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# Aligning economic development and conservation through marine biodiversity offsetting: An analysis of perspectives, policy and practice in Australia.

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Submitted for the degree of Doctor of Philosophy (PhD)

I, Holly June Niner confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

# Abstract

Biodiversity offsetting is increasingly used in diverse policy contexts to reduce, halt or reverse losses of biodiversity arising from development or other uses of the natural environment. To date, relatively little attention has been devoted to its use in marine environments. This thesis explores the policy basis for the marine application of the approach and its implementation in practice.

A systematic review of documents evidencing the application or inclusion of biodiversity offset principles in global policy frameworks is first presented. Analysis focusses on the uptake of the principles for biodiversity offsetting success and indicates that globally there is a limited policy basis for the holistic application of the approach in marine environments. Using Australia as a case study, I explore how these principles are being applied in practice. Through a further systematic review of marine and coastal development projects I find little evidence to suggest that marine biodiversity offsetting in Australia is meeting stated aims of no net loss (NNL).

In-depth interviews of participants with professional experience of the development and application of marine biodiversity offsetting policy were explored. Using two separate frameworks based around boundary objects and risk, interview data and participant perceptions were analysed to understand the influences governing current practice. Results indicate that marine biodiversity offsetting is not being applied with a view to meeting stated aims of NNL and that this trend is primarily driven by the challenges posed by marine environments and limited societal scrutiny. Current use of marine NNL seeks to maintain the legitimacy and credibility of government and industry alike, premised on ongoing trends of accepted marine biodiversity loss.

I conclude that a significant change in the narrative surrounding the use of marine NNL is required to acknowledge the trade-offs and biodiversity loss implicated by much of marine economic development.

# Impact statement

This thesis and research presented documents current biodiversity offsetting practice in marine environments. The policy approach for biodiversity offsetting has predominantly been developed for terrestrial application and the results contained herein advance understanding of how translation of policy into marine environments is undertaken in practice. Through a mixed-method approach, including systematic review and qualitative analyses, I conclude that marine biodiversity offsetting is not being applied with the intention of meeting stated aims of no net loss of biodiversity (NNL). Instead, the approach is being used to manage the risks perceived by government and industry to arise from decisions that implicate marine biodiversity loss.

Aims of NNL are challenged in marine environments for a range of ecological and administrative reasons, exacerbated by the limited knowledge and experience of ecological restoration. My research indicates that whilst aims of NNL are largely considered impractical, they are becoming an expected component of development consent decision-making. Aims of NNL set in motion a series of strategies to manage the risks of falling short of these expectations, which act to obscure biodiversity losses permitted by the use of offsets.

The results presented in this thesis provide a basis for further research into alternative mechanisms to support biodiversity protection and sustainable development. A key recommendation for policy-makers is to improve the transparency of development-consent decisions and to provide certainty in processes to support regulators and industry alike. A strong standardised process could lead to industry innovation in avoidance and mitigation measures and support the refusal of development where appropriate. These recommendations not only apply to Australia but are also relevant on a global scale and are increasingly relevant as the marine contribution to the global economy is set to increase in coming decades.

Initial findings have been communicated through two peer-reviewed journal articles and results have been presented at several international conferences. The articles have received media attention [1] and outreach has led to a collaboration looking at the application of biodiversity offsetting to manage deep-sea mining. This collaboration leant on the knowledge presented in this thesis and resulted in the publication of two articles[2,3] and an invitation from the World Economic Forum to contribute to their blog for World Oceans Day.[4] This blog has an enormous outreach potential of approximately five million people. This collaboration aimed to influence ongoing negotiations over developing governance for marine areas outside of national jurisdiction and the nascent deep-sea mining. Accordingly, the publications were used to underpin discussions at the 24th Annual Session of the International Seabed Authority in July 2018.

[1] Cirino, E., 2017. Bait and Switch? Scientists Question Use of 'Offsets' in Ocean — Oceans Deeply. Oceans Deeply. Available at: https://www.newsdeeply.com/oceans/articles/2017/10/17/bait-and-switch-scientists-question-use-of-offsets-in-ocean-projects.

[2] Van Dover, C.L. et al., 2017. Biodiversity loss from deep-sea mining. Nature Geoscience, 10(7), pp.464–465. Available at: http://www.nature.com/doifinder/10.1038/ngeo2983.

[3] Niner, H.J. et al., 2018. Deep-sea mining with no net loss of biodiversity—An impossible aim. Frontiers in Marine Science, 5. Available at: http://journal.frontiersin.org/article/10.3389/fmars.2018.00053/full.

