for both approaches (e.g. Lawton 2007; Sagoff 2004; Henley and Splash 1996; Ginn 2005). Sustainable development attempts to integrate both public and private concerns recognising both economics and societies' egalitarian objectives (see Chapter 2). To properly address the risks characterised in the Tragedy of the Commons private property rights are key, yet democratic societies such as New Zealand also best consider society and provide democracy when designing any modern market-based conservation approaches.

6.2.5 Democratic involvement

Democracy may be considered both deliberative and inclusive. It is deliberative where decision-making processes democratically represent all interests affected by decisions. Inclusive means that all individuals and groups have equal opportunity to contribute to decision-making (O'Riordan and Stoll-Kleemann 2002). Democratic involvement in biodiversity management is prioritised variously across literature (Ekins, Hillman and Hutchison 1993; Moote, McClaran and Chickering 1997; O'Riordan and Stoll-Kleemann 2002; Steelman 2002). Wide-ranging calls for democracy advocates involvement of stakeholder and civic-involvement groups, as management of biodiversity must regard the interests of the stakeholders with democracy being the mechanism to achieve this. (Gunningham and Young 1997; Agius 2001; Steelman 2002; Sagoff 2004; Ten Kate, Bishop and Bayon 2004).

"…'participative governance' means that the civil society (nongovernmental organizations [NGOs], local associations, etc.) join with governments and industrial lobbies in a common decisional pattern to achieve agreements between the three parties… Local communities—as part of the civil society—are increasingly pointed up in the literature as the most efficient bottom organizations to minimize social costs and maximize social welfare."

p 356, Ballet, Sirven and Requiers-Desjardins (2007)

O'Riordan and Stoll-Kleemann (2002) suggest such participation increases the ease and legitimacy of implementing management, while increased representation brings together improved knowledge and perspectives which better address complexities of biodiverse systems. Civic involvement and stakeholder participation may have a significant role addressing conflicts over regulatory management of environmental resources by centralised government that occurs in both the United States (Sagoff 2004) and New Zealand. Reducing conflict over how to best conserve and utilise national biodiversity is a prime objective for offset banking in New Zealand.

Regulations are used in both Californian and New South Wales to offer stakeholder involvement and civic participation in operation and decision-making, and for perspectives and concerns of civic groups to be expressed and considered. Although achieved differently in California and New South Wales, both systems share the similarity of operated under a democratic government. Subsidiarity is often promoted in literature: decision-making processes are allocated to the lowest organisational level possible. Conservation may be best at local and regional levels, reflecting the principle that the most effective policy operates at the scale the problems occur (Gunningham and Young 1997; Ekins, Hillman and Hutchison 1993; Agius 2001; Daly and Farley 2004). Regulations maintain a central role supporting and maintaining outcomes from stakeholder and civic processes, facilitating and strengthening democratic processes. This contrasts to command and control frameworks where regulations have previously driven focus towards divisive discussion and debate, potentially detracting from broader objectives (O'Riordan and Stoll-Kleemann 2002; Sagoff 2004). Establishing an appropriate role for democracy within offset banking therefore recognises current international practices and is informed by research into environmental conservation in the context of human systems and societies, discussed bellow (section 6.2.10).

6.2.5.1 *Democracy in case-study examples*

California

Policy in California supports participation by individuals, stakeholders or civic groups by allowing independent third party groups to hold easements, endowments and management responsibilities for specific banks[100]. Easement holders are directly involved with decision-making and implementation processes; some assuming direct management roles to achieve the conservation purposes of the easement (*Easements* see Chapter 5 Section 5.1.7.1). If meeting certain criteria, stakeholder or civic groups may alternatively manage a bank site's endowment fund, becoming directly involved with financial accountability and long-term financial security. Long-term success relies on the endowment's income stream, so its management has significant impacts on long-term outcomes (*Endowments;* see Chapter 5 Section 5.1.2). Both empower third-party groups with the rights and responsibilities to ensure the enduring integrity of the values in offset banks, allowing a range of society groups to maintain direct connections with conservation occurring through Mitigation and Conservation banking.

Public consultation and public access to information is also required for democratic involvement. For example, in Mitigation Banking in California under the Compensatory Mitigation Rule Timeline for Bank or ILF Instrument Approval (EPA, USACE 2008) a 30-day public consultation period is required, disclosing relevant information such as values and potential credits involved, and long-term provisions such as endowment and management plans. Additionally, submissions can also be made to counties, states or Federal agencies to make additional species eligible for banking, under Acts such as the EPA and the ESA, or jurisdictions such as county plans.

While offset banking may potentially offer a process including all society in decision-making regarding biodiversity values, delivering these outcomes remains questionable. Some argue merely providing an opportunity to represent groups' opinions and interests corresponds weakly to contributing towards and influencing final decisions. This can result from short timeframes for public submissions (which may be time and resource intense) and policy gaps in processing and considering submissions.

New South Wales

The New South Wales Biobanking system includes extensive provision for public involvement in the policies guiding scheme operation. Under the TSA (1995) public notification and invitation for submission is provided for species listings and reviews, critical habitat determination and formation of conservation plans. Also, importantly, the creation and review of Biobanking Assessment Methodology,

[100] Role subject to criteria-based agency approval. For more see Table 5.1 section 5.1, Chapter 5.

formal reviews of operation of the Biobaking Scheme and the process of review of the Act itself (TSA Reg. 2008).

The Scheme's open standing rights (see above Section 6.1.2.1) are central to increasing public participation in environmental law and environmental outcomes in Australia. It supports proper enforcement of government legislation, and reduces ability for individual entities to gain disproportionate levels of power in environmental issues, such as large corporations and development interests (Smith n.d.; EDO *per. comm.*). Legislatively stipulated public registers provide the necessary supporting information (see above 6.1.1.3).

Finally, in both California and New South Wales, a variety of stakeholders and civil groups may purchase and generate (sell) credits. For example, the first transaction under the New South Wales Biobanking Scheme involved the creation of credits and the establishment of the bank site by the non-profit community church group, the Missionaries of the Sacred Heart. In terms of buying power however, credits are generally purchased directly from independent and private sellers who are able to charge whatever price acceptable to them at the time. As previously discussed, controls on this price exist within the system, however there is a potentially wide margin of discretion available to the credit seller (see Chapter 5 section 5.4.1). Credit sellers are not required to sell to any person and credit prices are usually expensive. This impacts the ability of individuals and groups within society to participate in buying and selling credits.

6.2.6 Efficient and optimal democracy

Democracy and inclusive participation may be provided in offset banking in numerous ways, and at various levels as described. This has significant resource requirements, and therefore requires non-trivial trade-offs for efficient use of resources. Broadest participation allows involvement in decision-making, yet this requires significant time and money to distribute and then process information and for responses to be heard. This may take much longer if disputes need to be settled.

Democratic involvement may be via rights to review or question decisions and plans once they are made, such as the in the third-party standing rights observed in the New South Wales system. A benefit of this may be more efficient decision-making time-frames, but once decisions made it is arguably more challenging for third-parties to alter outcomes and would be more resource-intense than making changes within the decision-making process. If not, costs to change outcomes generally fall to under-resourced communities or sections of society therefore limiting how inclusive and representative this is in reality.

Democratic involvement is instrumental to successful and socially robust offset banking. California and New South Wales demonstrate the variety of mechanisms available, responding to the many risks that must be balanced to achieve this. Optimally integrating regulation for economic success and societal provision, together with ensuring efficiency and information provision are risks remaining for offset banking to balance and minimize.

6.2.7 CPR research: the role of institutions

A number of disciplines investigate how regulations can mitigate human and social risks if they create economic incentives for desired individual behaviour, while avoiding conflict with community and society needs. Research on Common Pool Resource (CPR) and Human-Environment Interactions focuses on how interactions are mediated between individuals in economies, in societies, and with biodiversity values. Offset banking may better mitigate the risks of balancing such factors with insight from this area of research[101]. A most relevant contribution from this research is an emphasis on creating incentives through establishing institutions.

"Solving CPR [*Common Pool Resource*] problems involves two distinct elements: restricting access and creating incentives"

p. 279 (Ostrom 1999)

Offset banking introduces exclusion and privatization, restricting access to incentivise management of biodiversity[102]. The right institutions are important for this (Ostrom, Gardner and Walker, 1994; Ostrom 1999; Burke 2001; Agrawal 2003; Dietz et al., 2003; Moran and Ostrom, 2005; Tucker and Ostrom 2005). Institutions are broadly defined as the rules and guidelines regulating individuals' behaviour, for example created by policy, law and regulation (Martin and ver Beek 2006). Offset banking is an institution for biodiversity management; it establishes rules regulating who, when and how a resource is

[101] Common Pool Resources (CPR) research builds upon Hardin's Tragedy of Commons presenting alternatives to traditional private/public property rights structures. CPR are defined as are non-excludable (or very costly/impractically so), substractable (use and exploitation by one reduces resource availability for another) therefore distinguishing them from non-subtractable public goods (Ostrom 1999; Ostrom, Gardner and Walker, 1994; Burke 2001; Dietz et al., 2002).

[102] See Chapter 5, section 5.2.1 - 3 and 5.2.5 respectively for discussion of exclusion and privatization within Offset Banking.

accessed and how decisions regarding such access and distribution are made (Baden 1998; Dietz et al., 2003; Tietenberg 2003).

Hardin (1968) and others consider these institutions require property rights; held privately as suggested by theorists such as Coarse[103], or by centralised government (Ostrom 1999; Gilpin 2000; Burke 2001; Dietz et al., 2003; Sugden et al., 2003; Moran and Ostrom 2005; Donald 2003; Yang et al., 2009). Emerging research such as CPR highlights a more complex reality where a variety of property rights, outside this strict dichotomy may also offer successful solutions and supports biodiversity management via novel property rights structures with greater capacity for communities. (Feeny et al., 1998; Ostrom 1999; Agrawal 2003; Donald 2003; Dietz et al., 2003; Sugden et al., 2003; Moran and Ostrom 2005; Ballet, Sirven and Requiers-Desjardins, 2007; Gadgil and Rao, 2005). Privatisation in the most complete sense may therefore be able to give way to novel, more community and socially advantageous institutional structures. The degree by which biodiversity is incompletely privatised by the New South Wales Biobanking scheme is one example (see Chapter 5, section 5.2.5). Debate over privatisation[104] highlights how different property rights produce different incentives for behaviour. The degree of equity a property right entails generates incentives for or against environmental stewardship.

> "It is a general finding of the property rights literature that the degree of equity represented by a property rights regime helps create the incentive structure which either promotes or inhibits stewardship of environmental resources." Hanna and Munasinghe (1995)

Tradable permits are suggested to be institution that may introduce appropriate privatization to CPR management (Ostrom et al., 2003; Rose 2003; Tietenberg 2003), with previous applications suggesting that positive economic and environmental outcomes are possible[105] (Gunningham and Young 1997). As an institution, offset banking intends to create effective and efficient incentives that mitigate risks of unwanted individual or societal outcomes occurring through biodiversity conservation and sustainable development. Understanding this in the process of designing an offset banking system can make a positive contribution to mitigating risks through design and implementation.

---

[103] See reference above (*Footnote 5 Chapter 3a)* regarding the work of Coase and discussion of private property rights (Excludability and privatisation section, Chapter 3a), such as the premise that private property rights internalize cost and benefits existing externally to the system (such as social costs/benefits in relation to 'free-riders'), thereby facilitating efficient allocation.

[104] See Chapter 5, section 5.2.5

[105] For example, see literature concerning fisheries permits in Canada, sulfur trading in the United States and water-rights trading in Australia.

6.2.8 Incentives: linking individual action with societal outcomes

Institutions are important because biodiversity conservation will succeed with the correct incentives (Agius 2001; Daily and Ellison 2002; Sagoff 2004; Doremus 2006; Gadgil and Rao 2005; Burke 2001; Darbi et al., 2009; Palmer and Filoso 2009). Aligning incentives offers a way to minimise the risk that offset banking and individuals' associated actions produce unsatisfactory societal outcomes.

"There are many instrumental approaches involving markets or regulation or other supports that hold out hope for improvement. All depend for their effectiveness on the quality and integrity of underlying institutions. All depend ultimately on patterns of resource allocation that makes [*the incentives for*] custodianship no less important than economic exploitation. If we can align our institutions and our rewards [*incentives*] systems, then we have means at our disposal to pursue growth without prejudicing future generations. If we cannot, then instruments will be inefficient, conflict and confusion will be pervasive and we will all lose."

p 8 Martin and ver Beek 2006

Studies concerning CPR suggest that lack of incentives may explain observed inadequacies of command and control mechanisms. Agrawal (2003) argues that human subjectives must be altered in order to effectively alter individuals' behaviour. This is achieved through incentives to change, rather than threats or fear of prosecution, as is the premise for command and control (Gunningham and Young 1997; see also Agius 2001). Market-based mechanisms are concerned with incentive structures that appeal to individuals' self interest, and are the basis for the strength of economic approaches (Gunningham and Young 1997; Gilpin 2000; Heal 2000; Daly and Farley 2004; Doremus 2006; Christensen 2007; McDaniel 2007).

"Many of the most helpful, cost-effective and sensible reforms in environmental policy have resulted from the suggestions of economists about how society, by altering incentive structures, can better reach its goals."

p 180, Sagoff (2004)

Examples presented in "The New Economy of Nature" (Daily and Ellison, 2002) provide evidence of the results achievable when incentive structures appeal to inherent self-interest motivations of individuals, as captured within economic assumptions. There is support for this also in New South Wales where:

"The EDO and TCE strongly support providing incentives for biodiversity conservation on private land in NSW. Providing sufficient income for landholders to manage land for biodiversity conservation, an also [*sic*] potentially carbon sequestration and other ecosystem services, is essential in combating land degradation."

p 5 EDO NSW & TEC (2008b)

6.2.9 Human-Environment interactions

To apply institutional structures and the right incentives to best mediate and mitigate risks, current research does not support policies of broad, generalised approaches (Moran and Ostrom 2005). Interactions are highly complex and contextual, with different interactions being present at different tempo-spatial scales (Moran and Ostrom 2005; Dietz et al. 2003). Consequently, policy (economic, technical, legal, social or political) is being called for that recognises the need for a mix of approaches, to reflect the contextual, scale-specific, highly complex reality of interactions (Feeny et al., 1998; Dietz et al., 2003; Dolsak and Ostrom 2003). One approach cannot be expected to mitigate risk in the same way in all contexts and the failure of one solution in one context is not grounds to assume no benefit can be gained from the approach elsewhere (Gunningham and Young 1997; Dolsak and Ostrom 2003). Particularly, reliance or focus on one type of property-right regime as being optimal has been discredited; instead all regimes retain potential for success in the appropriate context (Gunningham and Young 1997; Feeny et al., 1998; Moran and Ostrom 2005).

"A mix of for-profits, governments, bureaucracies and regulation, and innovative institutions such as public, nongovernmental boards of trusts allows us to address the particular circumstances of different common-pool goods."

p. 60 Baden (1998)

To be a successful institution establishing effective incentives and reduce risks, offset banking will optimally sit within a context relevant to the ideas and research described here. With a paradigm of a range of offsetting approaches, under a wider umbrella of sustainable development mechanisms, offset banking may minimise these risks and make a significant contribution.

6.3 Summary: A final connection between social risk and social liability

Within offset banking there are distinct human and social risks. Understanding how humans and society interact with biodiversity, conservation and the wider environment, particularly regarding institutions and incentives, is key to managing and minimizing these risks. Offset banking may also provide an appropriate vehicle to minimize and manage risks associated with recognizing both biodiversity's social value, and the benefit from social biodiversity conservation. In acknowledging these aspects, it is further appropriate to question what level of liability society should assume regarding these risks and benefits, in the context of offset banking.

This should be based on how a society such as New Zealand's chooses to relate to biodiversity and likely requiring more active and direct debate to resolve. Concerns over economic efficient conservation and who should assume liability and cost of biodiversity destruction and conservation require similar evaluation. Even within the free-market principles of offset banking governments may introduce fees, subsidies and levies so more or less government and taxpayer money is directed to biodiversity conservation within offset banking. A consensus must therefore be reached regarding such options. Societal participation and debate, formal or informal is an accompanying part of designing offset banking to appropriately balances too much or not enough social risk and liability in biodiversity conservation.

CHAPTER SEVEN

RESEARCH FINDINGS AND LESSONS TO BE TESTED IN NEW ZEALAND

There are many ways to inform opinion and make recommendations as to how New Zealand should consider offset banking. A wide body of empirical and theoretical literature is available exploring the foundations of offset banking: ecological economics, tradeable permits for environmental management, long-term land stewardship, ecosystem measurement and assessment, environmental law and policy, and sustainable development. Working with this literature is an important step towards understanding how offset banking works and how it may work best in New Zealand. Familiarity and prior use of these concepts are naturally extrapolated into expectations for offset banking. An important complement to this is to investigate how such concepts play out in practice by analysing existing offsetting examples. This thesis focuses upon the latter approach: advancing what New Zealand can learn by analytically observing real-time overseas examples, irrespective of predictions supported by theory. My research approach (literary review juxtaposed by independent observations of case studies) can be expected to return conclusions inherently subjective, perhaps contentious, in nature. Issues and opportunities revelled may surprise and conflict with pre-existing understanding, nevertheless providing an important, pragmatic contribution.

The findings I present here firstly emphasise that conservation and sustainable development has so far failed to highlighted any silver-bullet or universal, single solution or approach. Overseas examples do not offer a complete or perfect template and lessons they demonstrate are unlikely to apply in all future applications. My recommendations come from a line of observational enquiry and to make maximal contribution, should be combined with further New Zealand-specific analysis. Lessons learnt from overseas may be proved or disproved as a result. This process begins here: drawing conclusions from observations, to be tested further in the future.

In this concluding chapter I therefore make recommendations for a New Zealand offset banking system drawing on the on the support and evidence of my literary and observational research.

7.0 Concluding recommendations for a New Zealand system

California and New South Wales demonstrate what is possible for offset banking. Analysing their differences and similarities assists the design of a New Zealand system, yet the diversity internationally in offset banking approaches reflects the reality that successful systems are distinctly context-specific. Design of New Zealand offset banking should be tailored as such (Doremus 2006; Crowe and ten Kate 2010). Overseas experiences are not proof of concept, but examples by which advantages and disadvantages, opportunities and risks, may be explored. With this in mind, intent to achieve a 'perfect' system with exact and flawless mechanisms will only leave New Zealand disappointed and wanting for positive outcomes, while missing opportunities offset banking has to offer.

To begin a design and implementation process, perfect or otherwise, five main concerns must be addressed to develop New Zealand's offset banking system[106], elaborated bellow:

- Determining credit metric and methodology;
- Fulfilling legislative requirements and establishing the role of regulating agencies;
- Ensuring financial and economic conditions for successful trading;
- Creating an enabling social and political environment; and
- Position offsetting and offset banking within strategic biodiversity conservation

The last point may be the fist step, and yet the most pivotal. Primarily, offset banking must support conservation as a portfolio of approaches. All eggs should not be placed in the metaphorical offset banking basket. Not to be viewed as comprehensive, isolated or perfect, design must represent a synergistic and multi-disciplinary approach (Gunningham and Young 1997; Doremus 2003; eftec, IEEP et al., 2010; Ring 2010). Around the world it is increasingly recognised that offset banking is optimised when embedded within broader-scale strategic conservation. If a country such as New Zealand is to reap maximum efficiency and efficacy from offset banking then this must be in a framework where national and regional conservation priorities are clear. New Zealand must unanimously decide how to evaluate the merits of proposed projects, how best to address the limits of public conservation funding, and how the benefits of offset banking may be realised as a link between these. A codified strategy informs decisions and supports the evaluation of development projects, impacts and offsets. To begin achieving this, offset banking components such as site selection and credit definition must be viewed

[106] c.f. Agius 2001 p. 502 which highlights six points suggested to be necessary (in 2001) for NSW to develop a biodiversity trading system. See also Crowe and ten Kate, (2010), and Gunningham and Young 1(997) for additional principles for government policy and regulation for market-based systems of environmental management.

as representing the broader question of 'what are we trying to conserve', because sustainable development inherently questions which areas are to be developed and which are to be conserved.

7.1 The metric: defining a credit for trade

Progressing from current offset practices requires definition of what kind of trading credit will be used, and how to measure this at a given location (Crowe and ten Kate 2010, *c.f.* eftec, IEEP et al., 2010). This represents two distinct challenges, requiring both a metric and a methodology (Robertson 2004). California and New South Wales have different metrics and methodologies as a reflection of the different underlying regulations, yet insight from both will inform the optimal design for New Zealand. California trades acres of wetland and endangered species, assessed using various techniques. New South Wales trades ecosystems and non-ecosystem specific species, defined within the comprehensive BAM. Basing offset banking on species or ecosystem approaches in New Zealand may be feasible, yet the New Zealand context may respond better and the system be more successful utilising alternatives to a species or ecosystem metric.

When considering a species-based approach for New Zealand's context, focus goes towards indigenous (and potentially native) flora and fauna. However assumptions should be made with caution as many indigenous species are rare, range-restricted or endangered, and a number may fail to provide the fungibility a tradable credit requires. Such characteristics may be intrinsic, due to past decline, or a result of the many subspecies, hybrids and under-studied species (for example see Miskelly et al., 2008; de Lange et al., 2009). Numerous highly specific credit types present potential supply and demand problems expected to impede market functioning (Crowe and ten Kate 2010). If too many species indeed prove inadequately wide-spread or abundant (intrinsically or otherwise), New Zealand species are unlikely to satisfy the supply needs of the banking system, cause a perilous and undesirable imbalance between *species credit* supply and demand from development (eftec, IEEP et al., 2010).

Additionally, my research points to critically questioning how suitable it will be to apply ecosystem credits. Optimum metric systems enables comprehensive spatial mapping of the classifications used (Crowe and ten Kate 2010). Balancing supply and demand requires that commodities are well defined. Operation is far smoother if it is known where all the 'commodities' are and perhaps impossible without this. New Zealand's spatial mapping system may indeed be of comparable international standard, however observations of overseas offsetting examples suggest prudent questioning of how New Zealand's environment will stand up within offset baking. Offset banking requires a replicable, definitive classification to be made at each site requiring New Zealand's systems to respond with complete and unambiguous delineation specific to offset banking systems. New Zealand's prevalence of locally unique ecosystems, altitudinal gradients, eco-tones and impacts of invasive species present a very real likelihood that numerous determinations carry subjectivity or specificity impeding fungibility required. New South Wales' basis of Habitat Hectares was developed in Victoria, where all vegetation types had been classified and defined; a complete market was created making ecosystem trading possible. Whether the state of New South Wales' environmental context proves conducive enough will only become clear as the system operates. As a result, adopting the Victorian and NSW methodology in New Zealand may inadequately capture ecosystem values, and not support smooth economic functioning of supply and demand.

7.1.1 Towards New Zealand metrics

The Department of Conservation's Biodiversity Offset Research Program is expected to bring New Zealand closer to a recommendation regarding metrics and methodologies to represent New Zealand best practice[107]. While research outcomes are pending, understanding overseas methodologies contribute to this evolving discussion.

Also relevant is the Proposed National Policy Statement from the Ministry for the Environment[108]. Based on the version released for public consultation at the beginning of 2011, it is expected that this document will establish biodiversity as a 'significant' and therefore distinct concern under the RMA process of assessing and compensating for negative environmental effects. Potential trading metrics and methodology will be stronger if related directly to the policy, and therefore values (specifically, biodiversity), intended for conservation through credit trading. A 'conservation credit' specific to the New Zealand context may be favourable, potentially better serving biodiversity conservation purposes compared to a species or ecosystem-based approach. It may draw from a number of ecological concepts: key-stone or indicator species, ecological or functional communities, evolutionarily significant units, or specific process or functions are only some that may be designed.

[107] For details see: http://www.doc.govt.nz/publications/conservation/biodiversity-offsets-programme/
[108] For more information see: http://www.mfe.govt.nz/publications/biodiversity/indigenous-biodiversity/index.html

7.2 New Zealand methodology: potential for a 'conservation credit'

What would the methodology look like to define a conservation credit?

Once a unit of trade is defined, a process of assessing these values at a given site is required (Crowe and ten Kate 2010). Metrics are best determined methodically and directly relating to the objectives of measurement, i.e. the ultimate intentions for conservation (Robertson 2004; Hillman and Instone 2010). Compare the various regulatory drivers (and so methodologies) of conservation, mitigation and Biobanking, as discussed in sections 4.1.3.4 and 4.2.3. Advantages may be taken from the United States where private landowners are not discouraged from participation through onerous or risky methodologies and where trade is facilitated by the fungibility of an acre-based credit. This maybe combined with New South Wales' more ecologically comprehensive methodology to produce a specifically designed 'conservation credit' for New Zealand that best provides both ecological and economical benefits.

Conservation credits my be issued reflecting characteristics such as LENZ classification, species present, land area, surrounding land uses and other landscape factors. The additional conservation proposed by the active management under offset banking must also be accounted. Site scores against these factors could be then aggregated (and potentially weighted) resulting in an overall conservation credit score for a site. Similar to the New South Wales' methods, this instead focuses on the conservation value of the site, rather than a given ecosystem classification.

All offset banking sites would therefore sell a fungible form of credit, providing a streamlined, reliable process for those establishing a bank site: each bank owner can expect to be issued with conservation credits for their land. Site specificities are accounted when trading occurs, as in California where specific conservation values may be accommodated by requiring impacts to highly valuable areas purchase more credits (commensurately increasing conservation). The drawing on the 'credit profile' approach in New South Wales, a number of credits may also be required to match, potentially to varying degrees: i.e. credits must rate the same on 100, 80 or 50% of factors suggested above (LENZ classification, species present etc.) with remaining credits purchased from any available bank in defined, geographically proximate area. A given credit could therefore potentially be sold to those impacting exactly the same values, some of the same values, or a range of values in the geographic area.

Expanding the range of impacts and offset requirements a credit may be sold for, avoids restricting the seller to a limited market of identical species or ecosystem classifications. This is important as it supports the incentive to generate conservation values and makes offset banking more accessible to those wishing to generate conservation values and supply credits. Complementarily, this model also places greater requirements upon those impacting biodiversity, because credit purchase is more onerous that credit creation. This aligns with creating disincentives for activities with negative impacts and incentivising the creation and protection of conservation values. The importance of creating the right incentives is discussed in section 6.7.8 - 9.

Bearing important influence upon the efficacy of methodologies and credits types is the capacity of the supporting knowledge bass, a reoccurring point common to both New South Wales and California despite their contrasting approaches. A uniform, comprehensive knowledge base is necessary to support how credits are valued and traded (Crowe and ten Kate 2010). Difficulty conserving and including under-studied species notwithstanding, conflict within other schemes comes from lack of consensus on ecological and biological matters or the revision requirements to respond to a concurrently expanding knowledge base. Any recognised lack of knowledge regarding indigenous flora, fauna and ecosystems therefore compounds challenges to designing New Zealand's trading credit (Stephens 1999; Brockerhoff et al., 2008; Walker et al., 2008; de Lange 2009). Whether knowledge of New Zealand's floral and faunal ecology, distribution and conservation needs has the capacity to support offset banking and the level of ecosystem measurement required must be critically reviewed (Stephens 1999; Doremus 2006; Crowe and ten Kate 2010). New Zealand's floral, fauna and comprehensive biodiversity basis of knowledge may successfully support the country's current conservation to a standard comparable or indeed superior to international standards (and the accuracy of this assumption is for discussion elsewhere). Any capacity under an offset banking approach however has not been tested. Again, observations from overseas examples suggest this is a point requiring a higher level of scrutiny and advises caution against unsubstantiated overconfidence.

7.2.1 The Biodiversity metric

With the limitations underlying knowledge may represent, it is also important to appreciate the implications of a biodiversity-based measurement (Vorhies, 2011). Complex supporting methodologies necessary when applying such a complex and multi-faceted concept may potentially frustrate macro-level policy objectives (Hillman and Instone 2010). Even in New South Wales, where biodiversity conservation is central in policy, note that implementation is via ecosystem and species surrogates.

Conservation of biodiversity is an increasingly favoured policy ambition, yet there are both advantages and disadvantages to focus on such a complex concept. Primarily such policy is based on the assumption that increased biodiversity will provide wider benefits such as enhanced functioning, processes, services or stability of ecosystems, and therefore greater intrinsic, psychological or aesthetic value. How accurately these relationships are understood determines how well biodiversity-based offset banking fulfils expectations, so challenges are greater while understanding of biodiversity is actively changing and growing. As research continues, biodiversity represents a higher level of organisational complexity compared with species or ecosystems. There is danger this leads to a focus upon maximally comprehensive biological assessment likely detrimental to overall outcomes; a case of obscuring the forest with the trees and stagnating the system. For example, rarity, representativeness, threat, iconic status, or a specific ecosystem service may be relevant to conservation goals, in addition to overall biodiversity. Therefore, New Zealand must incorporate a balance of such concerns; in particular, objectively assess the implications of biodiversity-based policies.

7.3 The role for agencies and legislation

All offset banking systems require legislation; at a minimum to create the commodity that generates the market for trade. Regulation may further ensure the market functions within the confines desired by making provisions and giving legal strength to achieve requirements discussed here. Regulation may also serve to establish the roles and capacity for administrating bodies to provide necessary oversight (Crowe and ten Kate 2010).

In New South Wales, the Office of Environment and Heritage (OEH) is the sole administrative body regulating Biobanking, and the majority of regulations and framework under single legislation. Intended to offer a more streamlined approach, the OEH approves bank sites, credits, related development projects and credit trades. This sole-agency structure introduces conflicting interests, charged as a reason for the lack of confidence currently observed.

In California, the number of administrating agencies involved in bank creation and credit trading is a function of the multiple layers of legislating and regulating documents involved. Coordinating the interests and concerns of different agencies slowed the process early on. This frustrated participants and was viewed as inefficient. Through experience and cooperation these barriers have largely been resolved in California. Instead, involving various agencies provides a valuable balance of perspectives and accountability arguably lacking in New South Wales.

In New Zealand, there is a primary need for a clear regulatory framework to enable offset banking (Crowe and ten Kate 2010). There is advocacy for this to occur at a national level, responding to current lack of direction from central Government (PCE 2010). New Zealand has legislation applicable to offset banking in the RMA and surrounding offsetting case law. To move this towards a credit trading system where offsets are implemented prior to impacts and credits are used to recognise conservation actions, the following provisions must be made with strength and clarity. Regulation may be used to require the following (see also Crowe and ten Kate 2010):

- Land must be perpetually protected, potentially through a covenant such as through the QEII Trust or the Reserves Act. There is a distinction however between protecting the land and protecting the conservation values on the land. Some provisions below contribute to closing these gaps in current covenant tools.
- Comprehensive and defensible long-term management plans are essential. They must be supported by a monitoring program, include clear liability and enforcement provisions and binding to the land, protected values and all future landowners yet is currently not the case.
- A third-party endowment funding mechanism must be required to ensure financial support for effective perpetual protection.
- A clear process of enforcement, including where the responsibility of enforcement lies and how enforcement will occur. Enforcement processes in California and New South Wales are discussed in section 6.1.2 and illustrates different approaches possible. Drawing from these examples and in conjunction with current enforcement under the RMA, the context of the New Zealand legal system and RMA legislation requires further assessment. The third-part easement system used in California and across the United States provides a powerful and efficient enforcement mechanism and so New Zealand would do well to examine this model further.

7.4 Implementing regulation and legislation

Overseas, using planning legislation as a vehicle for the above regulation has been criticised. Environmental legislation instead directs greater emphasis to environmental outcomes; this smooths operation, coordination and planning yet better incorporates environmental perspectives. Arguably, the RMA combines both planning tools, guided by the intent to sustainably manage resources and protect environmental values. This may strengthen any offset banking system established within it.

Greater regulation of biodiversity offsetting is predicted under the proposed National Policy Statement on Biodiversity. Unfortunately, the version released for public comment in early 2011 does not include the points suggested in sections above, nor does it provide policy specifically facilitating biodiversity offset banking. It does however make a number of important contributions towards them. Primarily, biodiversity is given 'significant' status under the RMA, further emphasising and clarifying biodiversity as something of distinct value. This is an important initial step towards the value required to create and trade credits for offset banking. The NPS also establishes a number of national priorities; potentially indicating which of the biodiversity 'commodities' are the most 'valuable'. Policy 5 and the principles specified in Schedule 2 directly address biodiversity offsets. These may be viewed as an indicative of a future framework for creating and trading biodiversity credits.

While not evident in the currently circulated version, a National Policy Statement document could establish roles for agencies potentially involved in offset banking, defining their appropriate responsibilities and liabilities (Crowe and ten Kate 2010). Currently, the Local Territorial Authorities (TLA's: Councils at the District and Regional Levels) are responsible for maintaining biodiversity values under the Reserves Act, Local Government Act and the Biosecurity Act, as well as under sustainable development within the RMA. Such responsibilities may currently be delegated through Regional Policy Statements and District Plans, although a National Policy Statement has the capacity to provide national-level guidance and legislation (MfE 2001). A policy could describe the parameters and regulatory consideration of the definition of an offset, establish the requirement to offset impacts to certain values and sanction the use of offset banking credits for this purpose (Crowe and ten Kate 2010). While this is not included in the exhibited draft, optimistically, it does include the specific requirement of NNL (see section 4.1, Chapter 4) or net environmental benefit, and for the strict adherence to the mitigation hierarchy (Christensen and Burge 2010; PCE 2010; Crowe and ten Kate

2010). This could be strengthened however, by more explicit consideration of how the hierarchy is to be applied and enforced.

As a National Policy Statement under the RMA, it has legislative standing, requiring TLA's to comply with policy though regional and district plans. This may make it possible to establish a biodiversity or conservation credit-trading program to comply with the offsetting and conservation requirements of the NPS. This may be similar to the way in which conservation banking in California is administered through compliance with the ESA, without the ESA specifically creating the scheme. Irrespective of this, national-level coordination is the optimal way to implement offset banking in New Zealand. Supply and demand is likely to be heavily constrained by the small geographic and economic size of individual TLA's. Even with region-based administration, a nationally coordinated system would be much stronger though support possible from a structure incorporating a variety of existing national-level bodies.

7.5 Developing a multi-agency structure

Operation and administration of offset banking legislation will optimally occur within a multi-body framework where potential conflict of interest is minimised (Crowe and ten Kate 2010). When the body approving the bank also controls the metric used, how credits will be traded, and approves exchanges, consents and development projects potential conflict of interest is introduced, reducing participation and market confidence (Crowe and ten Kate 2010). There may be incentives for agencies to apply regulation and streamline processes to their advantage. It also exposes them to pressure from multiple conflicting sources, such as developers, bank owners and environmentalists (Crowe and ten Kate 2010,). Dividing such interests and pressures, as in the multi-agency approach in California, is therefore advisable for New Zealand. A multi-agency approach can enforce increased transparency, and more efficiently allocate time and resources so limiting potential political stagnation when functions are confined to one agency. These measures smooth market operation, in turn supporting improved environmental outcomes.

For the operation of offset banking legislation, TLA's are optimally positioned to be responsible for administering the legislation (and/or regulations) above. Important requirements include establishing exchange by the free-market and that participation in the scheme is voluntary[109]. Responding to objectivity and concerns over conflicting interests, the authority approving consent for development

[109] Whether or not to make a scheme voluntary is debated internationally. See section 5.3 for details, and support for a voluntary versus compulsory approach.

projects involving credit trading should remain separate from the authority establishing the parameters and rules of trade, administering the legislation and providing enforcement (Crowe and ten Kate 2010). Division of such tasks between the Regional and District Council levels may therefore be considered.

A body is required to approve banks, issue credits and may also define who conducts ecosystem assessment, defining what constitutes an offset bank and the exact definition of the credit traded. Another entity must be responsible for recording all scheme transactions in appropriate registries and provide this information publically (Crowe and ten Kate, 2010). This body may also administer monitoring and auditing, and operate as an approval or endorsement agency for assessors or assessment methodologies. The Ministry for the Environment and the recently created Environmental Protection Agency could both potentially fill such roles. Thought must be given as how to divide these tasks as jurisdiction may need to be specifically extended though regulatory mechanisms to provide them with the strength and efficiency required. Finally, provisions could be made so that The Office of the Parliamentary Commissioner for the Environment could be empowered to take an ombudsman role, providing an additional level of auditing and oversight.

7.6 Finance and economics

Endowment - to ensure the viability of each trade

Endowment systems are fundamental to ensure the long-term financial viability, supporting long-term biodiversity maintenance. The Californian template championed by the CNLM is highly regarded (*see* section 5.1.2 - 7, Chapter 5). Compared to New South Wales' Trust Fund the separation from government control is a particular strength of the Californian system; necessary under free-market operation and for participant confidence. Regulatory oversight is involved in stipulating how payments are to be made in or out of the account, but without directly administrating or distributing the funds. New Zealand should adopt this Californian approach.

Economic structure - to ensure the viability of all trades

Regulation's role within offset banking is distinct from existing regulation aimed at achieving environmental conservation. Appreciation of this distinction is vital, and requires significant attention towards understand and acting upon it. Regulatory approaches suitable for the New Zealand system will depend on our economic and development profile and size of the country, population and economy, so must be designed specifically and carefully. Successful offset banking occurs via trade within an active free-market. The role of regulation is to create mechanisms that facilitate a conducive environment, such that supply and demand can take effect (Crowe and ten Kate 2010). It is not the role for government oversight and regulation to set credit prices, but to create and maintain the conditions for appropriate pricing to occur:

> "… There are compelling reasons why the role of central government, at least in respect to some instruments, should be that of steering the boat rather than rowing it…"
>
> p. 283 Gunningham and Young (1997)

Minimum and maximum credit pricing is discussed in Chapter 5. Provided examples demonstrate how price is an emergent property of the Californian and New South Wales scheme design. This is a wise path for New Zealand to follow: stipulate the priority of free-market pricing, allow credit price to be based on long-term management, and facilitate competition in the market. Government intervention and regulation retains significant influence over competition's determination of the price of offsetting, influencing entrance and participation in the scheme and alternatives (i.e. competition) available (Gunningham and Young 1997; Crowe and ten Kate 2010).

As discussion accompanying Box 4.1 (Chapter 4) highlights, requirements for trade, and therefore trading ratios, must not be set at such a level as to counter-productively over-inflate credit prices. New Zealand must not be dominated by conservation-focused arguments advocating the highest possible price for offset banking credits. In attempts to strive for the maximum conservation benefit and reflect the paramount importance placed on biodiversity values, maximum credit price has been assumed to generate more money towards, and therefore achieve, more conservation: this represents an economic fallacy (see Chapter 5, section 5.4.1). Outside of augments surrounding discouragement of negative impacts (see discussion of incentives section 6.2.8 - 9), New Zealand must warily and critically understand the assumption that high costs of offsetting produce optimal conservation outcomes.

7.7 Political will and the national approach to biodiversity conservation

Once design decisions have been made, systems such as California and New South Wales mature and more nuanced issues may be observed. The tragedy of offset banking failure appears to lie less in the risk posed by economic or ecological uncertainty, but instead in the potential that when established and resources committed, the system fails to attract participants and the benefits are never realised. These are concerns facing New South Wales, California and across other United States, despite the different stages of implementation and with different design and development processes.

To achieve the desired outcomes for offset banking - expand access to conservation values through an alternative source of conservation for New Zealand - offset banking must be allowed to flourish once implemented. A strong offset banking system operates as a mechanism bringing in private capital to augment constrained public conservation systems. To realise this, both an economically and ecologically defensible system must be supported. Participation must be unrestrained by barriers such as high costs from highly complex or bureaucratic processes, or competitive challenges by those able to undercut a private credit supplier (potentially public, NGO or other directly or indirectly subsidised participants). This comes down to maintaining broad-scale respect not only for the biology of the system, but also the economics and social components, as reinforced here in Chapters 4, 5 and 6. There are a number a ways that regulation and policy may be used to foster this respect and avoid such pitfalls, but fundamentally, it is upon political will and social facilitation that success or failure depends. As such, the social and political context of a New Zealand offset banking system deserves attention.

The rural landholder has a significant role in offset banking as they hold potential offset banks. Financial conditions must align to generate supply from this sector, engaging them both economically and socially (MfE 2001; Doremus 2006). Particular regard must be given to existing culture surrounding private land-rights and stewardship (Meurk and Swaffield, 2000). Any restriction upon freedom of use on adjacent land use or traditional practices (occurring through the scheme's enforcement or regulations) will likely deter participation and reduce the supply of offset banks, regardless of the other advantages offered. Reliably interpreting the impact of NSW's Biobanking on traditional rights is a speculative reason for limited uptake among the private, rural landholding sector across the State.

Information supply and public community participation, together with appropriate regulations, offer key solutions to these issues (Gunningham and Young 1997; Stephens 1999; Doremus 2006). New Zealand's history of active and engaged public participation in conservation points to the importance of comprehensive, publically available information (Stephens 1999; PCE 2010). A valuable example is provided by the numerous databases that comprise the Biobanking Registry in New South Wales.

Technical and resource support is vital, yet when adequate, registries are powerful tools supporting democratic operation. This is a suitable template for New Zealand to adopt. Across the United States the importance of such information capacity has been recognised for several years. The transformation from recognising this need to implementing tools has taken much longer. This has been partly due to the number of agencies from which information must be coordinated. It is also because establishing tracking and tracing systems such as RIBITS[110] has occurred after much banking activity. As a result, entrenched processes need adjustment and existing information must be integrated; both involve time and resource commitments and challenges. Concurrent establishment of offset banking and information tracking registries have clear advantages and modern systems are near impossible without this approach.

Society's choice and involvement

Regulations drive offset banking but how these manifest is a product of society's attitude to how the environment should be managed - for development, resources and conservation. How New Zealanders choose to approach these decisions has direct implications for how successful offset banking, and required regulations, can be. Offset banking is a novel, innovative approach to environmental management and conservation, and so requires a departure from previous attitudes.