[4] Niner, H.J. et al., 2018. Mining the deep seabed will harm biodiversity. We need to talk about it. World Economic Forum. Available from: https://www.weforum.org/agenda/2018/06/mining-the-deep-seabed-will-harm-biodiversity-we-need-to-talk-about-it/.

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# List of communications

## Chapter 4 – A global review of biodiversity offsetting policy

Available in full - Niner, H.J. et al., 2017. A global snapshot of marine biodiversity offsetting policy. Marine Policy, 81, pp.368–374

## Chapter 5 - The marine application of biodiversity offsetting policy in Australia

Available in full - Niner, H.J. et al., 2017. Realising a vision of no net loss through marine biodiversity offsetting in Australia. Ocean & Coastal Management, 148, pp.22–30.

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# 1. Thesis scope, context and significance

## 1.1. Marine biodiversity and sustainable development

There is increasing consensus within scientific and political communities that biodiversity[5] is declining across all ecosystems and that this is likely to have profound implications for humanity (UNEP, 2012). The major cause of this loss is land-use change and exploitation for economic purposes, for example, through extractive industries such as fishing, mining and energy production (UNEP, 2012). These losses are compounded by anthropogenic climate change, driving unprecedented and unpredictable ecological shifts with biodiversity losses already predicted to be pushing the boundaries of the "*safe operating space*" known to support human societies (Mace et al., 2014; Rockström et al., 2009; Steffen et al., 2015).

[5] The term biodiversity is applied in its broadest interpretation following that provided by the Convention on Biological Diversity: *"…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"* (CBD, 1992a).

Biodiversity loss is of concern because of its essential role in the delivery and maintenance of ecosystem services on which human well-being is dependent. Ecosystem services describe the benefits that humanity derives from the environment including the provision of food, regulation of climate, cultural services and supporting activity such as nutrient cycling and the formation of soils (Haines-Young and Potschin, 2018; TEEB, 2010; UN, 2014). There is ambiguity as to the specific role of many individual biodiversity components in the delivery of many ecosystem services (Palumbi et al., 2009). Despite this, high diversity is thought to increase the resilience and stability of ecosystem functioning (and therefore services) through hedging against environmental fluctuations by the increased likelihood that key species of communities are present (Cardinale et al., 2012; Palumbi et al., 2009). Losses of biodiversity are not only likely to reduce the direct benefits accrued by humanity but a reduction in ecosystem function may decrease the resilience of the earth-system in its current state, the only state known to support human societies (Steffen et al., 2007).

Degradation of marine biodiversity is of equal or perhaps greater concern to that of terrestrial systems given their implication in processes essential for human well-being (Nash et al., 2017; Visbeck et al., 2014). Ecosystem services arising from marine biodiversity include provisioning, which is particularly critical in low-income countries (Halpern et al., 2015), and climate control among others. Trends of declining health and biodiversity are also prevalent in marine systems and these are likely to be exacerbated by an expected increase in pressure as such environments are further exploited. Current projections suggest that ocean-based industry is likely to increase its contribution to the global economy twofold by 2030 (European Commission, 2012a; OECD, 2016a). However, there are concerns that this potential economic growth could be limited by continued trends of environmental degradation (OECD, 2016a).

A major challenge for today's society is how to meet aims of economic growth and poverty alleviation without undermining the delivery of ecosystem services (Steffen et al., 2011; Visbeck et al., 2014). The conservation of biodiversity is a central aspect of this and is highlighted as a major risk given current trajectories and the limitations of current ecological knowledge to inform assessment of the relative risk of incremental and localised losses associated with development (Mace et al., 2014; Nash et al., 2017; Rockström et al., 2009; Steffen et al., 2011, 2015). There is international agreement on the need to reconcile economic development with improved biodiversity outcomes as demonstrated by the Convention on Biological Diversity (CBD) Aichi targets (CBD, 2012) and the United Nations Sustainable Development Goals (SDGs) (United Nations, 2015). The CBD Aichi targets set in 2010 define aims of sustainable use and consumption of biodiversity to bring "*the rate of loss of all natural habitats … close to zero*" (CBD, 2012). The targets outline that this will be achieved through positive incentives for conservation and sustainable development and the integration of sustainability plans by all Governments, business and stakeholders (CBD, 2012). Adopted in 2012, the SDGs extend the Millennium Development Goals of extreme poverty alleviation beyond their 2015 deadline and seek to integrate protection of environmental resources (United Nations, 2015). SDG 14 outlines aims to "*conserve and sustainably use the oceans, seas and marine resources*" (United Nations, 2015). For the effective protection of marine biodiversity these targets are described by Diz et al., (2018) as interdependent, and call for both the sustainable use and protection of marine biodiversity. The definition of sustainable development commonly follows that first published in The Brundtland Report authored in 1987: *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED, 1987). This report linked economic growth and social equity to environmental protection and to integrate all of these considerations into decision-making (WCED, 1987).

In line with the integration of economic growth and environmental protection goals described in The Brundtland Report (WCED, 1987) several tools have been applied. These tools include but not limited to those of a strategic nature, such as landscape-scale spatial planning or marine spatial planning (MSP) (Douvere, 2008; Jay et al., 2012) and strategic environmental assessment (SEA) (Fischer, 2003), and also include those at an individual project level, such as environmental impact assessment (EIA) (Glasson et al., 2005; Jay et al., 2007). These mechanisms all seek to assess the scale and significance of the potential environmental impacts of economic development are used to inform decisions as to the acceptability of an activity. MSP and SEA are often described as proactive approaches to embed sustainability through the exploration of use and development alternatives at a policy level, with EIA representing a more reactionary approach to manage impacts (Bidstrup and Hansen, 2014; Douvere, 2008; Noble, 2000). In practice, EIA methodologies are more developed than those for MSP and SEA and despite recognised failings and as such are strongly leant upon to deliver environmental protection (Alshuwaikhat, 2005; Jay et al., 2007). Biodiversity offsetting builds upon processes embedded within EIA frameworks. It attempts to improve environmental protection by strengthening the ecological interpretation of compensation for unavoidable impacts.

This thesis seeks to further understanding as to how biodiversity offsetting is being applied in marine environments and its contribution towards sustainable development. Chapter 1 provides the context of the research presented, with Section 1.2 providing an overview of the evolution of biodiversity offsetting and no net loss (NNL) policy. This includes discussion of the relative drivers for uptake of such policy approaches including through EIA and, in seeking efficient ways to meet aims of environmental protection using Market Based Instruments (MBIs). Section 1.3 follows with a summary of biodiversity offsetting and an introduction to the principles required if it is to successfully meet aims of NNL. This Chapter concludes with an overview of the thesis structure and a conceptual diagram illustrating how the research questions detailed in Chapter 2 have been addressed.

## 1.2. The origins of biodiversity offsetting

*Environmental governance*

The term governance broadly refers to the political and economic relationships between the state, businesses and civil society that define environmental actions and outcomes (Lemos and Agrawal, 2006; Rhodes, 1997). Examples of environmental governance include policies and legislation, local decision-making structures and environmental non-governmental organisations (NGOs). Since the 1980s there has been a shift away from centralised control in environmental governance driven by the increasing acknowledgement that governments do not have sufficient resources to manage their environments (Hardin, 1978; Lemos and Agrawal, 2006). The justifications for decentralisation include the potential for greater efficiencies through the introduction of competition, increased participation and accountability driven by this competition that allows decisions to be made on the most relevant knowledge about natural resources (Lemos and Agrawal, 2006). This decentralisation of authority seeks to push control and power away from government and into civil society (Osborne and Gaebler, 1993; Rhodes, 1997). This is done through focussing on outcomes that catalyse action by all civil sectors (public, private and voluntary) to solve problems (e.g. sustainable use and conservation of a marine natural resource) through efficient means (Osborne and Gaebler, 1993; Rhodes, 1997).

Biodiversity offsetting and aims of NNL have emerged in line with this trend of decentralisation. These approaches, in theory, provide an opportunity to instil the principles of 'good governance' within decision-making frameworks managing the sustainable use and conservation of marine biodiversity. Good governance is widely cited as being founded on the principle of legitimacy (Alexander et al., 2018; Craig et al., 2017; Rhodes, 1997; Rose-Ackerman, 2017). Analysis of the principles of 'good governance' describe how legitimacy is conferred through relationships of trust and integrity and can also be granted through effective democratic representation (Lockwood et al., 2010; Rhodes, 1997; Rose-Ackerman, 2017). Legitimacy is also described as being contingent on transparency and accountability, whereby aims and directions are clearly understandable and visible and the consequences of these are clearly demonstrated (Lockwood et al., 2010; Rhodes, 1997). Further principles of 'good governance' require that participation is inclusive and fair across all stakeholders, in addition to administrative factors to ensure the long-term relevance and effective delivery of a governance approach (Lockwood et al., 2010). Biodiversity offsetting requires the measurement and demonstration of how biodiversity losses and gains meet aims of NNL (see Section 2.3. for a description of the key principles for biodiversity offsetting). Accordingly, NNL should support 'good' environmental governance and lessen the tensions often present between economic development and environmental protection.