To effectively implement offset banking New Zealanders must choose to participate because they recognise offset banking as an additional tool necessary. Government resources for biodiversity conservation are currently insufficient and the environment continues to suffer significant, on-going biodiversity loss as a result. Without such decisions, outcomes are limited because market-based systems operate according to human choice. Economic mechanisms will not be optimally designed without desire to do so. Robust scientific and financial backing for offset banking requires significant government and taxpayer support so issues must be prioritised, driven through consumer and voter traction.

New Zealand will also choose to adopt offset banking as a result of reaching a consensus over how to manage development projects and resulting impacts. Rather than looking at a project and seeing if offset banking can reduce the negative environmental impacts, offset banking best responds where developments are seem as having distinct wider benefits and accounting for environmental negativities

---

[110] See APPENDIX TWO: Summary table comparing the key components of New South Wales Biobanking, and Conservation Banking in California, USA.

are a necessary component of making overall benefits from development possible. Offset banking is a process for aspiring to optimal environmental outcomes possible when development projects occur, inacted only after deciding where and how development projects should occur. This perspecitve potentially requires a shift in New Zealand's prevailing attitudes and perspectives.

Further analysis may shed light on how such shift occurred in California, and whether this shift can or will occur in New South Wales. In the absence of this, one observation stands out. In California, shifting focus towards the best conservation available through mitigation and conservation banking, and away from the debate over the merits of development projects has been possible because groups prioritising environmental concerns are actively engaged with achieving optimal conservation outcomes under offset banking. As well as potentially being bankers or landowners, environmental or conservation groups are able to hold easements, endowments and long-term management stewardship of banks.

This direct involvement has many benefits but most importantly provides a channel that aligns with groups' mandates for optimal conservation. It allows groups to assure the success of the systems' conservation goals, while also a mechanism whereby potential conflicts and issues are resolved in a proactive, rather than reactionary or confrontational manner. Bringing varying interests together under a common goal has enabled cooperation and displaced earlier confrontational relationships and interactions. Tension between conservation groups and the banking industry is minimised in California and is a powerful example for New Zealand to follow.

7.8 The role of higher governance: strategic conservation is key

Emphasising the importance of society's attitudes and perspectives consequently invites questioning of the role for higher government. This is debated within New South Wales as Biobanking develops, and in California where focus has redirected towards the maintenance and expansion of established banking systems. Such debates contain numerous perspectives, yet one trend emerges even within the different positions and stages. Site selection is critical - for economics and ecology - and is only maximised under a broader strategy for conservation. Locating offsets and bank sites within the landscape to make maximum conservation contribution is only possible when specific conservation needs are understood and these goals are articulated. In Californian conservation banking, the recovery of the species is the overall objective so sites are identified and prioritised based on how best this can be achieved. This is difficult when viewing sites individually. It is stronger with comparisons between a range of sites, options and combinations, and when the needs of the species and the threats and opportunities existing in the landscape are understood. This is where a strategic approach is required, and where selecting the best sites the guidance of a conservation strategy is necessary. A strategic approach may look at the needs of a species of specific environmental value, but also applies to critically assessing existing conservation goals, rationale behind (or existence of) prioritisation, how finances are allocated, how conservation decisions are made. Once these questions are answered through a strategy, it is possible to align offsets under this framework to achieve desired environmental and economic goals.

This should be a primary step for New Zealand: expanding the 2000 Biodiversity Strategy so it may incorporate the needs of an offset banking system and actively contribute to delivering associated policy objectives. Approached from a basis of critically assessing New Zealand's conservation priorities, current funding allocation frameworks, and how best to coordinate and utilise offsetting decisions to achieve new, optimal and defensible goals an effective Biodiversity Strategy is within reach. Upon establishing how offset banks are to be used to achieve conservation, a biological strategy may be formed to coordinate the conservation needs of specific species, ecosystems or other conservation values to inform specific site selection. There are examples of relevant strategic approaches in both New South Wales and California[111].

7.9 In summation

Offset banking is a tool to complement existing conservation, yet introduces a fundamentally novel perspective to how conservation is approached and biodiversity decisions are made. If offset banking is implemented from a framework without regard for such differences, only tentative efforts will be made and the process will stall, consume counter-productive resources, or fail altogether. With a true society-wide appreciation of, and desire for, sustainable development an offset banking system may be designed.

From the basis presented here, New Zealand will do well to keep two further points in mind moving forward. Firstly, paying close attention to the successes ensures full awareness of both the potential

[111] For more on NSW see http://www.environment.nsw.gov.au/biocertification/index.htm (accessed 18/06/2011); http://www.environment.nsw.gov.au/biocertification/GrowthCentres.htm (accessed 18/06/2011). For more on California see: http://www.dfg.ca.gov/habcon/ (accessed 18/06/2011); http://www.fws.gov/sacramento/es/hcp.htm (accessed 18/06/2011); http://www.ca-ilg.org/habitat (accessed 18/06/2011).

optimism and potential limits demonstrated by other successful offset banking systems (Crowe and ten Kate 2010). Perspectives from both inside and outside the Californian systems consider it highly successful; commanding support for New Zealand to continue active observation of such international successes.

Secondly, when looking at the kind of guidance and examples overseas systems can provide us with, New Zealand should look not only to where they have come from, but where they are going in the future. It is with this in mind that the role of strategic planning is discussed here. Concerns for climate change are also discussed with equal frequency, if not ease of solutions. This is predicted to impact upon the conservation needs of species and ecosystems, so potentially having important implications for offset banking. Additionally, increasing efforts to mitigate changing climate via schemes such as carbon trading are speculated to have some impact or interaction with offset banking trading systems, but examples to prove potential opportunities remain to be tested (EDO 2008b; Bekessy et al., 2010; Ring 2010; Crowe and ten Kate 2010).

In conclusion, New Zealand is in a position to improve current offsetting practices and how the national environment is conserved. What contribution can offset banking make? At a minimum, offset banking may be how New Zealand remains competitive with international best practice. Further, it may offer a mechanism for strengthening and expanding national capacity to conserve environmental resources and manage sustainable development. It may also be a process combining both aspirations. Both require many steps and decisions, informed by overseas examples as discussed in this thesis. In bringing this together, one lesson emerges most important: recognise that offset banking is a novel, unique and unprecedented approach to conservation. It presents both truly significant potential and inherent irreducible complexity; underestimating either ignores the greatest lessons pioneering overseas examples provide.

Thesis references

Research for this thesis was conducted through a series of interviews with personnel within Australia and the United States to provide information about the New South Wales and Californian banking systems respectively. Where information is not directly referenced or personal communications are noted this denotes that subject matter is the result from this interview-based research. Please see Appendix Four for a list of interviewees, noting their position/employment when the interview was conducted. Additionally, pleased note that all documents published by the New South Wales Department of Environment and Climate change, as referenced below, are available in their latest version on-line at www.environment.nsw.gov.au

Adams W., Brockinton D., Dyson J., Vira B (2003) **Managing Tragedies: Understanding conflict over Common Pool Resources.** *Science* 302(5652) p 1915 - 1916

Agius J, (2001) **Biodiversity credits: creating missing markets for biodiversity**. *Environmental and Planning Law Journal* 18 (5) 481 – 505

Agrawal A (2003) **Sustainable Governance of Common-Pool Resources: Context, Methods and Politics.** *Annual Review of Anthropology* 32 p 243 - 262

Ahuvia A (2008) **If money doesn't make us happy, why do we act as if it does?** *Journal of Economic Psychology* 29 491-507

Albrecht V., Wenzel M., (1996) **A View from the Private Sector.** *In* Chapter Five: Point/counterpoint: Two perspectives on mitigation banking. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Andelman S., Fagan W. (2000) **Umbrellas and Flagships: Efficient conservation surrogates or expensive mistakes?** *Proceedings of the National Academy of Sciences* 97(11) 5954-5959

Andelman S., Groves C., Regan H. (2004) **A review of protocols for selecting species at risk in the context of US Forest Service viability assessments** *Acta Oecological* 26 75-83

Anderson (2010a) **Nature's Sting: the real cost of damaging Planet Earth**. BBC World New Business 11th October 2010. www.bbc.co.uk/news/business -11495812

Anderson R (2010) **Nature's law: business will pay the costs of depleting natural resources.** BBC World News Business 20th October 2010 www.bbc.co.uk/news/business-11564693 accessed 21st Feb 2011

Andreasen J., O-Neill R., Noss R., Slosser N. (2001) **Considerations for the development of a terrestrial index of ecological integrity.** *Ecological Indicators* 1 21-25

Angel J., Wamsley R. (n.d.) **"Red Flag Variations under the Biobanking Scheme"** Letter to the Hon Verity Firth MP, Minister Assisting the Minister for Climate Change, Environment and Water. *Environmental Defenders Office New South Wales* and *Total Environment Centre.*

Anton A (2000) **Part 1; Chapter 1: Public Goods as Commonstock: Notes on the Receding Commons.** P. 4 - 40 *IN* Anton A, Fisk M, Holstrom N *Eds.* (2000) Not for Sale: In Defence of Public Goods. Westview Press, Boulder-Colorado.

Anton A, Fisk M, Holstrom N *Eds.* (2000) **Not for Sale: In Defence of Public Goods.** Westview Press, Boulder-Colorado.

Apestegui J, Maier-Rigaud F. P., (2006) **The role of rivalry: Public goods versus common-pool resources**. *Journal of Conflict resolution* 50 (5) p 646-663

Atkinson I. (1999) **Managing New Zealand's Biodiversity: Identifying the priorities and widening the options.** *In* Biodiversity Now! Joint societies conference, Wellington 29 June - 3 July 1997 Selected Papers. *(eds)* Blaschke P., Green K. Department of Conservation, Wellington. 1 - 12

Atkinson I., Cameron E (1993) **Human Influence on the Terrestrial Biota and Biotic Communities of New Zealand.** *TREE* 8(12) 447 - 451

Backgrounder: US Conservation banking http://www.speciesbanking.com/pages/dynamic/key_resources.page.php?page_id=pub12&category_class=books_papers_reports Accessed 16.04.2010 Copyright 2008, The Katoomba Group

Ballet J., Sirven N., Requiers-Desjardins M., (2007) **Social Capital and Natural Resource Management: A critical perspective**. *The Journal of Environment and Development* 16(4) 355 - 574

Balmford A., Bruner A., Cooper P., Costanza R., Farber S., Green R., Jenkins M., Jefferiss P., Jessamy V., Madden J., Munro K., Myers N., Naeem S., Paavola J., Rayment M., Rosendo S., Roughgarden J., Trumper K., Turner R. (2002) **Economic Reasons for Conserving Wild Nature**. *Science* 297 950 -

Bayon R, Carroll N, Fox J (2008) **Chapter 1: Introduction**. *In*: Conservation and Biodiversity Banking. *Ed:* Carroll N., Fox J., Bayon R. *Earthscan*. London, Sterling.

Beder S. (2000) **Costing the Earth: Equity, Sustainable Development and Environmental Economics** New Zealand Journal of Environmental L. 4 227 - 243

Bedward M., Pressey R., Keith D. (1992) **A new approach for selecting fully representative reserve networks: addressing efficiency, reserve design and land suitability with an iterative analysis.** *Biological Conservation 62 115 – 125*

Bekessy S., Wintle B., Lindenmayer D., Mccarthy M., Colyvan M., Burgman M., Possingham H. (2010) The biodiversity bank cannot be a lending bank. *Conservation Letters* 3 p 151-158

Bestelmeyer B., Miller J., Wiens J. (2003) **Applying species diversity theory to land management** *Ecological Applications* 13(6) 1750 - 1761

Bingham G., Bishop R., Brody M., Bromly D., Clark E., Cooper W., Costanza R., Hale T., Hayden G., Kellert S., Norgaard R., Norton B., Payne., Russell C., Suter G. (1995) **Issues in ecosystem valuation; improving information for decision making**. *Ecological Economics* 14 73 - 90

Binswanger M (2006) **Why does income growth fail to make up happier? Searching for the treadmills behind the paradox of happiness.** *The Journal of Socio-Economics* 35 366-381

Birner R., Wittmer H. (2003) **Using Social Capital to Create Political Capital: How do local communities gain political influence? A theoretical approach and Empirical Evidence from Thailand.** *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

Bishop et al., (2010) **The Economics of Ecosystems and Biodiversity Report for Business - Executive Summary** (TEEB). TEEB Web www.tebweb.org (accessed 21st Feb 2010)

Bockstael N., Freeman A., Kopp R., Portney P., Smith V. (2000) **On Measuring Economic Values for Nature** *Environmental Science and Technology* 34 1384 - 1389

Bol'shakov V., Luschekina A., Neronov V. (2009) **Biodiversity Conservation: From Ecosystem to the Ecosystem Approach** *Russian Journal of Ecology* 40(2) 73 - 80

Bonnie R., Wilcove D., (2008) **Chapter 5: Ecological Considerations**. *In:* Conservation and Biodiversity Banking. *Ed:* Carroll N., Fox J., Bayon R. *Earthscan*. London, Sterling.

Brito D., Ambal R., Brooks T., De Silva N., Foster M., Hao W., Hilton-Taylor C., Paglia A., Rodriguez J. P., Rodriguez J. V. (2010) **How similar are national red lists and the IUCN Red List?** *Biological Conservation* 143 1154 – 1158

Brockerhoff E., Shaw W., Hock B., Kimberly M., Paul T., Quinn J., Pawson S. (2008) **Re-examination of recent loss of indigenous cover in New Zealand and the relative contributions of different land uses.** New Zealand Journal of Ecology 32(1) 115-126

Brown P, Lant C (1999) **The effect of wetland mitigation banking on the achievement of no net loss**. *Environmental Management* 23(3) 333–345

Brown A., Veneman P. (2001) **Effectiveness of compensatory wetland mitigation in Massachusetts, USA**. *Wetlands* 21(4) 508-518

Browning C., (2001) **State of the environment: report urges NZ to act.** www.pundit.co.nz/content/state-of-the-environment-reports-urge-nz-to-act. 4th Feb. 2011

Bruggeman D., Jones M., Scribner K., Lupi F. (2009) **Relating tradeable credits for biodiversity to sustainability criteria in a dynamic landscape** *Landscape Ecology* 24 775-790

Burgin S, (2008) **BioBanking: an environmental scientist's view of the role of biodiversity banking offsets in conservation**. *Biodiversity conservation* 17 807 – 816.

Burgman M., Lindenmayer D., Elith J. (2005) **Managing Landscapes for Conservation under Uncertainty**. *Ecology* 86 (8) 2007 - 2017

Burgman M., Walshe T., Godden L., Martin P (2009) **Designing regulation for conservation and biosecurity**. *The Australasian Journal of Natural Resources Law and Policy* 13 (1) 93 - 102

Burke B (2001) **Hardin Revisited: A critical look at perception and the logic of the commons.** *Human Ecology* 9 (4) 449 - 476

Business and Biodiversity Offsets Programme (BBOP) 2010. **The risks of biodiversity offsets**. *BBOP,* Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009a. **Biodiversity Offset Cost-Benefit Handbook**. *BBOP*, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009b. **The Relationship between Biodiversity Offsets and Impact Assessment: A BBOP Resource Paper**. *BBOP*, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009c. Business, **Biodiversity Offsets and BBOP: An Overview**. *BBOP*, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009d. **Biodiversity Offset Implementation Handbook.** *BBOP*, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009e. **Biodiversity Offset Design Handbook: Appendices**. Appendix A: Approaches and methodologies in use and / or available as drafts, and associated policy requirements. Appendix B: Approaches relevant to biodiversity offsets by banks. Appendix C: Methodologies currently being developed. Appendix D: Supportive or supplementary approaches and methodologies. *BBOP*, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009f **Biodiversity Offset Design Handbook** *BBOP*, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009g. **Biodiversity Offsets and Stakeholder Participation:** A BBOP Resource Paper. BBOP, Washington, D.C.

Business and Biodiversity Offsets Programme (BBOP). 2009h. **Compensatory Conservation Case Studies.** BBOP, Washington, D.C.

C.J. Barrow (1995) **Chapter 4: Stable environment? Sustainable development?** *In* Developing the Environment: Problems and Management. Longman Scientific & Technical, New York.

Californian Government Department of Fish and Game (2009) **Conservation and Mitigation Banking In California under the Californian Govt. Dept. of Fish and Game.** http://www.dfg.ca.gov/habcon/conplan/mitbank/ Accessed 16.04.2010

Carignan V., Villard M.A. (2002) **Selecting Indicator Species to Monitor Ecological Integrity: A Review** Environmental Monitoring and Assessment 78: 45 - 61

Carroll C (2010) **Role of climatic niche models in focal-species-based conservation planning: Assessing potential effects of climate change on Northern Spotted Owl in the Pacific Northwest USA.** *Biological Conservation* 143 1432-1437

Carroll N, (2008) **Compliant Biodiversity offsets. Payments for Ecosystem Services: Market Profiles**. *Forest Trends, and the Ecosystem Marketplace* 18 – 20

Carroll N., Fox J., Bayon R. (e*ds*) (2008) **Conservation and Biodiversity Banking**. *Earthscan*. London, Sterling.

Chomitz K, Thomas T, Brandao A, (2004) **Creating markets for habitat conservation when habitats are heterogeneous.** Policy Research Working Paper *World Bank* 3429 pp.1 – 34.

Christensen M (2007) **Biodiversity Offsets - An Overview of Selected Recent Developments: New Zealand - Where to from here**? Anderson Lloyd Lawyers, Christchurch.

Christensen M., (2009) **Biodiversity offsets - a suggested way forward**. Resource Management Law Journal, April, p. 8 - 16

Christensen M., Burge O (2010) **Biodiversity offsets - An Update**. Resource Management Journal 27 - 31

Committee on Mitigating Wetland Losses, Board on Environmental Studies and Toxicology, Water Science and

Technology Board, National Research Council (2001) **Compensating for Wetland Losses Under the Clean Water Act** National Academies Press, http://www.nap.edu/catalog/10134.html 1 - 348 (ISBN: 978-0-309-07432-2)

Conroy M., Noon B. (1996) **Mapping of species richness for conservation of biological diversity: conceptual and methodological issues** *Ecological Applications* 63(3) 763-773

Costanza R., d'Agre R., de Groot R., Farber S., Grasso M., Hannon B., Limburg K., Naeem S., O'Neil R., Paruelo J., Raskin R., Sutton P., van den Belt M. (1997) **The value of the world's ecosystem services and natural capital**. *Nature* 387 (May) 253 - 260

Costanza R., Daly H., (1987) **Towards an Ecological Economics**. *Ecological Modelling* 38 1 - 7

Counsell K., Evans L, Mellsop J (2010) **Objective RMA decision-making: Cost benefit analysis as an economic and practical framework** *Resource Management Journal* November 2010 4-8

Crowe, M., ten Kate K. (2010) **Biodiversity Offsets: Policy Options for Governments**. *Business and Biodiversity Offsets Programme,* Forest Trends, Washington DC.

Curnow P, Fitz-Gerald L (2006) **Biobanking in NSW: Legal issues in the design and implementation of a biodiversity offsets and banking scheme.** *Environmental Policy Law Journal* 23 p. 298 – 308

Daily G, Ellison K (2002) **The New Economy of Nature: The quest to make nature profitable**. Island Press/Shearwater Books 2002 Washington.

Daly, H., Farley, J. (2004) **Ecological Economics**. Island Press, Washington

Darbi, M., Ohlenburg, H., Herberg, A., Wende, W., Skambracks, D. & Herbert, M. (2009**) International Approaches to Compensation for Impacts on Biological Diversity.** Final Report. Leibniz Institute of Ecological and Regional Development and Berlin University of Technology (TUB), Institute for Landscape Architecture and Environmental Planning

Davis T. (2009**) Objectors to wind farms to be bought off: A scheme to reward local people is being considered**. *The Sunday Times*, August 23, 2009 www.business.timesonline.co.uk/tol/business/industry_sectors/utilities/article6806408.ece

Dayton, P., Sala, E. (2001) **Natural History: the sense of wonder, creativity and progress in ecology**. *Scientia Marina* 65 (sup. 2) 199 -206 (*note that this document is saved as sm65s2199.pdf*)

De Lange P., Norton D., Courtney., Heenan P., Barkla J., Cameron E., Hitchmough R., Townsend A., (2009) **Threatened and uncommon Plants of New Zealand** (2008 revision) *New Zealand Journal of Botany* 47: 61 - 96

Dean J, (2007) **National welfare and individual happiness: Income distribution and beyond**. *Journal of Policy Modeling* 29 567-575

Denisoff C (2008) **Environmental banking in the USA**. NSW DECC http://www.environment.nsw.gov.au/biobanking/biobankingusa.htm Accessed 16.04.2010

Department of Environment and Climate Change (2005) **Biodiversity certification and banking in coastal and growth areas** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2007) **Scheme Overview** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (2006) **BioBanking: An Investigation of Market-based instruments to secure long-term biodiversity objectives**. *Background Paper.* Department of Environment and Climate Change, New South Wales Government, Sydney, NSW

Department of Environment and Climate Change (DECC) (2008) **BioBanking Assessment Methodology** *Department of Environment and Climate Change* Sydney, New South Wales.