*Environmental impact assessment (EIA)*

One reason for the rapid and increasing uptake of NNL policy lies in the apparent inability of current development consent and licensing frameworks to modify development to reduce or mitigate environmental impacts. In addition to this, there is a desire to increase the scientific rigour of development consent processes and improve biodiversity outcomes. This policy which seeks an aim of NNL has been taken up by governments, financial institutions (such as development banks) and industry (Madsen et al., 2011; Rainey et al., 2014). Further, several prominent environmental NGOs have advocated for better integration of business and biodiversity through a range of mechanisms including through the application of NNL and biodiversity offsetting (Calvet et al., 2015; Hrabanski, 2015; Hrabanski et al., 2013). NNL requires that any residual impacts identified, through processes such as those involved in EIA, are counterbalanced with equivalent 'new' biodiversity through biodiversity offsets and follows the steps outlined in the mitigation hierarchy (avoid, minimise, remediate, offset; Figure 1.1) to achieve this.

Formal EIA systems arose in the United States under the US National Environment Policy Act (NEPA) in recognition of the need to manage environmental damage and loss through rapidly increasing urbanisation and industrialisation in the post-war era (Cashmore, 2004). EIA has since been adopted internationally and outlines a process that is common to many if not most development consent processes (Petts, 1999). The basic premise of EIA is to present an appraisal of the associated environmental impacts of an activity so that this can be factored into assessments of acceptability by decision-makers (Morgan, 2012). However, despite the wide-spread uptake of EIA, declining trends of biodiversity attributed to economic development persist (Cashmore, 2004; UNEP, 2012). Reviews of EIA effectiveness have shown that the contribution of the framework towards improving environmental protection has, thus far, been relatively minor (Cashmore, 2004; Jay et al., 2007; Wood and Jones, 1997). This has been attributed to the absence of an agreed theoretical basis defining how to incorporate political drivers and scientific information into decision-making (Cashmore, 2004; Wright, 2014). A general failing of EIA is cited as being the marginalisation of impact predictions within decision-making when weighed against economic and political factors (Jay et al., 2007) which are further undermined by the limited provision for the evaluation of impacts and the determination of their significance, leaving decision-makers to rely heavily upon expert opinion or precedents within the planning system (Benson, 2003).

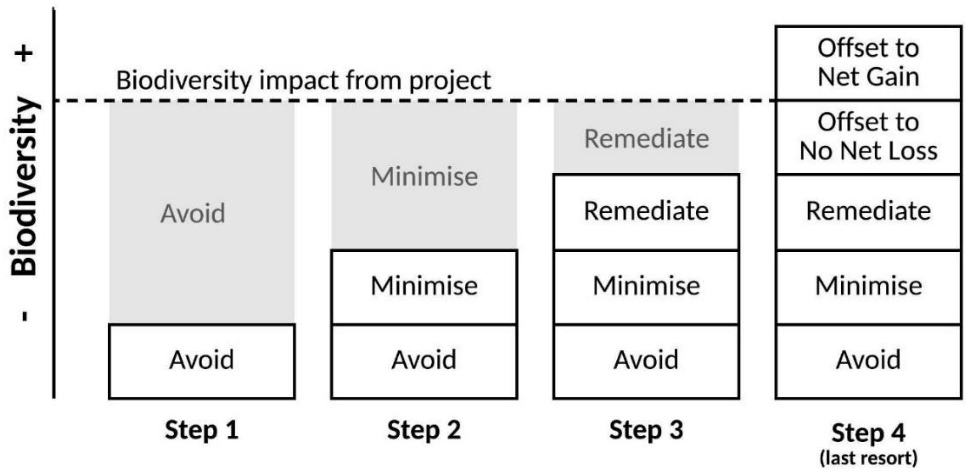


**Figure 1.1.** The mitigation hierarchy

Conceptually, the roots of current NNL policy lie in the evolution of wetland protection policy in the US starting in the 1970s and formalised with the Bush Administration that nationally adopted the goal as a response to US wetland habitat destruction in 1989 (Boisvert, 2015; Hrabanski, 2015; Robertson, 2000). The aim was consequently integrated into wetland policy in 1990 where a formal requirement was established for NNL to be realised through the application of the mitigation hierarchy or 'sequence' (Corps and EPA, 1990; Hough and Robertson, 2009). In the decades following to date an aim of NNL has been expanded to apply to biodiversity and has been adopted globally (IUCN, 2016; Madsen et al., 2011).