Department of Environment and Climate Change (2008a) **BioBanking Guide to Biodiversity Assessment for Developers** *Department of Climate Change* Sydney.

Department of Environment and Climate Change (DECC) (2009a) **BioBanking and other conservation options for private land. Information Fact Sheet** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2009b) **BioBanking Guide to Biodiversity Assessments for Developers** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2009c) **BioBanking Compliance Assurance Strategy** Department of *Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2009d) **Biobanking agreement application.** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC)(2009e) **BioBanking Handbook for Local Government** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2009f) **BioBanking Assessors Course Information Sheet.** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2009g) **Information for CMAs** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Environment and Climate Change (DECC) (2009h) **Arrangements for BioBanking Assessor Accreditation** *Department of Environment and Climate Change* New South Wales, Sydney.

Department of Climate Change and the Environment (DECC) (2009i) **BioBanking: Biodiversity Banking and Offsets Scheme** ***Seminar*** Department of Climate Change and Environment, New South Wales Government, Sydney.

Department of Environment and Climate Change (DECC) (2009j) **The Science Behind Banking**. *Department of Environment and Climate Change.* Sydney, NSW

Department of Environment and Water Resources (DEWR), Australian Federal Government (2007) **Use of Environmental offsets Under the *Environment Protection and Biodiversity Conservation Act 1999*.** External discussion paper, Australian Federal Government, Canberra

Dietz T., Dolsak N., Ostrom E., Stern, P. (2003) Chapter One: **The Drama of the Commons.** *In:* National Research Council (2003) Drama of the Commons. Committee on the Human Dimension of Global Change, Ostrom E., Dietz T., Dolsak N., Stern P., Stovich S., Weber E.D *Eds*. Division of Behavioral and Social Sciences and Education. National Academy Press, Washington

Dietz T., Ostrom E., Stern P (2003) **The Struggle to Govern the Commons**. *Science* 302(5652) p 1907 - 1912

Dobson A., Bradshaw A., Baker, A. (1997) **Hopes for the future: Restoration Ecology and Conservation biology.**

Dodds S. (1997) **Towards a 'science of sustainability': Improving the way ecological economics understands human well-being** *Ecological Economics* 23 95 -111

Dolsak N., Brondizio E., Carlsson L., Cash D., Gibson C., Hoffman M., Knox A., Meinzen-Dick R., Ostrom E. (2003) **Adaptation to Challenges** *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

Dolsak N., Ostrom E. (2003) **The challenges of the commons** *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *(eds)* The MIT Press, Massachusetts.

Donald K., (2010) **Sustainability and the Commons.** *Science* 302(5652) p 1861

Doremus H. (2003) **A policy portfolio approach to biodiversity protection on private lands**. *Environmental Science and Policy* 6 217-232

Drechsler M, Watzold F (2008) **Applying tradable permits to biodiversity conservation: effects of space dependent conservation benefits and cost heterogeneity on habitat allocation**. *Ecological Economics*. doi:10.1016/j.ecolecon.2008.07.019

Early R., Thomas C. (2007) **Multispecies conservation planning: Identifying landscapes for the conservation of viable populations using local and continental species priorities.** *Journal of Applied Ecology* 44 253 - 262

Editorial (2000) Ecological Modernisation. *Geoforum* 31 1-8

Eftec, IEEP et al., (2010) The Use of Market-based Instruments For Biodiversity Protection - the Case of Habitat Banking - *Technical report*. http://ec.europa.eu/environment/eveco/index.html

Ekins P. (1993) 'Limits to growth' and 'sustainable development': grappling with ecological realities *Ecological Economics* 8 269 - 288

Elliot J. A. (2009) Sustainable Development. University of Brighton, Brighton, UK. 117 - 131

Engleman R (2009) Population and sustainability. *In* Scientific American Earth 3.0 19 (2) 22 – 29

Environmental Defender's Office (NSW) (EDO NSW)(2009) Climate change and the legal framework for biodiversity protection in Australia: a legal and scientific analysis. Discussion paper. Environmental Defender's Office (NSW)

Environmental Defenders Office New South Wales (EDO NSW), The Environment Centre (TEC), (2008b) Submission on the Proposed Biodiversity Banking Scheme. *Environmental Defenders Office, New South Wales, Sydney.*

Environmental Law Institute (2007) Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities. Environmental Law Institute. Washington DC

Environmental Protection Agency (EPA), US Army Corps of Engineers (USACE) (2008) Compensatory Mitigation Rule Timeline for Bank or ILF Instrument Approval. http://water.epa.gov/lawsregs/guidance/wetlands/upload/IRT_Timeline_v5.pdf accessed 22/06/2011

Faith D., Walker P. (1996) How do indicator groups provide information about the relative biodiversity of different sets of areas? On Hotspots, Complementarity and Pattern-based Approaches. *Biodiversity letters* 3(1) 18 0 25

Faith D., Walker P. (1996a) Environmental Diversity: on the best-possible use of surrogate data for assessing the relative biodiversity of sets of areas. *Biodiversity Conservation* 5 399-415

Falcon, A (2008) "Aristotle on Causality", *The Stanford Encyclopedia of Philosophy* (Fall Edition) *(eds)* Zalta E. N.

Farrell A., Morgan M. (2003) Multilateral Emission Trading: Heterogeneity in Domestic and International Common-Pool Resource Management *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

Federal Guidance on the Use of the TEA-21 Preference for Mitigation Banking to fulfill Mitigation Requirements under Section 404 of the Clean Water Act, July 2003. Federal Highway Administration, USEPA, US Army Director of Civil Works.

Feeny, D., Berkes, E, McCay, B., and Acheson, J. M. (1990). The tragedy of the commons: Twenty-two years later. *Human Ecology* 18(1): 1-19.

Fisher D, Freudenburg W (2001) Ecological Modernization and Its Critics: Assessing the Past and Looking Towards the Future.

Fisk M (2000) Part 1 Chapter 2: Surviving with Dignity in a Global Economy: The Battle for Public Goods. P. 41 - 68 *IN* Anton A, Fisk M, Holstrom N *Eds.* (2000) Not for Sale: In Defence of Public Goods. Westview Press, Boulder-Colorado.

Fleischer and Fox (2008) Chapter 4: The Pitfalls and Challenges. *In*: Conservation and Biodiversity Banking. *Ed:* Carroll N., Fox J., Bayon R. *Earthscan*. London, Sterling.

Fleishman E., Noss R., Noon B (2006) Utility and limitations of species richness metrics for conservation planning *Ecological Indicators* 6 543-553

Fortin M-J., Agrawal A. (2005) Landscape Ecology Comes of Age *Ecology* 86 (8) 1965 - 1966

Foxall J, Grigg A, ten Kate K (2005) Protecting shareholder and natural value: 2005 benchmark of biodiversity management practices in the extractive industry. *Insight Investment and Fauna and Flora International*

Freitag S., Jaarsveld A., Biggs H. (1997) Ranking priority Biodiversity Areas: an iterative conservation value-based approach *Biological Conservation* 82 263 - 272

Froude V. (1999) **Landowners, Resource Management Act District Plans and Biodiversity Protection: What is happening?** *In* Biodiversity Now! Joint societies conference, Wellington 29 June - 3 July 1997 Selected Papers. *(eds)* Blaschke P., Green K. Department of Conservation, Wellington. 53 - 61

Fudge C, Rowe J (2001) **Ecological modernization as a framework for sustainable development: a case study in Sweden**. *Environment and Planning A* 33 1527 - 1546

Gadgil M and Rao S. P. R. (1995) **Chapter 5: Developing Incentives to Conserve India's Biodiversity**. *In* Property rights in a social and ecological context: case studies and design application *Eds*. Hanna S., Munasinghe M. Published by World Bank.

Gardner R., Radwan T., (2005) **What happens when a Wetland Mitigation Bank goes Bankrupt?** Environmental Law Reports: News and Analysis. 35 10590 - 10604

Garnett S., Crowley G., Stattersfeild A. (2003) **Changes in the conservation status of Australian birds resulting from differences in taxonomy, knowledge and the definitions of threat.** *Biological Conservation* 113 269 - 276

Gemmell N. (2001) **Book review: Priorities for the Conservation of Mammalian Diversity. Has the Panda Had its Day?** *Biology and conservation* 10 1605 - 1607

Geneletti D. (2003) **Biodiversity Impact Assessment of Roads: an approach based on ecosystem rarity** *Environmental Impact Assessment Review* 23 343 - 365

Geores M. (2003) **The relationship between resource definition and scale** *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

Gibbons P., Briggs S., Ayers D., Sedon J., Doyle S., Cosier P., McElhinny C., Pelly V., Roberts K. (2009) **An operational method to assess impacts of land clearing on terrestrial biodiversity**. *Ecological Indicators* 9 26 - 40

Gilpin A. (2000) **Environmental Economics: a critical overview** John Wiley and Sons Ltd. Chichester

Ginn W. (2005) **Investing in Nature**. Island Press. Washington, Covelo, London.

Gippoliti S., Amori G. (2007) **The Problem of subspecies and biased taxonomy in conservation lists: the case of mammals.** *Folia Zoologica* 56(2) 113 - 117

Godal O., Klaassen G. (2006) **Carbon trading across sources and periods constrained by the Marrakesh Accords** *Journal of Environmental Economics and Management* 51 308 - 322

Goldman R., Tallis H., Kareiva P., Daily G. (2008) **Field evidence that ecosystem service projects support biodiversity and diversify options.** *Proceedings of the National Academy of Science (PNAS)* 105(27) 9445-9448

Goldman-Carton J., McCallie G., (1996) **An Environmentalists Perspective - Time for a reality check.** *In* Chapter Five: Point/counterpoint: Two perspectives on mitigation banking. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Gorrod E., Keith D. (2008) **Observer variation in field assessments of vegetation condition: Implications for biodiversity conservation.** ***From*** **Evaluation vegetation condition measures for cost-effective biodiversity investment planning; ACERA Project No. 0706, Lawson K.** ***Australia Center of Excellence for Risk Analysis***

Gotelli N., Colwell R. (2001) **Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness.** *Ecology Letters* 4 379 - 391

Grantham H., Pressey R., Wells J., Beattie A (2010) **Effectiveness of Biodiversity Surrogates for Conservation Planning: Different Measures of Effectiveness Generate a Kaleidoscope of Variation** *PLoS (Public Library of Science) ONE* 5(7) e11430

Grundy, K. J., Gleeson B. J. (1996) **Sustainable Management and the Market - the politics of planning reform in New Zealand** Land Use Policy 13 (3) 197 - 211

Gunderson L. (2000) **Ecological Resilience - In theory and Application**. *Annual Review of Ecology and Systematics* 31 425 - 439

Gunningham N., Young. (1997) **Towards Optimal Environmental Policy: The Case of Biodiversity Conservation** *Ecology Law Quarterly* 24: 243-298

Haeuber R. (1996) **Setting the Environmental Policy agenda: the Case of Ecosystem Management** *Natural Resources Journal* 36(1) 1 -28

Hallwood P, (2007) **Contractual difficulties in environmental management: the case of wetland mitigation banking**. *Ecological Economics* (63) 446 – 451

Hammond-Deakin, N. (2009) **BioBanking: Overview and Case Study**. New South Wales Sustainable Development Conference 2009 1 - 15

Hammon-Deakin, N. (2009a) **Biobanking in New South Wales - Stalemate between landowners and developers?** *Impact! A National Journal of Environmental Law* 88 26 - 29

Harding R. (2006) **Ecologically sustainable development: origins, implementation and challenges** *Desalination* 187 229-239

Hartig F., Drechsler M. (2009) **Smart Spatial incentives for market-based conservation** *Biological Conservation* 142 779-788

Hass P., Jasanoff S., Rochlin G. (2003) **Series Forward** *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

Heal G (2000) **Nature and the Marketplace**. Island Press, Washington.

Hickie S (2010) **Design Options for Tradable Rights in Ecosystem Service Markets.** Department of Environment and Climate Change, Sydney, NSW.

Hilderbrand R., Watts A., Randle A. (2005) The myths of restoration ecology. *Ecology and Society* 10(1) 19

Hillman M., Instone L., (2010) **Legislating nature for biodiversity offsets in New South Wales, Australia.** *Social and Cultural Geography* 11(5) 411 - 431

Hinchey L, Hogg A (2009) **Environmental compensation under the RMA: An appropriate tool to "avoid, remedy or mitigate" adverse effects on the environment?** Resource Management Bulletin 45 -48

Hitchmough R., Bull L., Cormarty P. (*Compilers)*(2005) **New Zealand Threat Classification System Lists**. *Science and Technical Publishing, Department of Conservation*, Wellington New Zealand p. 1 - 134

Hobbs R., Morton S. (1999) **Moving from descriptive to predictive ecology** *Agroforestry Systems* 45 43-55

Holstrom N (2000) **Part 1, Chapter 3: Rationality, Solidarity and Public Goods.** P. 69 - 88 *IN* Anton A, Fisk M, Holstrom N *Eds.* (2000) Not for Sale: In Defence of Public Goods. Westview Press, Boulder-Colorado.

Hooper D., Chapin F., Ewel J., Hector A., Incausti P., Lavorel S., Lawton J., Lodge D., Loreau M., Naeem S., Schmid, Setala H., Symstyad A., Vandermeer J., Wardle D (2005) **ESA Report: Effects of biodiversity on ecosystem functioning: a consensus of current knowledge** *Ecological Monographs* 75(1) 3 - 35

Housman R (1992) **A Kantian Approach to trade and the environment**. *Washington and Lee Law Review* 49 1373 - 1388

Jackson T., Dickson J. (2007) **The New Zealand Resource Management Act: an exercise in delivering sustainable development through an ecological modernization agenda**. *Environment and Planning B: Planning and Design.* 34 107 - 120

Jenkins M., Kapos V., Cox N., Jakubowska J., Morton A., Groombridge B. (2000) **Living Planet Report**. *(eds)* Loh, K. *World Wide Fund For Nature*, London.

Johansson-Stenman O. (1998) **The importance of Ethics in Environmental Economics with a Focus on Existence Values**. *Environmental and Resource Economics* 11(3-4) 429 - 442

Jorgensen B., Jamieson R., Martin J. (2010) **Income, sense of community and subjective well-being: combining economic and psychological variables.** *Journal of Economic Psychology.* In Press.

Keith (1998) **An Evaluation and Modification of World Conservation Union Red List Criteria for Classification of Extinction Risk in Vascular Plants** *Conservation Biology* 12(5) 1076 - 1090

Ki-Moon B. (2010) **Ecosystem Services Our Natural Capital; Allowing Their Decline Is 'Like Throwing Money Out the Window', Secretary-General Tells High-level Biodiversity Event.** *Secretary-General United Nations* SG/SM/13127; GA/10994; ENV/DEV/1160 United Nations, New York, NY.

Kiesecker J., Copeland H., Pocewicz A., McKenney B. (2009) **Development by design: blending landscape-level planning with the mitigation hierarchy.** Frontiers in Ecology and the Environment. The Ecological Society of America (doi: 10.1890/090005)

Knight J., (2005) Forward. *In* **Protecting shareholder and natural value: 2005 benchmark of biodiversity management practices in the extractive industry.** Foxall J, Grigg A, ten Kate, K. (2005) *Insight Investment and Fauna and Flora International*

Kraan D., in't Veld R. (*eds)* (1991) **Environmental protection: public or private choice**. Kluwer Academic, Boston, USA.

Lambeck R (1997) **Focal Species: a Multi-Species Umbrella for Nature Conservation** *Conservation Biology* 11(4) 849-856

Lamoreux J., Akcakaya R., Bennun L., Collar N., Boitani L., Brakett D., Brautigam A., Brooks T., da Fonseca G., Mittermeir R., Rylands A., Gardenfors U., Hilton-Taylor., Mace G., Stein B., Stuart S. (2003) **Value of the IUCN Red List** *Trends in Ecology and Evolution: Letters* 18(5) 214 - 215

Laurance W., Lovejoy T., Vasconcelos H., Bruna E., Didhman R., Stouffer P., Gascon C., Bierregaard R., Laurance S., Sampaio E. (2002) **Ecosystem Decay of Amazonian Forest Fragments: a 22-year Investigation**. *Conservation Biology* 16(3) 605 - 618

Lawhead D (1997) **Bucks in the Bank…Land bank that is**. Outdoor California. July-August issue. P. 4 - 8

Lawton J., (2007) **Ecology, politics and policy**. *Journal of Applied Ecology* **44**, 465–474

Lee, K (2001) **Sustainability, concept and practice of** *Encyclopaedia of Biodiversity* 5 553 - 567

Lehmann S. (1995) **Privatising public lands**. Oxford University Press, New York.

Light A (2000) **Part 3, Chapter 10: Public Goods, Future Generations and Environmental Quality**. P. 209 - 226 *IN* Anton A, Fisk M, Holstrom N *Eds.* (2000) Not for Sale: In Defence of Public Goods. Westview Press, Boulder-Colorado.

Ling A, Waghorn J., Forrest S., Lanstone M., Fletcher M., Manley R., Mallin-Jones P., Vigna M. (2004) **Global Energy: Introducing the Goldman Sacs Energy Environmental and Social Index**. *Goldman Sachs Global Investment Research* 24th February

Lipper D., Sagehorn E. (2007) **Credit where Credit is due**. Builder/Architect, Sacramento Edition. 13(9) *no page numbers*

Lister N. (1997) **A systems approach to biodiversity conservation planning.** *Environmental Monitoring and Assessment* 49 123 - 155

Lloyd B (2007) **The Commons revisited: The tragedy continues**. *Energy Policy* 35 (2007) 5806–5818

Lucht M (2007) **Does Kant have anything to teach us about environmental ethics?** American Journal of Economics and Sociology 66(1) 127 - 149

Mace G., Lande R. (1991) **Assessing Extinction Threats: Towards a re-evaluation of IUCN Threatened Species Categories** *Conservation Biology* 5(2) 148 - 157

Mack J., Micacchion M., (2006) **An ecological assessment of Ohio mitigation banks vegetation, amphibians, hydrology and soil.** Ohio EPA Technical Report WET/2006-1. Ohio Environmental Protection Agency, Division of Surface Water, Wetland Ecology Group, Columbus, Ohio.

Madsen B., Carroll N., Moore Brands K., (2010) **State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide**. Available at: http://www.ecosystemmarketplace.com /documents/acrobate/sdbmr.pdf

Madsen, Becca; Carroll, Nathaniel; Kandy, Daniel; Bennett, Genevieve, 2011. **State of the Biodiversity Markets Report: 2011 Update**. *In Press* Available at: http://www.ecosystemmarketplace.com/xxxx expected 2nd June 2011

Maron M., Dunn P., McAlpine C., Apan A. (2010) **Can offsets really compensate for habitat removal? The case of the endangered red-tailed black-cockatoo**. *Journal of Applied Ecology* 47 348-355

Marsh L., Porter D., Salvesen D (1996) **Introduction and Overview.** *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Marsh L., Porter D., Salvesen D., (1996a) **Conclusion**. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Marsh L., Sokolove R., Rhodes R., (1996) **Chapter Seven: Legal Considerations**. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Marsh L., Young J., (1996) **Chapter Nine: The Practice of Mitigation Banking**. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Martin P., Verbeek M. (2006) **Sustainability Strategy**. *The Federation Press.* Sydney, Australia.

McCarthy, M., Parris K., van der Ree R., McDonnell M., Burgman M., Williams N., McLean N., Harper M., Mayer R., Hahs A., Coastes T. (2004) **The Habitat Hectares approach to Vegetation assessment: An evaluation and suggestions for improvement.** *Ecological Management and Restoration* 5(1) 24 - 27

McCay B. (2003) **Forward** *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

McElfish J., Nicholas S., (1996) **Chapter Two: Structure and Function of Wetland Mitigation Banks**. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

McKenney B., Kiesecker J., (2010) **Policy Development for Biodiversity Offsets: A review of Offset Frameworks.** Environmental Management 45 165-176

MEA (2003) **Millennium Ecosystem Assessment** Ecosystems and Human Well-being. A Framework for Assessment. Island Press. See also http://www.maweb.org/en/index.aspx (accessed 19/06/2011)

Mead D (2008) **Chapter 2: History and Theory**: The Origin and Evolution of Conservation Banking. *In:* Conservation and Biodiversity Banking. *Ed:* Carroll N., Fox J., Bayon R. *Earthscan*. London, Sterling.

Mebratu D. (1998) **Sustainability and sustainable development: Historical and conceptual review** *Environmental Impact Assessment Review* 18 493-520

Memon A, Skelton P (2004) **The Practice of Environmental Compensation Under the Resource Management Act 1991.** New Zealand Journal of Environmental Law 8, p. 177

Meurk C.D., Swaffield S.R. (2000) **A Landscape ecological framework for indigenous regeneration in rural New Zealand-Aotearoa** *Landscape and Urban Planning* 50 129 - 144

Ministry for the Environment (MfE) (2001) **Biodiversity outside public conservation lands: the Government's response.** Ministry for the Environment, Wellington. http://www.mfe.govt.nz/publications/biodiversity/biodiversity-outside-public-lands-response-jan01.html accessed 18/06/2011

Ministry for the Environment (MfE) (2007) **Environment New Zealand 2007**. Introduction. *Ministry for the Environment*, Wellington, New Zealand. P. 1 - 7

Ministry for the Environment (MfE) (2007a) **Chapter 12: Biodiversity** *In* Environment New Zealand 2007. *Ministry for the Environment*, Wellington, New Zealand.

Ministry for the Environment (MfE) (2007b) **Chapter 9: Land** *In:* Environment New Zealand 2007. *Ministry for the Environment*, Wellington, New Zealand.

Miskelly C., Dowding J., Elliott G., Hitchmough R., Powlesland R., Robertson H., Sagar P., Scofield R. P., Taylor G. (2008) **Conservation Status of New Zealand Birds, 2008** *Notornis* 55: 177-135

Moilanen A, van Teeffelen A, Ben-Haim Y, Ferrier S (2008) **How much compensation is Enough? A Framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat.** *Restoration Ecology*. doi: 10.1111/j.1526-100X.2008.00382.x p. 1 – 9

Mol A., Sonnenfeld D (2000) Ecological modernisation around the world: an introduction'' *In* Ecological Modernisation Around the World: Perspectives and Critical Debates (*eds)* Mol A., D Sonnenfeld, D. special edition *Environmental Politics* 9(1) 3

Moore A., Wallington T., Hobbs R., Ehrlich P., Holing C., Levin D., Lindenmayer D., Pahl-Wostl C., Possinghan H., Turner M., Westoby M. (2009) Diversity in Current Ecological Thinking: Implications for Environmental Management. *Environmental Management* 43 17 - 27

Moore J. (2001) Diversity, Taxonomic versus functional *Encyclopaedia of Biodiversity* 2 205 - 215

Moote M., McClaran M., Chickering D. (1997) Theory and Practice: Applying Participatory Democracy Theory to Public Land Planning. *Environmental Management* 21 (6) 877-889

Moran E., Ostrom E., *Eds.*(2005) Seeing the Forest and the Trees: human-environment interactions in forest ecosystems. Massachusetts Institute of Technology, Cambridge MT.

Morris R, Asonso I, Jefferson R, Kirby K (2006) The creation of compensatory habitat – can it secure sustainable development? *Journal for Nature Conservation* (14) 106 – 116

Morris R, Huggett D (2007) Mitigation banking – practical reality or Trojan horse? *Town and Country Planning* 76 (12) 439 - 446

Naeem S. (2002) Ecosystem consequences of biodiversity loss: the evolution of a paradigm

Naumann S., Vorwerk A., Brauer I. (2008) REMEDE Resource Equivalency Methods for Assessing Environmental Damage in the EU. D12: Compensation in the form of Habitat Banking Short-Case Study Report - *DRAFT. European Commission*. See http://www.envliability.eu/docs/D12CaseStudies/D12_REMEDE_Habitat_Banking_Oct%2008.pdf (accessed 19/06/2011)

Nelson R, Sharman B (2007) More than tilting at windmills: A bird's eye view of a bio-offsets scheme under the EPBC Act. *Environmental Planning Law Journal* 24 (17) 17 - 34

Nevel B., Milam J., Arnold G., Harris R (2004) Measuring Mitigation: A Review of the Science for Compulsory Mitigation Performance Standards. *Environmental Law Institute,* Washing D.C.

New South Wales (NSW) Threatened Species Database. Accessed from: www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm, 10th June 2011

New South Wales (NSW) Vegetation Type Database. Accessed from www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm, 10th June 2011

New South Wales (NSW) Vegetation Benchmarks Database. Accessed from: www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm, 10th June 2011

Nicholopoulos J. (1999) The Endangered Species Program *Endangered Species Bulletin* 24(6) 6

Norton D. (2009a) Species Invasions and the Limits to Restoration: Learning from the New Zealand Experience. *Science* 325 569 – 571

Norton D. (2009b) Biodiversity Offsets: Two New Zealand Case Studies and an Assessment Framework. *Environmental Management* 43 698 - 706

O'Brien S., Mayr E. (1991) Bureaucratic Mischief: Recognizing Endangered Species and Subspecies. *Science* 251(4998) 1187 -1188

O'Riordan T., Stoll-Kleemann S. (2002) Chapter 5: Deliberative Democracy and participatory biodiversity. *In* Biodiversity, Sustainability and Human Communities: Protecting beyond the Protected. O'Riordan T., Stoll-Kleemann S. *Eds*. Cambridge University Press, Cambridge

Ostrom E., Gardner R., Walker J (1994) Rules, games and common pool resources. The University of Michigan Press, Michigan.

Ostrom E., Gardner R., Walker J., *(eds) with* Agrawal A., Blomquist W., Schlager E., Tang S Y. (1994) Rules, games and common-pool resources. The University of Michigan Press, USA

Palmer M., Filoso S. (2009) Restoration of Ecosystem Services for Environmental Markets. *Science* 325 (1st July) 575 - 576

Parkes D., Newell G., Cheal D. (2003) Assessing the quality of native vegetation: The 'Habitat Hectares' approach. *Ecological Management and Restoration* 4 (S2) S29 - S38

Parkhurst G., Shogren J., Bastian C., Kivi P., Donner J., Smith R. (2002) **Agglomeration bonus: an incentive mechanism to reunite fragmented habitat for biodiversity conservation**. *Ecological Economics* 41 305 - 328

Parliamentary Commissioner for the Environment (PCoE) (2010) **Making difficult decisions: mining the conservation estate** *Office of the Parliamentary Commissioner for the Environment* 1 -37 www.pce.parliment.nz

Parliamentary Commissioner for the Environment (PCoE) (2010b) **How clean is New Zealand. Measuring and reporting on the health of our environment.** Office of the Parliamentary Commissioner for the Environment, Wellington, New Zealand. 1 - 48

Parma A., National Centre for Ecological Analysis and Synthesis (NCEAS) Working Group on Population Management (P. Amarasekare, M. Mangel, J. Moore, W.W. Murdoch, E. Noonburg, M.A., Pascual, H.P. Possingham, K. Shea, C. Wilcox, and D. Yu.) (1998) **What can Adaptive Management do for Our Fish, Forests, Food and Biodiversity?** *Integrative Biology: Articles* (XX) 16 - 26

Possingham H., Andelman S., Burgman M., Medellin R., Master L., Keith D. (2002) **Limits to the use of Threatened Species Lists** *Trends in Ecology and Evolution* 17(11) 503 – 507

Possingham H., Gibbons P., Parkes D. (2007) Peer review of the May 2007 Draft of the BioBanking Assessment Methodology. *Department of Environment and Climate Change NSW*

Pretty J., (2003) **Social Capital and the Collective Management of Resources.** *Science* 302 (5652) p. 1912 - 1914

Pricewaterhouse Cooper (PWC)(2010) **Biodiversity offsets and the mitigation hierarchy: a review of current application in the banking sector.** PricewaterhouseCoopers LLP, London.

Redclift M. (1992) **The Meaning of Sustainable Development** *Geoforum* 23(3) 395 - 403

Redmond A., Bates T., Bernadino F., Rhodes R., (1996) Chapter 4: **State Mitigation Programs: The Florida Experience**. *In* Mitigation Banking: Theory and Practice. *Eds* Marsh L., Porter D, Salvesen D. Island Press, Washington

Robertson M (2004) **The Neoliberalization of ecosystem services: wetland mitigation banking and problems in environmental governance**. *Geoforum* 35 361-373

Robertson M and Hayden N (2008) **Evaluation of a Market in Wetland Credits: Entrepreneurial Wetland Banking in Chicago**. *Conservation Biology*, Volume 22, No. 3, 636–646

Rodgers J. (1996) **Chapter 8: Wetland Mitigation Banking and Watershed Planning**. *In* Mitigation Banking: Theory and Practice. *Eds* Marsh L., Porter D, Salvesen D. Island Press, Washington

Roemer G., Wayne R. (2003) **Conservation in Conflict: the Tale of Two Endangered Species.** *Conservation Biology* 17(5) 1251-1260

Rubinoff D. (2001) **Evaluating the California Gnatcatcher as an Umbrella Species for Conservation of Southern California Coastal Sage Scrub.** *Conservation Biology* 15(5) 1374 - 1383

Saeed K (2004) **Designing an Environmental Mitigation Banking Institution for Linking the Size of Economic Activity to Environmental Capacity.** *Journal of Economic Issues* 38(4) 909 - 938

Sagoff M (2004) **Price, Principle and the Environment**. Cambridge University Press, New York

Sala O., Chapin III F., Armesto J., Berlow E., Bloomfield J., Dirzo R., Huber-Sanwald E., Huenneke L., Jackson R. Kinzig A., Leemans R., Lodge D., Mooney H., Oesterheld M., Poff N., Sykes M., Walker B., Walker M., Wall D. (2010) **Global biodiversity Scenarios for the year 2100**. *Science* (287) 1170 - 1174

Samways M., Bazelet C., Pryke J. (2010) **Provision of ecosystem services by large-scale corridors and ecological networks**. *Biodiversity Conservation* 19 2949 - 2962

Shabman L., Scodari P., King D., (1996) **Chapter Six: Wetland Mitigation Markets**. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington

Shepheard M., Martin P. (2009) **The multiple meanings and practical problems with making a duty of care work for stewardship in agriculture.** *Macquarie Journal of International and Comparative Environmental Law* 6 191 - 215

Shields J (2008) Chapter 14: Australia's Biodiversity Credits. *In*: Conservation and Biodiversity Banking. *Ed:* Carroll N., Fox J., Bayon R. *Earthscan*. London, Sterling.
Slootweg R., Kolhoff A. (2003) A generic approach to integrate biodiversity considerations in screening and scoping for EIA *Environmental Impact Assessment Review* 23 657- 681
Smith J. (undated) The Precautionary Principle and the Public Interest. Environmental Defender's Office (NSW)
Smith J. (undated (a)) Draft Paper on Property Rights and Compensation. Environmental Defender's Office (NSW)
Spieles D. (2005) Vegetation development in created, restored, and enhanced mitigation wetland banks of the United States. *Wetlands* 25(1) p51-63
Spieles D., Coneybeer M., Horn J. (2006) Community structure and quality after 10 years in two central Ohio mitigation bank wetlands. *Environmental Management* 38 837-852
Statistics New Zealand (2009) Measuring New Zealand's progress using a sustainable development approach: 2008. *Statistics New Zealand,* Wellington, New Zealand p.1 - 170
Stephens T. (1999) Measuring conservation achievement. *In* Biodiversity Now! Joint societies conference, Wellington 29 June - 3 July 1997 Selected Papers. (*eds)* Blaschke P., Green K. Department of Conservation, Wellington. 13 - 41
Studt, Sokolove (1996) Chapter Three: Federal Wetland Mitigation Policies. *In* Mitigation Banking: Theory and Practice. *(eds)* Marsh L., Porter D, Salvesen D. Island Press, Washington
Suding K., Gross K., Houseman G. (2004) Alternative states and positive feedbacks in restoration ecology. TRENDS in Ecology and Evolution 19(1) 46 – 53
Suding K., Hobbs R. (2008) Chapter 1: Models for Ecosystem Dynamics as Frameworks for Restoration Ecology. *In* New Models for Ecosystem Dynamics and Restoration. *Eds.* Hobbs R., Suding K. Island Press, Washington.
Sugden A., Ash C., Hanson B., Smith J. (2003) Where do we go from here? *Science* 302 12 December, p 1906.
Sukhdev P., (2010) Forward *In* The Economics of Ecosystems and Biodiversity Report for Business - Executive Summary (TEEB) Bishop et al., (2010) TEEB Web www.tebweb.org (accessed 21st Feb 2010)
Suvantola L. (2009) Regulatory Concerns Regarding the NSW BioBanking Scheme *The Australasian Journal of Natural Resources Law and Policy* 13 (1) 113 - 135
Ten Kate, K. (2003) Biodiversity offsets: mileage, methods and (maybe) markets. *Insight Investments Management Limited*, London.
Ten Kate, K. (2003a) Consultation document to accompany Insight's presentation to the World Parks Congress, 13 September 2003. Biodiversity: towards best practice for extractive and utility companies. Issued by *Insight Investment Management Limited*, London.
Ten Kate, K. (2009) Can Biodiversity Offsets and Conservation Banking Help the British Countryside? http://www.futurecountryside.com/articles.php/resourcesandregulations/20/can-biodiversity-offsets-and-conservation-banking-help-the-british-countryside - comments
Ten Kate K., Bishop J., Bayon R. (2004) Biodiversity offsets: Views, experience and the business case. IUCN, Gland, Switzerland and Cambridge, UK and Insight Investment, London, UK.
Teresa S (2008) Chapter 9: Financial Considerations. *In:* Conservation and Biodiversity Banking. *Ed:* Carroll N., Fox J., Bayon R. *Earthscan*. London, Sterling.
Tietenberg T., (2003) Chapter 6: The Tradable Permits Approach to Protecting the Commons: What have we learned? *In* Drama of the Commons (*eds)* Ostrom E., Dietz E., Dolšak N., Stern P., Stonich S., Weber E. (2002) National Academy Press, Washington, DC.
Todd C., Burgman M. (1998) Assessment of Threat and Conservation Priorities under Realistic Levels of Uncertainty and Reliability *Conservation Biology* 12 (5) 966 - 974
Toyon Environmental Consultants Inc. (undated) Conservation Banking - A technical report. California Department of Fish and Game, California Wildlife Foundation.

Tucker C.M., Ostrom E., (2005) Chapter 4: **Multidisciplinary Research Relating Institutions and Forestry Transformations**. *In* Seeing the Forest and the Trees: human-environment interactions in forest ecosystems. (*eds)* Moran E., Ostrom E. Massachusetts Institute of Technology, Cambridge MT.

Turner R (2005) **On the Cusp of Restoration: Science and Society.** *Restoration Ecology* 13 (1) 165 – 173

Turner, R.E., Redmond, A.M., Zedler, J.B. (2001) Count it by acre or function: mitigation adds up to net loss of wetlands. *National Wetlands Newsletter* 23(6) 5–6.

U. S. Fish and Wildlife Service (USFWS) (2009) **Conservation Banking: Incentives for Stewardship.** USFWS http://www.fws.gov/endangered/. Accessed 16.04.2010

United States Department of the Interior, U.S. Fish and Wildlife Service (1973) **Endangered Species Act of 1973. As amended through the 108th Congress**. Washington, D.C.

United States Environmental Protection Agency (EPA) (2010) **Mitigation Banking Factsheet**. United States Environmental Protection Agency http://www.epa.gov/owow/wetlands/facts/fact16.html Accessed 16.04.2010

United States Environmental Protection Agency (*undated*) **Compensatory Mitigation for Losses of Aquatic Resources**, 40 CFR Part 230 Subpart J and 33 CFR Part 332.

United States Fish and Wildlife Service (USFWS) (1983) **Endangered and Threatened Species Listing and Recovery Priority Guidelines** Federal Registry48 (184) Notices United States Fish and Wildlife Service. 43098 - 43105

US Army Corps of Engineers Alexandria, Virginia 22315 (2006) **National Wetland Mitigation Banking Study: Model Banking Instrument**. IWR Technical Paper WMB-TP-1. *Institute for Water Resources Support Centre, US Army Corps of Engineers Alexandria, Virginia 22315*

US Fish and Wildlife Service (2004) **ESA Basics: 30 Years of Protecting Endangered Species.** http://www.fws.gov/endangered/esa-library/pdf/ESA_basics.pdf

van Geel P., (2005) Forward. *In* **Protecting shareholder and natural value: 2005 benchmark of biodiversity management practices in the extractive industry.** Foxall J, Grigg A, ten Kate K (2005) *Insight Investment and Fauna and Flora International*

Van Patten M. (2009) **Building the Ecosystem Marketplace** http://www.ecosystemmarketplace.com/pages/dynamic/article.page.php?page_id=6914&section=news_articles&eod=1 Downloaded 9.03.10 *Ecosystem Marketplace.*

Vie, J-C., McNeely J., Stuart S., Smart J. (2009) **In defence of the Red List** *New Scientist* 202(2702) 20 – 21

Vorhies F., (2001) **Biodiversity - What Are We Talking About?** Earthmind Blog. Forbes. http://blogs.forbes.com/francisvorhies/2011/06/17/biodiversity-what-are-we-talking-about/?utm_medium=twitter&utm_source=twitterfeed accessed 22/06/2011

Walker S, Brower A, Clarkson B, Lee W, Myers S, Shaw W and Stephens T (2008) **Halting indigenous biodiversity decline: ambiguity, equity and outcomes in RMA assessment of significance.** New Zealand Journal of Ecology 32 (2) 225 - 237

Walker S., Brower A., Clarkson B., Lee WI., Myers S., Shawo W., Stephens T (2008) **Halting indigenous biodiversity decline: ambiguity, equity, and outcomes in RMA assessment of significance.** *New Zealand Journal of Ecology* 32(2) 225 - 237

Walker S., Brower A., Stephens T., Lee William., (2009) **Why bartering biodiversity fail**s. *Conservation Letters* **2** 149-157

Walker S., Price., R., Stephens T (2008) **An Index of Risk as a Measure of Biodiversity Conservation Achieved through Land Reform**. *Conservation Biology* 22(1) 48 - 59

Wallington T., Hobbs R., Moore S. (2005) **Implications of Current Ecological Thinking for Biodiversity Conservation: A review of the Salient Issues.** *Ecology and Society* 10(1) art 15

Walsh M. (1999) **Maximising financial support for biodiversity in the emerging Kyoto protocol markets** *The Science of the total environment* 240 145 - 156

Watts K., Handley P. (2010) **Developing a functional connectivity indicator to detect change in fragmented landscapes** *Ecological Indicators* 10 552 - 557

Wilkinson J., Thomas R., Thompson J. (2006) **The Status and Character of In-Lieu Fee Mitigation in the United States**. Environmental Law Institute. Washington DC

Wilkinson J., Thompson J. (2006) **2005 Status Report on Compensatory Mitigation in the United States.** Environmental Law Institute. Washington D.C.

Wilson J (2002) **Chapter 10: Scientific Uncertainty, complex systems and the design of common pool institutions**. *In:* National Research Council (2002) Drama of the Commons. Committee on the Human Dimension of Global Change, Ostrom E., Dietz T., Dolsak N., Stern P., Stovich S., Weber E.D *Eds*. Division of Behavioral and Social Sciences and Education. National Academy Press Washington

Wilson K. A., Underwood E., Morrison S., Klausmeyer K., Murdoch W., Reyers B., Wardell-Johnson G., Marquet P., Rundel P., McBride M., Pressey R., Bode M., Hoekstra J., Andelman S., Looker M., Rondinini C., Karevia P., Shaw R., Possingham H. (2007) **Conserving Biodiversity Efficiently: What to Do, Where and When** *PLoS Biology* 5(9) 1850 - 1861

Wissel S., Watzold F. (2010) **A Conceptual Analysis of the Application of Tradable Permits to Biodiversity Conservation**. *Conservation Biology* 24 (2) 404-411

Yandle T., Deweese C. (2003) **Privatizing the commons…Twelve years later: Fishers' experience with New Zealand's market-based fisheries management**. *In* The Commons in the New Millennium. Dolsak N., Ostrom E. *Eds.* The MIT Press, Massachusetts.

Yang X., Wilkes A., Yang Y., Xu J., Geslani C., Yanf X., Gao F., Yang J., Robinson B (2009) **Common and Privatized: Conditions for wise management of Matsutake Mushrooms in Nortwest Yunnan Province, China**. *Ecology and Science* 14 (2) 30 - 51

Young M., Gunninghamm N., Elix J., Lambert J., Howard B., Grabosky P., McCrone E. (1996) **Reimbursing the future: an evaluation of motivational, voluntary, price-based, property-right, and regulatory incentives for the conservation of biodiversity. Biodiversity Series, Paper No. 9**. CSIRO Division of Wildlife and Ecology, the Australian Centre for Environmental Law, and Community Solutions Biodiversity Unit, Department of the Environment, Sport and Territories. Canberra, ACT.

Zhang Q., Zhang D. (2007) **Consequences of individual species loss in biodiversity experiments: an essentiality index** *ACTA Oecologica* 32 236-242

Zylicz T (undated) **Chapter 6: Will new property rights regimes in Central and Eastern Europe serve the purposes of nature conservation?** 63 - 72 *IN* Property Rights in a Social and Economic Context *Eds* Hanna S, Munasinghe M (1995) World Bank

Glossary

As offsetting and related industries have developed so diversely and simultaneously around the world, giving rise to a wide volume of terms used. Terms variously take on different meanings in different jurisdictions and many terms frequently refer to the same concept. As a result it is frequently confusing discussing issues across and between regions. Terms are defined bellow in the context of this thesis, drawing from definitions in use elsewhere; not intended to represent a consensus for broader application but rather a guide to the contents of this thesis. A number of more general terms are also included here, as establishing common definitions is instrumental to effective discussions and outcomes.

Words in *italics* are defined elsewhere in the **GLOSSARY**

Additionality - Where a given set of conservation actions occur over and above existing *conservation* (or *preservation*) previously occurring or planned to occur. This principle is applied to ensure that the *conservation actions* that are being attributed to *offset banking* and *credit trading* are having 'additional' effect i.e. they are increasing the overall level of *conservation* occurring as compared to a the status quo, or the situation in the absence of the banking operation, rather than replacing existing *conservation.*

Amelioration: various actions that may be taken with the intent to minimise damage, or improve biodiversity outcomes. Used in a similar manner to minimisation, mitigation or remedy.
Associated terms include: tradable emissions permits, tradable emissions quotas, tradable development rights (Drechsler and Watzold 2010).

Authority: Government (at Federal, National, State, Regional or Local level) with the responsibility, as given under the legislation that establishes and regulates an *offset banking* system, to administer the scheme and ensure the schemes' rules are adhered to and outcomes are achieved.

Avoid: "measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of *biodiversity*. This results in a change to a 'business as usual' approach[113]."

Bank[114] - An entity that creates values recognised through issuing *offset banking credits* to the *bank*, subsequently sold to another party. The term *bank* reflects the analogy to a traditional,

---

[113] BBOP OIH (2009d)

[114] Also Note: Crowe and ten Kate (2010) p. 28 of 41 "An aggregated offset is similar to a conservation bank except that the offset demand or requirement is known in advance and the aggregated offset can be specifically designed to

financial institution commonly called a 'bank' through which money and other units of exchange are held and traded. It may also be used to refer to a specific parcel of land for which offset banking credits are issued in relation to (see *offset*).

Bank Sponsor - see *Banker* above. The term is used in reference to the financial support the *banker* provides for the establishment of the *bank.*

Banker - an individual who conducts conservation work (or commissions such work) in order to have *credits* issued to them, for which they sell on to a third party.

Benchmark: An established point of reference (represented by specific measurement values, conditions or other qualifiers and quantifiers), against which differences across time and space may be compared and expressed. Commonly, a specific *habitat* or *ecosystem*, (potentially also a feature or component of a *habitat* or *ecosystem*) as described by specific conditions or parameters may be used as a benchmark to which other ecosystems, habitats, features or components are compared[115].

BioBank A *bank* to which *credits* have been issued pertaining to a definition of biodiversity as established under enabling legislation and may be sold to satisfy ' *biodiversity* conservation' requirements defined under specific legislation. This thesis uses this term to specifically refer to a *bank* within the New South Wales Biobanking Scheme (see Chapter 3)

Biobanker - See *banker* above.

Biobanking Credit - a *credit* as described above, which directly represents *species* or *ecosystems credits* as issued within the New South Wales *Biobanking* Scheme.

Biodiversity Credit - a *credit* as described above, which directly represents *biodiversity* values

---

compensate for a particular set of biodiversity impacts… draws together the offset requirements of a number of projects where the biodiversity losses are known and supplies the required credits from a large single site or series of connected sites… Over-the-counter schemes are similar to conservation banks but are designed to supply small offsets where it is particularly important to minimise transaction costs [often government operated]."

[115] BBOP (2009e) provide the following description:
"A benchmark can be used to provide a reference point against which losses of biodiversity due to a project and gains through an offset can be quantified and compared consistently and transparently. It usually comprises a number of representative and characteristic 'attributes' used to represent the type, amount and quality of biodiversity which will be lost / gained. Comparing the observed level (or 'score') of each benchmark attribute at the impact site (before and as predicted after the impact) against the level at the benchmark can help to quantify the loss of biodiversity to be caused by the project. Similarly, comparing the observed level (or 'score') of each benchmark attribute at the offset site (before the offset and as predicted after the offset intervention) against the level at the benchmark can help to quantify the gain in biodiversity caused by the offset. A benchmark can be based on an area of land that provides a representative example, in a good condition, of the type of biodiversity that will be affected by the proposed development project. A synthetic benchmark can also be used if no relatively undisturbed areas still remain."

Biodiversity resources - Aspects of *biodiversity* from which goods and services are produced that are directly important valuable to humans.

Biodiversity: The variation in biology at all organisational levels, at a given location. It includes diversity in genetics, species traits, form and function; habitat diversity, in species, structure, age, and biology; diversity in *ecosystem process* and function, and concepts of variety, distinctiveness and abundance. The Convention on Biological Diversity (1992) refers to "…the variability among living organisms from all sources including, *inter alia,* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems" Article two, p. 146. The New Zealand Biodiversity Strategy (2000) adopts this definition, and also recognises the distinction of genetic diversity, species diversity and ecological (ecosystem) diversity.

Bioprospecting: The exploration of *biodiversity* for genetic and bio- chemical resources of social or commercial value.

Compensation[116]**:** Often used in place of the term *mitigation*, in the context that *offsetting* is achieving *compensation*. Both *compensation* and **mitigation** may be taken to mean the process of addressing the negative environmental impacts (through offsetting or other actions) of a project so that the final outcome has minimal enduring effects of the overall condition of the environment, or specific aspects of the environment; measures which aim to reduce impacts to the point where they have no adverse effects. In some settings *compensation* may refer to a far broader collection of environment and *conservation* related activities (such as capacity building, research, education, financial payments etc.) outside of those considered within the scope of direct offsetting. In the United States the term *compensation* is used to refer to efforts (of which conservation banking is one) occurring to achieve the objectives of the *ESA* when development projects negatively impact endangered species. *Compensation* is distinguished from *mitigation* where mitigation is used to refer to the *Mitigation Banking* process and wetland impacts under the *CWA*. Is also considered the 'European' term for *mitigation*, where *mitigation* is the collection of activities of the *mitigation hierarchy* such as avoid, minimise (and/or other terms), that precede any offset and that this offset (of the residual impacts only) would be considered *compensation.*

Conservation Actions: Activities conducted with the intention of *conserving biodiversity*, most commonly referring to one or a combination of *preservation*, *restoration, creation, enhancement,*

[116] For further clarification of the distinction between compensation and mitigation see Appendix Five: Table A5 Distinction of terms relating to compensation and mitigation, by geographic region. Taken from eftec, IEEP et al., 2010 Glossary of terms.

rehabilitation, remediation, establishment or re-creation to achieve the active, planned maintenance and management of natural resources and the environment, in order to secure their long-term survival.

Conservation Bank - A *bank* to which *credits* have been issued that may be sold to satisfy 'conservation' requirements defined under specific legislation.

Conservation Credit - a *credit* as described above, which directly represents *conservation*, or *conservation actions*.

Creation: See *establishment* bellow

Credit -an item of exchange in a trading system, issued in recognition of an increase in value, quantity or quality of some commodity or resource. C.f. **debit,** which recognises a reduction in some value such as may occur when a development removes or degrades an environmental resource such as biodiversity.

Credit-trading system - a system where *credits* are issued to individuals, and subsequently bought, sold or retained by the owner. A *credit* may reflect (depending on design) recognised increase in something, such as the amount or condition of a resource (c.f. a permit, which pertains to an action or inaction being permitted).

Ecological Economics: "The union of economics and ecology, with the economy conceived as a subsystem of the earth ecosystem that is sustained by a metabolic flow or throughout from a back to the larger system[117]". Recognises that market allocation is only one possible allocation process.

Ecological Lift - an increase in the value of the *ecosystem* through increased functioning, area, protection, provision of environmental services or other metrics.

Economics - For a glossary of terms used in relation to economic theory in this thesis see *Glossary* Daly and Farley 2004.

Ecosystem - a dynamic, interacting network of biotic and biotic components of

Ecosystem Credit - a *credit* as described above, which directly represents *ecosystem* values, and may be used in relation to specific *ecosystems* as described in enabling legislation. The term is used in the New South Wales System in relation to a range of specifically defined *ecosystems*, and represents the *conservation* of a range of flora and fauna and other biotic and abiotic conditions.

Ecosystem functions: "Functions or processes carried out or enabled by an *ecosystem* that are necessary for the self-maintenance of that *ecosystem*, such as seed dispersal, primary production, nutrient cycling and pollination… energy capture, production, decomposition, nutrient and

[117] Daly and Farley 2004

energy cycling, dispersal, and pollination… Some ecosystem functions are often also *ecosystem services* because they are directly beneficial to people.[118]"

Ecosystem process: "An intrinsic *ecosystem* characteristic whereby an *ecosystem* maintains its integrity. *Ecosystem* processes include de- composition, production, nutrient cycling, and fluxes of nutrients and energy[119]."

Ecosystem Services - Processes or functions of an *ecosystem* directly benefiting humans due to life-supporting or life-enhancing provisions such as food and water; flood and disease control; spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

Efficiency: A state of being where no other state (be that distribution, price or allocation) would produce more desirable outcomes - i.e. more outcomes or more welfare/benefit to individuals. In an economic sense this is Pareto efficient allocation where no other allocation could make at least one person better off without someone else being made worse off.

Enhancement: *Conservation actions* that intend to reinstate the operation (in quality or quantity) of a specific function or process within an ecosystem, in order to increase the overall environmental condition of an area.

Entrepreneurial Banker/Entrepreneurial Banking: Commercial entity (person, company or corporation) that invests capital and/or resources into offset banking with the intention of making a commercial profit from selling *credits* generated. This may be distinguished from a private land-owner who engaged in offset banking as a way to make a profit from land that is owned and the management required to maintain credits as an alternative to previous or traditional land uses such as agriculture, horticulture or grazing - i.e. from a land uses perspective. Distinction can be made based on the perspective taken: a way of making profit (entrepreneur) vs. a way of managing land (traditional private land-owner).

Environmental Economics: A subset of earlier economics, recognising that welfare depends on ecosystem services, suffers from pollution, but that *efficiency* is still important. It focuses on using previously established economic techniques to assign market values that will allow them to be incorporated into the economic market and therefore allocated *efficiently*.

Environmental Lift - increase in the environmental value of a site or area, which may occur through *ecological lift* or other broader aspects of the environment.

Establishment: The process of manipulating the biotic and abiotic (including, but not limited to, geomorphic and hydrological manipulation) conditions of a location so that an *ecosystem* or

[118] BBOP ODH (2009f)
[119] Ibid

set of *biodiversity* values not previously observed at that location are established from direct anthropogenic inputs.

Habitat: The biotic and abiotic conditions (usually defined on the basis of geology, vegetation, and location) an organism utilises for existence, is normally found, and which individuals or populations of the same species are typically associated. Areas within a habitat occupied by a particular species or community are described as microhabitats.

Habitat Bank: A *bank* to which *credits* have been issued that may be sold to satisfy ' habitat conservation' requirements defined under specific legislation. Conservation actions, monitoring and other aspects of the bank are designed around specific habitat definitions and conservation needs as defined by enabling legislation. *Habitat bank* is a term most commonly associated with European offset banking. Note also use of the term **Habitat Banking** referring to both species and habitats - therefore in context of this study it is analogous to '*conservation banking*' and '*biodiversity banking*".

Habitat Credit: a *credit* as described above, which directly represents *habitat* values, such as a specific *habitat*, or specific characteristics of a *habitat*.

Indicator (Biological): A level of biological organization (species, stand or ecosystem) of which features or elements provide information about other biological aspects that may be difficult to measure directly.

Indicator species: A species whose presence or absence may be used to indicate or support a range of other species. Lambeck (1997) and Noss (1999) proposed a wide variety of potential indicators such as:

– 'Umbrella' Species (area-limited/dispersal-limited/resource-limited/ process-limited): species that require certain resources (large area, specific resources, high-quality processes or conditions) to maintain viable populations and whose requirements for persistence are believed to encapsulate those of an array of associated species because such resource needs are so great i.e. if resources are present for these species, there will also be enough resources for a wide range of other species.

– Flagship species: species that can easily attract public support for conservation so enable the conservation of a range of species in the associated ecosystem (e.g. Giant Panda, *Ailuropoda melanoleuca*; whales).

– Keystone species: species whose strong interactions with other species generate effects that are large relative to their abundance.

Institutions: The rules that guide how people within societies live, work, and interact with each other. Formal institutions are written (or codified) rules. Examples of formal institutions would be a constitution, judiciary laws, an organized market, and property rights. This thesis considers *offset banking* an institution for *conserving biodiversity* and other environmental values.

Market-based instruments (or mechanisms): Mechanisms that create a market for *ecosystem services* in order to improving the *efficiency* in the way the service is used. The term is used for mechanisms (government managed or otherwise) that create new markets by creating incentive structures that put a price on environmental products, but also for responses such as taxes, subsidies, or regulations that affect existing markets[120].

Minimise: designing a project (or any activity or undertaking that is expected to cause negative impacts) in such a way that harm is reduced in terms of duration, intensity or extent, as far as practically feasible.

Mitigation Bank - A *bank* to which *credits* have been issued that may be sold to satisfy 'mitigation' requirements defined under specific legislation.

Mitigation Hierarchy: a principle requiring that to properly offset negative environmental impacts, a sequential process of actions should occur, prior to undertaking *offsetting* and/or *offset banking*, specifically: (i) avoidance of impacts (ii) minimisation of impacts (iii) rehabilitation/restoration measures taken on the ecosystem impacted; and (iv) offset measures to compensate for significant adverse residual impacts. A number of different interpretations of the *mitigation hierarchy* may be observed, for example BBOP; *eftec, IEEP et al., 2010*

No-Net-Loss/Ecological Lift/Environmental Lift/Net Gain: These terms are used to represent goals intended as outcomes from *offsetting* and *credit* trading, where some improvement in the environment occurs, directly as a result of the *offsetting* process. The degree and nature of the improvement may be noted in distinctions between the specific terms used across policy and systems. Note the use of this term in relation to conservation, by Drechsler and Watzold (2010 pg. 2) "Based on the concept of tradable permits, such a system would allow economic development of a formerly conservation area if a permit is submitted to the conservation agency which certifies that an area with previously no conservation value has been transformed back into a conservation area of ecological value equal to the area to be destroyed. There is no requirement that developers establish new habitats themselves, but the permit can be bought from other landowners. This allows a market for tradable development rights to emerge."

Net gain - term used to a desired outcome where after all activities and/or trades have occurred a positive overall benefit is achieved. This is commonly measured as the net *environmental gain*, but the term could be used to refer to a collection of forms of gain possible such as social, economic, or gain to specific components of the environment.

No Net Loss - "A target for a development project in which the impacts on *biodiversity* caused by the project are balanced or outweighed by measures taken to *avoid* and *minimise* the project's impacts, to undertake on-site *restoration* and finally to offset the residual impacts, so that no loss remains[121]".

Offset (Biodiversity, environmental, habitat or other) - a specific *offsetting* project, specifically referring to the location at which *offset activities* occur.

Offset Activities: the set of activities identified to achieve specific outcomes for *biodiversity* or other concerns involved, specific to the context of the development project concerned. They may involve a mixture and broad range of activities. While often used and advocated for awareness campaigns, environmental education, research and capacity building are not normally considered part of the core offset, unless there is evidence of measureable on-the-ground conservation outcomes.

Offset Bank - see *Bank* above. Within this thesis this term refers to a more generalised or unspecified banking system, distinct from banks within specific *mitigation*, *conservation*, wetlands, species, habitats or *biodiversity banking* programs as above. The prefix 'offset' is used to denote the use of the *bank* for the purpose of *offsetting* negative impacts, as above.

Offsetting - a process where negative anthropogenic impacts are in some way reduced in severity, by actions taken after the impact. The term offset may be prefixed by words such as *biodiversity*, environment, species, *habitat*, vegetation, landscape or others to indicate the specific aspects of concern the actions intend to address i.e. a *biodiversity offset* intends to address impacts to *biodiversity*, whereas a species *offset* intends to address impacts to species etc. As a result these terms are used to refer to a wide variety of projects, programs, systems and actions around the world, and so the term is broad and loosely defined to encompass this. Emerging best practice emphasise the use of this term in reference to efforts occurring offsite of the impact and are directed at reducing residual negative impacts (not all negative impact), where residual impacts are those still remaining after following the *mitigation hierarchy*.

Permittee-responsible/location-specific/site-specific/in-house/bespoke/traditional offset - These terms all refer to development projects required to '*offset*' specific negative impacts and has done so (by choice or as a result of the framework present) via an *offset* project for this purpose. Offsetting occurs independently of an *offset banking* program; independently to any other development or offsetting project; and created in response to the specific need created as a result of the impact. It may be at the same location as the development project, directly adjacent to the impact site or some distance away. The term '**permittee-responsible**' is

[121] BBOP OIH (2009d)

used in California and elsewhere in the USA, to refer work being conducted by the entity (or on behalf of the entity) that is undertaking the offset in order to obtain a permit, as required in *CWA* and *ESA* legislation, for a given development project. This is how the term 'permittee' is involved. The term '**traditional**' is used where such one-off projects have most commonly been the first instances of offsetting in a region, preceding (chronologically) *offset banking* approaches.

Precautionary principle: The management concept stating that in cases "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation," as defined in the Rio Declaration[122].

Preservation: protective actions taken to ensure continued quality and quantity of *conservation* values through preventing threats that would cause loss of such values. Such actions may be physical, legal or financial in nature.

Property rights: The right to specific uses, perhaps including exchange in a market of *ecosystems* and their *services*.

Re-creation: The process of manipulating the biotic and abiotic (including, but not limited to, geomorphic and hydrological manipulation) conditions of a location so that a previously existing, but presently absent *ecosystem* or set of *biodiversity* values is established.

Rehabilitation - *conservation actions* to alter a degrading process or function occurring within an *ecosystem* (usually as a result of external negative impacts) to one which is making a positive contribution to the environmental values of the area.

Remediation: Actions aimed at recover of the damage environmental resource either on the site where damage occurs or on another site (off-site). While the terms '*remediation*', '*mitigation'* and 'clean-up activities' are sometimes used interchangeably they can have specific legal meanings[123].

Remedy: A variety of actions that may account for (reduce or minimise) negative environmental impacts. Compare with *amelioration*.

Resilience: The ability of an ecosystem or components of an *ecosystem* to experience changes in conditions or inputs whereby the system responds by returning to pre-change conditions without effecting the overall functioning, operation or viability of the system over the long-term.

Resistance: The ability of an ecosystem or components of an *ecosystem* to withstand environmental perturbations without negatively impacting the functioning, operation or viability of the *ecosystem* or components within.

---

[122] Millenium Ecosystem Assessment Board (2005), p. 897
[123] eftec, IEEP et al., 2010 p.12 - 13

Restoration: may include *rehabilitation, reallocation, reconstruction* actions which all contribute to returning to an environment to some previous condition of higher value.

Single User/Client Bank - a bank site created by an entity that intends to use all credits produced for their own *mitigation* uses i.e. the *credits* are not sold to a third party. This differs from *permittee-responsible* mitigation defined above. The process is identical to establishing any other *mitigation* or *conservation bank* and occurs within the *offset banking* process of the region: *credit* crediting and debiting occur as with other *bank* transactions.

Species Bank - A *bank* to which *credits* have been issued that may be sold to satisfy requirements to offset or mitigate species impacts, defined under specific legislation requiring conservation actions, monitoring and other aspects of the bank to be designed around the conservation needs of one or more specific species.

Species Credit - a *credit* as described above, which directly represents species values, such as a specific number of a specific species.

Steward (Stewardship): The role of protecting, managing and monitoring the conservation and environmental values (species, *habitats*, *biodiversity* or other) of a piece of land. Stewardship may be practiced irrespective of ownership for the land so is undertaken with the express purpose of the continued existence of these values for conservation purposes rather than any subsequent use of values through *credit* selling or other development.

Surrogates: Similar to an *indicator* or *benchmark*, it is a unit of measurement which the values of are assumed to represent or be commensurate with another unit or entity for which measurements are not made. A unit of measurement made in place of another.

The biosphere (such as plant and animal and micro-organism communities and their non-living environment) interacting as a functional unit together producing emergent systems, functions and processes that are self-maintaining and evolutionary.

Tradable Permits - a share of some resource which may be issued to individuals, the ownership of which may then be bought or sold between individuals or parties. The owner of the permit may therefore be permitted to use or access some resource, depending on the design of the permit or tradable entity so is a mechanism by which property rights are allocated.

Wetland Bank - A *bank* to which *credits* have been issued that may be sold to satisfy 'wetland mitigation' requirements defined under specific legislation. Note also the synonymous use of the term '**Wetland Mitigation Bank'**.

Wetland Credit - a *credit* as described above, which directly represents wetland values, such as a specific wetland type or condition.

CASE STUDIES

Each scheme internationally, including New South Wales and California employs a variety of terms and definitions particular or unique to the area the operate in. Terms defined here are either used in New South Wales exclusively, or are used in a specific manner or definition in the scheme.

NEW SOUTH WALES

Accredited Assessor: A suitable qualified and experienced person who is accredited by the Direct-General to undertake and prepare surveys and assessments for use in the *Biobanking* Scheme, under s. 142B of the TSA 1995.

Benchmark Attributes: features (structural, compositional, functional) of a *habitat* (can also be species, community or landscape based) used to establish a *benchmark* representing the type, amount and quality of *biodiversity* present at a site.

Biobanking Agreement: A legally binding document between the landowner establishing a *biobank* site on their land and the Government Department administering the Biobanking scheme, containing certain conditions that must be satisfied in order to obtain a specific number and kind of credits. It specifies management actions, reporting, long-term funding, monitoring and other obligations assumed by the bank owner.

Biobanking Assessment Methodology (BAM): Document establishing the operating rules of the *Biobanking Scheme*, specifying how biodiversity (ecosystems and species) values are assessed, credited and traded. The regulatory standing of the document is established in the TSA (1995) s. 127B, where (9) maintains that the Scheme may not operate prior to its creation and publication.

Biobanking Scheme: System of *offset banking* operating in the state of New South Wales, Australia, according to the Threatened Species Conservation Act (1995) and the Threatened Species Conservation Biodiversity Banking Regulation (2008).

Biobanking Statement: a document stating if the development will improve or maintain values and the nature and number of *credits* to be retired to meet these criteria. The statement satisfies the biodiversity assessment criteria and exempts the developer from needing an assessment of significance or species impact statement for the proposal.

Catchment Management Authority (CMA): A division of local governance, whereby the State is geopolitically divided into regions defined as Catchments, and each is managed and administrated by a governing authority termed the Catchment Management Authority. They operate as a point of information and promotion between the Schemes' administrators within *The Department* and private landowners establishing *banks*, and developers pursuing *Biobanking Statements* and *credit* purchases.

Credit Calculator: Computer software used by an *Accredited Assessor* to calculate the number and nature of credits to be issued based on outputs from the *Biobanking Assessment Methodology*.

Credit Profile: A description of the type (ecosystem or species) and specific nature of credits issued in a *Biobanking Agreement*, or required in a *Biobanking Statement,* including information on how such credits may be traded in order to meet the 'improve or maintain' requirements (see **IMT** bellow).

Ecosystem Credit: A credit type acknowledging the conservation of an ecosystem type (faunal and flora values) defined through vegetation surrogates, types, classes and formations as defined by the Vegetation Types Database.

Habitat Hectares: An explicit, quantitative method for assessing the quality of vegetation by adding scores that are assigned to 10 habitat attributes and assessing the condition or nature of vegetation patches to allow comparison between different patches, developed for use in the State of Victoria (See Parkes et al., 2002). This statewide, standardised approach estimates vegetation/habitat quality on a scale from zero (complete loss) to one (complete retention of natural quality as described by benchmark characteristics). The quality measure is combined with area to create a "Habitat Hectares" score (habitat score x area) with the number needed for a given offset depending upon the conservation significance of the situation.

Habitat Surrogates: components of a *habitat* such as the biogeographic location and vegetation classifications, coverage, condition or area used to assess the habitat of a given site.

Improve or Maintain (Test - *IMT* see ACRONYMS AND ABBREVIATIONS**):** Term used to reflect the overall intended outcome from trading and exchange of *Biobanking credits*, reflecting the prioritisation of minimally maintaining a commensurate level of *biodiversity* (of *ecosystems* and species) over time, but giving preference to improving (i.e. increasing in condition and frequency) of values over time.

Management Actions: Actions required at the *Biobanking* site to create/maintain biodiversity (*ecosystem* and species) values and hence *credits*. These may be standard actions or additional *management actions* (where *ecosystem credits* are being created requiring the improvement in population, or *habitat* of a particular threatened species requiring *ecosystem* credits)

Minister: The Minister of the New South Wales State Government Department that administers the TSA (1995 and reg. 2008) that enables, creates and regulates *Biobanking* in NSW.

Red Flag Area: "An area of land at the development site with high *biodiversity* conservation values where the impact of the development on *biodiversity* values cannot be offset by the retirement of biodiversity credits in order to improve or maintain values, unless the Director General determines that strict avoidance of the *red flag* area is unnecessary in the circumstances." Page 48 Biobanking Assessment Methodology DECC 2008. See section 6.2.3

Species Credit: A credit type acknowledging the conservation of a species whose presence may not be accurately predicted by vegetation *surrogates* (typically because the inhabit a number of vegetation types). Species that require species credits are listed in the Threatened Species Profile Database

The Department: The New South Wales State Government Department that administers the TSA (1995 and reg. 2008) that enables, creates and regulates *Biobanking* in NSW. Between the creation of the legislation this department has been then **Department of Environment, Climate Change (DECC), Department of Climate Change and Water (DECCW),** and at the time of thesis submission, **Office of Environment and Heritage (OEH).**

Total Fund Deposit: The total amount, divided into scheduled payments, which must to deposited into the *Trust Fund* to meet legislative requirements and ensuring management financing from when the *Biobanking Agreement* is signed into perpetuity.

Trust Fund Manager - the person charged by the Minister of the Department to administer the *Trust Fund* and all aspects of its operation.

Trust Fund: Money set aside, as a precent of *credit* sales and managed by a Trust Fund Manager to provide a perpetual income stream to the manager/owner of the *Biobank* site for perpetual management and the on-going maintenance of the biodiversity on the *Biobank* site.

CALIFORNIA

See also ACRONYMS AND ABBREVIATIONS *bellow*

Bank Enabling Instrument: Documentation establishing the agreement between the parties to the bank (including land owner, *banker*, *agencies*, *easement holder* and other relevant parties on a case-specific basis) that formally creates the *bank* and operational components.

Conservation Bank - a *bank* established to provide compensatory conservation as relating to the *ESA* and the impact to and recovery of listed endangered species under the same act.

Conservation Bank Agreement: Similar to *BEI's*, agreement between parties involved in a *Conservation Bank's* creation that establishes the bank and defines operational components within the ESA-based conservation banking system.

Management Plan: Agreed schedule of actions that must be taken in order to maintain the specific values of the bank (used in both *Mitigation* and *Conservation Banking*).

Credit Release Schedule: predicted, but not guaranteed, issuance of *credits* over time, in response to the meeting of specified criteria (used in both *Mitigation* and *Conservation Banking*).

Service Area: Area within which credits may be sold that will be able to offer impact mitigation. If a project is located within the service area, then they may achieve mitigation by purchasing that bank's credits, however if the project is not in the *Service Area*, then *mitigation* will not be satisfied but purchases may be made without the intention of mitigating or compensating impacts (used in both *Mitigation* and *Conservation Banking*). See section 6.2.2.1

Endowment: A fund, or pool of money from which the interest generated from investing the capital, is drawn from over time to generate income, such as income for operation and maintenance of a *bank* (used in both *Mitigation* and *Conservation Banking*). See sections 5.1.2 -.7, 7.6.

Non-wasting Endowment: As above, however a portion of the interest is re-invested as capital, to maintain the earning capacity of the capital base, so that the steady income stream which is produced may retain its purchasing power indefinitely (used in both *Mitigation* and *Conservation Banking*).

Endowment Holder: the legal entity that manages and has responsibility for the *endowment* fund, its investment and spending allocations.

Easement: Legal instrument documenting an agreement between a landowner and the *easement holder* that transfers specific rights and/or responsibilities from the landowner to the *easement holder*. In the context of banking, a conservation *easement* is used, whereby the *easement holder* assumes the rights and responsibilities of upholding, maintaining and protecting the conservation values of the bank that the land the *easement* it pertains to is located on.

Easement Holder: the legal entity that manages and has responsibility for the *easement*.

Permittee: the holder of a permit to conduct development activities, as issued by legislation, such as the *CWA* or the *ESA*. See *permittee-responsible* above.

Sequencing: A term used similar to *mitigation hierarchy* where a sequence of actions must be taken in order, before final *banking* is deemed appropriate.

(Bank) Manager: A person charged with co-ordinating and supervising the completion of actions required on the bank site pertaining to the on-going *conservation* of the bank's values. This term may be used synonymously with the term *steward* or the *steward* may assign/delegate the management task accordingly.

In Lieu Fee Program: A program whereby money is collected from permittees and accumulated over time to a point where it is cost effective to conduct *mitigation* on behalf of a number of permittees in aggregate, where this options offers improved *efficiency* in time, costs and biology than individual banking or *offsetting*. A program may also be established in the case where there is not the upfront land or capital to fully support the establishment of a *bank*, enabling money to be collected as permits are issued, and providing a mechanism to accumulate the needed resources for *mitigation*. See section 3.2.1

In Lieu Fee Holder: The entity that receives this money, along with the responsibility for conducting the *mitigation*, and is authorised to do so by the relevant agency.

ACRONYMS AND ABBREVIATIONS

The following is a list of acronyms and abbreviations commonly used in literature relevant to offset banking and adopted in this thesis. References to the regions/countries (commonly) of use follow in italics: NSW - New South Wales, CA - California, USA - (United States of America), NZ - New Zealand.

BAM - BioBanking Assessment Methodology *NSW*

BBOP - Business and Biodiversity Offsets Program - "The Business and Biodiversity Offsets Programme (BBOP) is a partnership between companies, governments, conservation experts and financial institutions that aims to explore whether, in the right circumstances, biodiversity offsets can help achieve better and more cost effective conservation outcomes than normally occur in infrastructure development, while at the same time helping companies manage their risks, liabilities and costs. BBOP has been researching and developing best practice on biodiversity offsets and testing it through a portfolio of pilot projects in a range of contexts and industry sectors, aiming to demonstrate improved and additional conservation and business outcomes." OIH

BEI - Bank Enabling Instrument *CA*

CBA - Conservation Bank Agreement - *CA, USA*

CBD - Convention on Biological Diversity.

CDFG - California Department of Fish and Game - *CA*

CNLM - Centre for Natural Lands Management - *CA*

COP - Conference of the Parties (to the CBD)

CWA - Clean Water Act *CA (USA)*

DECC - Department of Environment and Climate Change (disbanded in 2009) - *NSW*

DECCW - Department of Environment, Climate Change and Water (11 July 2009 to Present) - *NSW*

DOC - Department of Conservation -*NZ*

EDO - Environmental Defenders Office - *NSW*

EPA - Environmental Protection Agency - *(USA)*

ESA - Endangered Species Act - *CA (USA)*

HCP - Habitat Conservation Plan *CA, USA*

ILF - In-Lieu-Fee

IMT - Improve or Maintain Test *NSW*

ITP - Incidental Take Permit (within the ESA) - *CA, USA*

MfE - Ministry for the Environment - *NZ*

NGO - Non-Governmental Organization

NMFS - National Marine Fisheries Service *(USA)*

NNL - No-Net-Loss

NOAA - National Ocean and Atmospheric Administration (*USA)*

NRCS - Natural Resources Conservation Service *(USA)*

NSW - The Australian State of New South Wales - *NSW*

NZBS - New Zealand Biodiversity Strategy - *NZ*

OEH - Office of Environment and Heritage *NSW*

ODH - Offset Design Handbook (BBOP 2009f)

OIH - Offset Implementation Handbook (BBOP 2009d)

PAR - Property Analysis Record

PCE - Parliamentary Commissioner for the Environment *NZ*

RMA - Resource Management Act - *NZ*

TSA - Threatened Species Conservation Act (1995)

TSR - Threatened Species Conservation Act Biobanking Regulation (2008) aka "BioBanking Bill" *NSW*

USACE - United States Army Corps of Engineers - *USA*

USFWS - United States Fish and Wildlife Service - *USA*

APPENDIX ONE: THE PRINCIPLES OF BIODIVERSITY OFFSETTING AS DESCRIBED BY VARIOUS SOURCES

1.1 DEVELOPMENTS AND DIVERSITY IN OFFSET PRINCIPLES

A primary focus of developing offsetting, and by extension offset banking, is the identification of principles by which individual offset decisions can be made. Decision-making should be replicable and transparent in order to support robust and defensible offsetting. As noted in text, there is great diversity in offsetting and offset banking approaches around the world, so a variety of principles have been developed (BBOP 2009f). This partly reflects the variation in objectives across schemes, but also the different contexts and the specific conservation needs and issues of each region. Each set of principles may have relevant components that can contribute and inform the development of offsetting and offset banking in new regions such as New Zealand. Understanding the scope of principles adopted around the world provides an appropriate context to understand how offset banking may be practiced.

1.2 BBOP OFFSET PRINCIPLES

The group *Business and Biodiversity Offset Program* (BBOP) has produced a set of principles from investigation and observation of a variety of offsetting applications around the world (endorsed in eftec, IEEP et al., 2010). A voluntary, independent, non-legally active group, BBOP has developed these principles with input and consultation from a variety of organisations from a number of countries. Therefore they are well placed to represent an overview of practical experience and multi-party consensus. This makes them highly valuable when designing methodologies and guiding principles for a banking system.

Principles on Biodiversity Offsets Supported by the BBOP Advisory Committee

Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve no net loss and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people's use and cultural values associated with biodiversity.

These principles establish a framework for designing and implementing biodiversity offsets and verifying their success. Biodiversity offsets should be designed to comply with all relevant national and international law, and planned and implemented in accordance with the Convention on Biological Diversity and its ecosystem approach, as articulated in National Biodiversity Strategies and Action Plans.

1. *No net loss:* A biodiversity offset should be designed and implemented to achieve *in situ*, measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.

2. *Additional conservation outcomes:* A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.

3. *Adherence to the mitigation hierarchy:* A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimization and on-site rehabilitation measures have been taken according to the mitigation hierarchy.

4. Limits to what can be offset: There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.

5. Landscape Context: A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.

6. Stakeholder participation: In areas affected by the project and by the biodiversity offset, the effective participation of stakeholders should be ensured in decision-making about biodiversity offsets, including their evaluation, selection, design, implementation and monitoring.

7. Equity: A biodiversity offset should be designed and implemented in an equitable manner, which means the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements. Special consideration should be given to respecting both internationally and nationally recognised rights of indigenous peoples and local communities.

8. Long-term outcomes: The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.

9. Transparency: The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner.

10. Science and traditional knowledge: The design and implementation of a biodiversity offset should be a documented process informed by sound science, including an appropriate consideration of traditional knowledge.

1.3 Principles in New Zealand

Principles to guide decision-making regarding offsets, and provide a framework for establishing a New Zealand offset banking system have emerged through case law and several pivotal cases brought before the Environment Court[124]. Of these, JF Investments Ltd. v Queenstown Lakes District Council saw the following 'desiderata' adopted in arriving at the final decision (J F Investments Ltd. v Queenstown Lakes District Council (Environment Court, Christchurch C 048/2006 27th April 2006 Judge Jackson); see also: Hinchey and Hogg 2009[125]; Christensen 2010):

1. It should preferably be of the same kind and scale as work on-site or should remedy effects caused at least in part by activities on-site;
2. It should be as close as possible to the site (with a principles of benefit diminishing with distance) so that it is in the same area, landscape or environment as the proposed activity;
3. It must be effective; usually there should be conditions (a condition precedent or bond) to ensure that it is completed or supplied;
4. There should have been public consultation or at least the opportunity for the public participation in the process by which the environmental compensation is set'
5. It should be transparent in that it is assessed under a standard methodology, preferably one that is specified under a regional or district plan or other public document

---

[124] Other cases that Hinchey and Hogg (2009) state have also adopted these principles: *Canterbury Museum Trust Board v Christchurch City Council* (Environment Court, Christchurch C059/06 17 May 2006 Judge Jackson); *Lakeview Properties Ltd v Queenstown Lakes District Council* (Environment Court, Christchurch C 080/06 19 June 2006, Commissioners Manning and Grigg); *Director-General of Conservation v Wairoa District Council* (Environment Court, Wellington W 081/07, 19 September 2007, Judge Thompson); *Merton v Rodney District Council* (Environment Court, Christchurch A 008/07, 2 February 2007, Judge Jackson); *Long Bay-Okura Great Park Society Inc. v North Shore City Council* (Environment Court, Auckland A 078/08 16 July 2008 Judge Jackson).

[125] Hichey L., Hogg A. (2009) **Environmental compensation under the RMA: An appropriate tool to "avoid, remedy or mitigate" adverse effects on the environment?** Resource Management Bulletin, July p. 45 - 48

1.3.1 Norton (2009) Principles

Subsequently, Norton (2009) put forward a further set of Offset Principles that were subsequently adopted in the case *Royal Forest and Bird Protection Society Inc. v The Gisborne District Council* (Hinchey and Hogg, 2009) as building upon and superseding the desiderata adopted in *JF Investments* above (Summary from Christensen 2010; Norton 2009):

1. Biodiversity offsets should only be used as a part of a hierarchy of actions in which a development project must first seek to avoid impacts and then minimise the impacts that do occur. Biodiversity offsets should not be used to justify adverse impacts; rather they are the final step in a process that focuses first on avoidance and minimisation
2. Some for a guarantee must be provided that the offset proposed will occur. One of the major criticisms of offsets, especially in North America, is that most approved offsets fail to meet their objectives or never actually occur.
3. Biodiversity offsets are inappropriate for certain ecosystems (or habitat) types because their rarity or the presence of a particular species within them makes the clearance of these ecosystems inappropriate under any circumstances. Notwithstanding the hierarchy in principle one, it seems clear that there are some ecosystems or habitat types for which offsets are never going to be possible. These may be ecosystems that have already been diminished to such an extent that any further loss is unacceptable, or habitats of species whose loss would most likely lead to the extinction of the species as well.
4. Biodiversity offsets can involve protection of existing habitat but most often involve the creation of new habitat, especially when existing habitat already enjoys a degree of protection.
5. A clear currency is required that allows transparent quantification of value to be lost and values to be gained in order to ensure ecological equivalency between cleared and offset areas. Any biodiversity offset proposal must be founded on very good knowledge of the biodiversity value of both the site that is to be impacted and the offset site, including composition, structure and pattern, function as well as dynamics and resilience of the system. The development of a clear currency to quantify the vales at different sites being considered as part of biodiversity offsets is essential to ensure that clearance of high quality habitat or a rare ecosystem is not offset using an area of low quality habitat or common ecosystem and thus that biodiversity credits have credibility.

6. Determination of what is an appropriate offset must take into account both the uncertainty involved in obtaining the desired outcome for the offset area and the time lag that is often involved in reaching this point. Uncertainty relates primarily to the inability of ecologists to accurately predict what a system will be like at some point in the future as a result of management actions implemented as part of the offset (e.g. restoration).

These principles were not designed to specifically apply to an offset banking system, yet are a useful guide to the ideals that a system would be advised to include. In particular, these principles are important from a legal continuity perspective as they are currently applied to New Zealand Resource Management legislation and development impact decisions.

1.4 Additional principles discussed in literature

The following observations of how offsets are implemented around the world reflect a body of literature that has developed. Principles suggest how offsets can be more appropriately implemented and suggest how offsetting proceeses should be guided; for example, Bekessy et al., 2010. The following principles from this paper may be highlighted and summarised as follows:

- Maintain a net-gain approach: "While we agree in principle with the use of offsetting and biobanking as instruments to conserve biodiversity, most offsetting schemes that use these two approaches are resulting in net losses of biodiversity. We recommend instead policies that are likely to provide net benefits for biodiversity." P. 152

- Preclude the use of existing 'biodiversity assets' as offsets: "If the objective of a vegetation management policy is to achieve not-net-loss [*or net gain as above*], then actions that merely place offsets into a different tenure or security arrangement should not be permitted." P. 152

- Do not 'lend' biodiversity values, instead adopt a 'savings' approach - "We propose that the only workable and equitable system is one in which assets [*biodiversity values*] are banked for the future and trading is only possible once it can be demonstrated that assets have matured (reached ecological equivalence with whatever losses they are being traded against). The value of biodiversity assets (savings) should be demonstrated before they can be used to offset loss of biodiversity elsewhere." P. 153 -

- Employ a metric that incorporates irreplaceability, spatial context and landscape dynamism, to reflect biological realities. "In order to achieve equity between biodiversity losses and offsets with high confidence, metric that better reflect the value of biodiversity are required…Metrics must incorporate irreplaceability…Metrics must reflect the dynamic nature of landscapes… Spatial context must be considered both in the valuation and planning of offsets [including] metapopulation dynamics and retaining landscape connectivity." P. 154 - 155

- Maintain clear provision for when offsetting is and is not appropriate: "Some things, such a critical habitat for listed threatened species are not tradeable. Offsetting is not a panacea for unbridled development and must be firmly established as the last and most costly step of the '*avoid*, mitigate and compensate' hierarchy from the convention on Biological Diversity 9UNEP 1992)." P. 154

- Implementation of biodiversity-offset schemes must be closely regulated and legally enforceable:
"Offsetting schemes should be overseen by an independent authority such as the relevant environment protection agencies with the power to reject proposals that breach fundamental criteria… they must be attached to a regulatory framework that is legally enforceable and that provides sufficiently serious penalties as a disincentive to noncompliance." P. 155 -156

Appendix Two: Summary table comparing the key components of New South Wales Biobanking, and Conservation and Mitigation Banking in California, USA.

Scheme Feature		Conservation Banking, USA	Mitigation Banking, USA	Biobanking, New South Wales, Australia
Seminal Dates	First Legislation passed	1973 - Endangered Species Act (ESA)	1972 - Federal Water Pollution Control Act (CWA)	Threatened Species Conservation Act 1995; Threatened Species Conservation Biodiversity Banking Regulation 2008
	First Bank created/ credits issued	April 1995	January 1984	10th May 2010 607 Credits
First Bank/banking transaction		Calrsbard Highland Conservation Bank, San Diego County, California	The Tenneco LaTerre Mitigation Bank in Louisiana.	Douglas Park, SW Sydney, New South Wales
Primary legislation		Endangered Species Act (ESA) 1973; California Endangered Species Act (CESA) 1970; superseded in 1984;	Federal Water Pollution Control Act (CWA) 1972	Environmental Planning and Assessment Act 1979; Threatened Species Conservation Act 1995 (Part 7a); The Threatened Species Conservation Amendment (Biodiversity Banking) Bill 2006.
Significant/relevant documents or regulations		National Environmental policy Act 1970; Californian Environmental Quality Act (1972); Memorandum of Agreement 1990 (USACES, EPA); ESA Amendment 1995 (EPA); Official Policy on Conservation Banks (CEPA)	Federal Guidance on the Establishment, Use and Operation of Mitigation Banks 1995; Federal Guidance on the Use of In-Lieu- Fee Arrangements for Compensatory Mitigation Under Section 404 of the Clean Water Act and Section 10 of the Rivers and	The Environment Protection and Biodiversity Conservation Act 1999; Native Vegetation Act 2003 (Regulation 2005); The Threatened Species Conservation (Biodiversity Banking) Regulation in 2008;

Administrative body(s)		US Fish and Wildlife Service; National Ocean and Atmospheric Administration Fisheries; Californian Fish and Game Department;	US Army Corps of Engineers (USACE)	Department of Environment and Climate Change (and Water *2010*)(DECC(W)), New South Wales Government.
Regulatory origin of demand		Sections 7, 10, Endangered Species Act (ESA) (1973)	Section 404, Federal Water Pollution Control Act (CWA) (1972)	Parts 3,4 and 5, Environmental Planning Act (1979)
Scheme inclusion	**Lands that can may be eligible to sell credits**	All privately owned lands not currently managed for conservation, including state, county or tribal lands, with discussion on Federal Government Conservation lands (i.e. National Parks)	All privately owned lands not currently managed for conservation, including state, county or tribal lands, with discussion on Federal Government Conservation lands (i.e. National Parks)	Land where the Native Vegetation Act 2003 applies; only on private land or crown land but not managed for conservation, including local government land not managed for conservation.
	Entities required to purchase credits	Entities pursing activities (or permits for activities) that may require species take permits/jeopardize species existence under sections 7 or 10 of the ESA, which pertain to State, Federal, Tribal or County actions, or private actions respectively	Those impacting upon wetlands (i.e. 'waters of the United States', as defined in the CWA) i.e. those draining, damaging or removing wetlands, or waters of the US directly related to wetlands.	Part 4 and 5 of the Environmental Planning and Assessment Act (1979) requires threatened species assessment of significance; Part 3A may also require offset impacts as prescribed in the Biobanking Assessment Methodology.
Regulatory alternatives		In-lieu Fee payment	In-lieu Fee payment	Threatened species 'assessment of significance'

Scheme objective (c.f. no-net-loss/net gain)	Further the intentions of the ESA, namely support recovery of endangered species through ensuring development activities and project do not place an endangered species' continued survival in jeopardy. Species are listed as endangered under the ESA 1973	No Net Loss of wetland function or acreage. The CWA more broadly requires the maintenance of the 'waters of the US' for purposes of navigation.	Not legislatively stated within objectives a) - d) of the Threatened Species Conservation Act (1995); Offsetting used to satisfy the 'Improve or maintain test' - improving or maintaining environmental outcomes in accordance with the principles of ecologically sustainable development (*see* Native Vegetation Act 2003)
Credit types	Species-Specific Credits (24 currently in operation/ 54 listed in the State of CA); Habitat/ecosystem credits in some jurisdictions	Wetland types as defined by the Wetland Delineation Methodology adopted by the USACE.	Ecosystem Credits (~1600; profile types 1600+) Species Credits (135 Indentified/listed threatened species)
Mechanism of ecological assessment	At a bank site, one acre typically equates to one credit. Various assessment protocols - extensive use of expert opinion.	Wetland Delineation Methodology as Defined by the USACE	The Biobanking Assessment Methodology, DECC, 2008
Formative Documents (to create a bank)	Conservation Banking Agreement; Conservation Easement; Long-term Management Plan	Bank Enabling Instrument or Memorandum of Agreement; Conservation Easement; Long-term Management Plan	Biobanking Assessment; Biobanking Statement; Land Title Deed
Credit Price Structure	As determined by the credit owner - as the market will bear, but not less than on-going operating costs.	As determined by the credit owner - as the market will bear, but not less than on-going operating costs.	As determined by the credit owner - as the market will bear, but not less than on-going operating costs.

Area of Trading	Credits are sold within bank-specific credit trading areas, which are commonly based on species' range, conservation units and geopolitical boundaries. Impacts located within the geographic service area of a bank with matching credit types may purchase credits for mitigation.	Credits are sold within bank-specific credit trading areas, which are normally defined by watersheds and/or Hydraulic Unit Codes (HUC) as per USACE definition. Impacts located within the geographic service area of a bank with matching credit types may purchase credits for mitigation.	Credits may be sold within all areas of NSW in line with Assessment Methodology regulations; Credits may be purchased from CMA regions or sub-regions as specified in the credit profile.
Tracing/tracking mechanism	Various/agency based. USACE operates RIBITS, USFWS soon to integrate with this.	USACE operates RIBITS to track all banks and banking data	Various registries: Biobanking Registry; DECC Credit Registry; DECC Transaction Registry; DECC Biobanking Statement Registry; DECC Biobanking Agreement Registry.
Long-term funding mechanism	Endowment account held by non-profit third party organization	Endowment account held by non-profit third party organization	Biobanking Trust Fund Account held by NSW Govt. Dept.
Land tenure protection mechanism	Conservation Easement held by third party organization (private or governmental)	Endowment account held by non-profit third party organization	Credit and Bank recorded on Land Title Deed with Department of Lands NSW.
Transactions to 2011	113 Banks (active, inactive, pending, sold out or unknown status) according to Ecosystem Market Place 2011 Update	1137 Banks (active, inactive, pending, sold out or unknown status) according to Ecosystem Market Place 2011 report *In Press*	7 agreements, representing 7 bank sites as per 13/06/2011 http://www.environment.nsw.gov.au/bimsprapp/BiobankingPR.aspx

APPENDIX THREE: ACTS AND OTHER OFFICIAL POLICY DOCUMENTS IN CALIFORNIA AND NEW SOUTH WALES CA.

Table A3.1 California, USA: Summary of relevant documents pertaining to mitigation and conservation banking in California and other United States of America. * Reference taken from Box 2.1 Mead 2008. See *Glossary* for a list of abbreviations, particularly for Acts and corresponding agencies.

Title	Type	Year	Agency/ Authority	Jurisdiction	Form of Banking it pertains to	Relevance
National Environmental Policy Act of 1969	Act	1970	Enforcement via court system	All federal agencies in the executive branch	Potential relevance to both systems through jurisdiction over Environmental Impact Assessments/Statements	Among other functions it (broadly) defines mitigation as "everything from avoiding the impact through to compensating for the impact by replacing or providing substitute resources." Mead 2008 p. 15
Federal Water Pollution Control Act. (aka "Clean Water Act")	Act	1972	USACE	Federal Government - all United States of America	Mitigation Banking	"The CWA provides for protection of wetlands and waters of he US and is administered by the [USACE] with oversight from the [EPA]… require mitigation for projects that will impact wetlands." *Mead 2008 p 10.* This Act established the platform for project-specific offsetting and mitigation that eventually gave rise to wetland and mitigation banking, and indirectly, conservation and species banking.
Endangered Species Act	Act	1973	EPA	Federal Government - all United States of America	Conservation Banking	Established legal constraints of 'Species take' 'ITP' and listing of threatened species, which forms the basis of the tradable unit, and demand for conservation/species banking in California and all other States.

Section 10 Amendment to the ESA	Amendment	1982	EPA	Federal Government - all United States of America	Conservation Banking	*"Section 10 of the ESA was amended to include the use of Habitat Conservation Plans (HCP), thus allowing mitigated, incidental take of federally listed species by private land-owners." P. 12
Interim Guidance on Mitigation Banking (1983)	Memorandum (Interim guidance)	1983	USFWS	Regional Directors of USFWS (i.e. National)	Mitigation Banking	* "USFWS issued interim guidance on mitigation banking through a memorandum to its regional directors that recognised the potential for mitigation banking." P. 12
Californian Endangered Species Act	Act	1984 (effective 1985)	CDFG	State of California	Conservation Banking.	* "It superseded the state's original 1970 Act and now closely resembles the federal ESA" p. 12 This Act recognises some species/ conservation values as relevant for banking, that are not recognised at a national level, allowing some values to be banked at federal level, and some at a state level.
"The Determinant of Mitigation under the Clean Water Act Section 404 (b)(1) Guidelines."	Memorandum of Agreement	1990	Between the Department of the Army (USACE) and the EPA	Federal level - with regional documents issued subsequent	Mitigation Banking	* "USACE and EPA issued memorandums of agreement regarding mitigation banking. A number of regional guidance documents from various federal agency offices clarified agency expectations regarding mitigation banking and officially sanctioned their use."
California Natural Community Conservation Plan (NCCP) Act	Act	1991	CDFG	State of California	Conservation Banking	Allowed/provided for the creation of NCCP's and established a role for banking within this framework.

"Official Policy on Conservation Banks"	Policy Statement	1995	California State Government	State of California	Conservation Banking	From the Document: "The executive and legislative branches have endorsed the use of conservation banks as a means to accomplish important resource management goals. This document provides formal policy guidance on how to achieve this directive." It defines the concepts, including six aspects to a conservation bank, and 14 precepts to guide agency implementation.
"Federal Guidance for the establishment, use and operation of mitigation banks."	Federal Guidance	1995	USACE, EPA, NRCS, USFWS and NOAA Fisheries.	Nation-wide according to agency jurisdiction.	Mitigation Banking	From the Document: "[the Agencies] are issuing final policy guidance regarding the establishment, use and operation of mitigation banks for the purpose of providing compensation for adverse impacts to wetlands and other aquatic resources. The purpose of this guidance is to clarify the manner in which mitigation banks may be used to satisfy mitigation requirements of the Clean Water Act (CWA) Section 404 permit program and the wetland conservation provisions of the Food Security Act (FSA) (i.e., ''Swampbuster'' provisions). Recognizing the potential benefits mitigation banking offers for streamlining the permit evaluation process and providing more effective mitigation for authorized impacts to wetlands, the agencies encourage the establishment and appropriate use of mitigation banks in the Section 404"

"Guidance for the establishment, use and operation of conservation banks"	Guidance Document	2003	USFWS	Federal level/Nation-wide	Conservation Banks	From the Document: "The policies and procedures discussed herein are applicable to the establishment, use, and operation of public conservation banks, privately sponsored conservation banks, and third party banks (i.e., entrepreneurial banks). The guidance they provide is intended to help Service personnel; (1) evaluate the use of conservation banks to meet the conservation needs of listed species; (2) fulfill the purposes of the ESA; and (3) provide consistency and predictability in the establishment, use, and operation of conservation banks. In this regard, it is important to apply consistent standards and principles of mitigation whether mitigating through conservation banks or through other means. The purpose of this policy is not to se t the bar higher for conservation banks than for other form s of mitigation, but articulate generally applicable mitigation standards and principles and to explain how they are to be accomplished in the special context of conservation banks." P. 2
"Guidance on the Use of Financial Assurances, and Suggested Language for Special Conditions for Department of the Army Permits Requiring Performance Bonds."	Regulatory Guidance Letter	2005	USACE	Federal/Nation-wide.	Mitigation Banking	From the Document: "The purposes of this guidance are: 1) to provide general guidance on the use of letters of credit, performance bonds and other financial assurances, and 2) to provide specific guidance for the use of performance bonds to ensure the completion of compensatory mitigation projects."

"Implementation Guidance fort he Water Resources Development Act of 2007 - Section 2036(c) Wetlands Mitigation	Memorandum (for Commanders, Major Subordinate commands) - Policy Statement	2008	USACE	Federal, as per agency jurisdiction	Mitigation Banking	This document "directs the Secretary, where appropriate, to fist consider the use of a mitigation bank to compensate for wetland impacts that occur within the service area of an existing, approved mitigation bank. The mitigation bank must be approved in accordance reference…This memorandum provides guidance on the use of mitigation banks for wetlands mitigation…" (From the Document).
"Compensatory Mitigation of Losses of Aquatic Resources; Final Rule."	Federal Ruling	2008	USACE, EPA	Federal/Nation-wide according to agency jurisdiction.	Mitigation Banking (interpretive application to Conservation Banking)	"The regulations establish performance standards and criteria for the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects...This rule improves the planning, implementation and management of compensatory mitigation projects by emphasizing a watershed approach in selecting compensatory mitigation project locations, requiring measurable, enforceable ecological performance standards and regular monitoring for all types of compensation and specifying the components of a complete compensatory mitigation plan, including assurances of long-term protection of compensation sites, financial assurances, and identification of the parties responsible for specific project tasks. This rule applies equivalent standards to permittee-responsible compensatory mitigation, mitigation banks and in-lieu fee mitigation to the maximum extent practicable…" p. 19594

Public Notice number 200500420	Public Notice	2008	USACE, USFWS, CDFG, California Resource Agency, NMFS, EPA, NRCS.	State of California	Mitigation and Conservation Banking	Notified the development of standardized templates for Banking Agreements (BEI's, Conservation Easements, Management Plans, checklist for conceptual bank submittals, banking prospectus submittal, and draft BEI's). From the Document: "These templates are to be used in the development of mitigation banks which are being developed to provide mitigation for impacts from projects which have received authorizations to proceed under the authorities of Section 10 of the Rivers and Harbors Act of 1899 for structures or work in or affecting navigable waters of the United States and/or Section 404 of the Clean Water Act for the discharge of dredged or fill material in waters of the United States. Additionally, these templates are to be used when those mitigation banks would also propose to provide mitigation for projects which have been required to provide mitigation by USFWS, CDFG, NMFS, and/or NRCS."

Table A3.2 List of documents and Acts pertaining to the Biobanking Scheme in New South Wales, Australia. * denotes interaction with stated Act. All administered by *The Department/The Minister* (see GLOSSARY) unless specified. See also notes bellow.

Title	Type	Year	Jurisdiction	Relevance
Threatened Species Conservation (Biodiversity Banking) Regulation	Regulation	2008	“	Part 2 Provides for the establishment of the assessment methodology; Provides additional prescription of the scheme including Part 3 which addresses Biobanking Agreements, Part 4 which addresses Biodiversity Credits, Parts 5 and 6 addressing Biobanking Statements, Part 7 which addresses the Trust Fund.
Biobanking Assessment Methodology	Legislation under TSR 2008	2008	Biobanking Scheme in The State of New South Wales	Metrics for operating the Biobanking Scheme including: determining the ‘Improve or Maintain’ test; assessment and measurement of biodiversity values; assessment and measurement of threatened species; calculation of ecosystem credits and species credits; credit profiles and offset rules for using credits
Native Vegetation Act (no 103)	Act	2003	Native vegetation (indigenous existing prior to European settlement [1750]) on (non-urban) private land within The State of New South Wales.	Not directly related to Biobanking as it provides for Offsetting within the Property Vegetation Planning framework. Excludes certain lands from Biobanking. Establishes some relevant definitions, such as native vegetation. * TSA 1995;
Environmental Protection and Biodiversity Conservation Act	Act	1999	Commonwealth Government - all Commonwealth land and values of ‘commonwealth significance’.	Some species listed under this Act are also listed/included in the Biobanking Assessment Methodology of the TSA 1995 and the TSR 2008
Threatened Species Conservation Act (no 101)	Act	1995	Flora and Fauna of the New South Wales	Part 7A “Biodiversity banking… provides for the establishment of a biodiversity banking and offsets scheme.”
Environmental Planning and Assessment Act (No 203)	Act	1979	The State of New South Wales	Section 75JA; 96 (5)(a); 96AA (1B)(b); 111(2)(d). General guidance as to the application of the Biobanking Process as it pertains to development consents. Specifies the requirement for development consent. * TSA (1995). *NB* administered by the Department of Planning

Appendix Four: List of Interviewees

New South Wales

Anna Lashko
Acting Scientific Director
Environmental Defenders Office New South Wales, Sydney Office
Friday 20th August

David Nicholson
Manager, Biodiversity and Vegetation Programs
Department of Environment, Climate Change & Water
Sydney Office,
Wednesday 1st July 2009

Derek Sellar
Coordinator of the Growth Centres Biodiversity Offset Program
DECCW, Hurstville Office
Wednesday 18th August 2010

Dominic Fanning
Director
Environmental Insites, Sydney Office
Thursday 19th August 2010

Kirsty Graham
Scientific Officer
Environmental Defenders Office New South Wales, Sydney Office
Friday 20th August

Natasha Hammond-Deakin
Solicitor
Environmental Defenders Office New South Wales, Sydney Office
Friday 20th August

Professor Paul Martin
Director, Australian Centre for Agriculture and Law,
AgLaw Centre,
University of New England, Armadale, NSW
Thursday 19th August 2010

Pete Ridgeway
Flora and Fauna Projects Officer
The Sustainability Team,
The Hills Shire Council, NSW

Rob Humphries
Ecological Consultant and Biobanking expert,
EcoLogical, Sutherland Office
Wednesday 18th August

Scott Hickie
Advisor to Ian Cohen MCL
Parliamentary Office of Ian Cohen The Greens,
New South Wales Legislative Council
Friday 20th August 2010

Sylvie Ellsmore
Policy Coordinator
Policy and Research Unit
NSW Aboriginal Land Council
Wednesday 18th August 2010

Tim Robertson
General Manager, Policy
The Urban Development Institute of Australia NSW, Sydney Office
Thursday 19th

Tom Grosskopf
Director for the Landscapes and Ecosystems Conservation
DECCW, Sydney Office
Thursday 19th

CALIFORNIA

Christopher Theriot
Manager of Conservation Programs
Ducks Unlimited
May 2009

Craig Desinoff
Vice President,
Westervelt Ecological Services (Corporate),
Rocklin, CA
May 2009

Deborah Mead
National Conservation Banking Coordinator,
U.S. Fish and Wildlife Service, Arlington, Virgina
May 2009

Ed Flynn
Mitigation Banker/Project Partner
Elsie Gridley Mitigation Bank
May 2009

Gregg McKenzie
Executive Vice President / Partner at Restoration Resources,
Principal at The McKenzie Land Company, LLC
Rocklin, CA
May 2009

Kari Hawkins and Erik Grotte
Conservation Resources,
Sacramento CA.
May 2009

Katie Freas
Regulatory Project Manager
US Army Corps of Engineers
Savannah, Georgia Area,
Georgia State, USA
May 2009

Michael Horton
National IPaC Program Coordinator
U.S. Fish and Wildlife Service
Arlington, Virginia.
May 2010

Nathaniel Carroll
Director of Ecosystem Marketplace,
Forest Trends,
Washington, D.C.
May 2009

Ryan Lopez
Associate Conservation Planner/Biologist
Wildlands Inc. Corporate Office,
Rocklin, CA
May 2009

Sherry Teresa
Eco-Logical Solutions Consulting
Springdale, UT
May 2009

Todd Garner
Manager, Conservation Incentives
American Forest Foundation,
Washington DC
May 2009

Travis Hemman
Business and Market Development,
Westervelt Ecological Services,
Scaramento, CA
May 2009

Wayne White
Director of Business Development
Wildlands, Inc
May 2009

APPENDIX FIVE: Table comparing and distinguishing variation in definition of associated terms, across regions.

Table A 5: Distinction of terms relating to compensation and mitigation, by geographic region. Taken from eftec, IEEP et al., 2010 Glossary of terms. See also GLOSSARY this volume

EUROPEAN TERMINOLOGY		UNITED STATES TERMINOLOGY			NEW ZEALAND, WITHIN THE RMA	
	Avoid	Sequencing (Mitigation Hierarchy)		Avoid	Section 5 (1)(c)/ current case-law: Compensation	"avoid *OR* remedy *OR* mitigate any adverse effects of activities on the environment…"
Mitigate	Minimize		Minimize			
	Rehabilitate/restore		Rehabilitate/restore			
Compensate	Offset	Mitigate	Permittee-Responsible Mitigation	In-kind On site		
	'Habitat' banking - species and conservation		Banking -mitigation/ wetland/species/ conservation	In-Kind Off site	Compensate - Memon and Skelton 2004	Restoration Compensation: on-site, in-kind environmental compensation of lost values
						Replacement compensation: off-site and/or out-of-kind compensation of lost values.
Additional Measures	Educational funding	Compensation	Educational funding	Out-of-kind Off site.	Mitigation - Memon and Skelton 2004	Avoid, minimize, redesign
	Awareness increasing		Awareness increasing			
	Research Funding		Research Funding			
NB: **On-Site:** compensatory mitigation located on a portion of the project area or an adjacent parcel. [**Off-site** referring to a location geographically separate from the impact site]. **In-kind:** Preserving, enhancing, restoring or enhancing the same type of habitat that was impacted by the project. **Out-of-kind:** compensating impacts with a different type of habitat or other natural resource from that which was impacted. Taken from Mead 2008, in Carroll, Fox and Bayon 2008.					NB. See Memon and Skelton 2004, table 1 for summary of definition and use of environmental compensation in district and regional plans around New Zealand, highlighting differences between them.	