*Market-based instruments (MBIs)*

Another factor attributed to the increase in popularity of NNL and specifically the option to compensate through biodiversity offsets, is the move towards the use of market-based instruments (MBIs) for environmental protection and conservation (Balmford, 2002; Bayon and Jenkins, 2010; TEEB, 2010). A major reason for biodiversity loss across all ecological systems is theorised to stem from a lack of societal value placed on the natural world. A result of this has been the widespread and general assumption that natural capital (ecosystem services – the benefits that humans derive from biodiversity) are limitless and so the values placed on those services extracted has historically been underestimated (Costanza et al., 1997; Gómez-Baggethun et al., 2010). The notion that the natural world is limitless pervades and consequently it is not politically palatable or popular for the environment to be valued above other issues such as economic growth and this evidenced by the challenges facing the application of EIA for environmental protection (Jay et al., 2007). As such, decisions have been made that have led to the current trend of biodiversity decline and there is seldom sufficient finance provided from government to meet agreed targets for protection despite being ratified at an international level (Bos et al., 2015; Hein et al., 2013). This dilemma has led to the introduction of market-based instruments (MBIs) as a solution, the theory behind which is that the costs of environmental degradation are internalised into project or commodity pricing resulting in cost-efficient conservation (Boisvert, 2015; Dauguet, 2015; Hrabanski, 2015). Through internalising externalities (such as environmental degradation) into commodity pricing the market will effectively decide how much degradation is acceptable and how much it is willing to pay for access to that commodity when the price includes efforts to maintain the ecological values supporting the provision of that commodity.

Through internalising the costs of environmental damage within project budgets it is hoped to reduce the need for regulation and for projects to be held up by excessive 'green tape' (Grech et al., 2013; Queensland Government, 2012). An aim of NNL facilitates this by requiring a transparent and upfront assessment of the environmental costs of development proposals. Proposals that have associated risks of damage or biodiversity loss that is deemed significant, should reflect these risks or losses in the financial costs of meeting such an aim. An aim of NNL seeks to encourage developers to appreciate these costs at early stages of project planning with biodiversity offsets providing an early signal as to the financial viability of the proposal. Through this process, it is hoped that aims of NNL should discourage the progression of the most damaging activities. However, the approach has provoked controversy not least because achieving NNL is ecologically challenging but also because some view it as commodifying nature (Robertson, 2000) and eroding moral boundaries that have historically led society to protect the environment on intrinsic grounds (Apostolopoulou and Adams, 2015; Ives and Bekessy, 2015; Spash, 2013). Further, classifying biodiversity offsetting as an MBI is challenged by economists as it deviates from classic MBI and incentive characteristics and has yet to demonstrate it's potential to yield cost-efficient conservation (Boisvert, 2015; Spash, 2015; Vaissière and Levrel, 2015). Critics indicate that the inappropriate adoption of the language of economics to describe biodiversity offsetting reshapes and simplifies complex decisions. So that development consent decisions implicating biodiversity offsetting are viewed as "*rational choices*" and easy transactions that tend to focus on the benefits and what is gained as opposed to what is lost (Boisvert, 2015).

## 1.3. Biodiversity offsetting and no net loss (NNL)

Biodiversity offsetting offers an approach through which continued economic growth can be aligned with international commitments to sustainable development. Despite historic requirements for compensation, such as through EIA, trends of biodiversity loss arising from economic development have not halted. This is attributed to a lack of political will to refuse or modify development projects on environmental grounds (Hough and Robertson, 2009). Biodiversity offsetting seeks to address this issue directly by improving the rigour with which the mitigation hierarchy is applied and the ecological relevance of compensation through proportional and efficient conservation action (ten Kate et al., 2004). Furthermore, aims of NNL delivered through the use of biodiversity offsets is often described as a way to demonstrate a business' commitment to sustainable development (ten Kate et al., 2004). This demonstration is seen as an essential requirement of the social licence increasingly recognised as necessary for business to operate and government to govern legitimately (Boutilier, 2017; Dare et al., 2014; Prno and Scott Slocombe, 2012). Broadly, a social licence to operate (SLO) describes the relationship between society and an organisation and is, in effect, tacit approval of an organisation and activity (Bice and Moffat, 2014; Parsons and Moffat, 2014a) . Despite the lack of formality surrounding the concept of an SLO, it is closely tied to the way in which an organisation operates within other governance frameworks including that of EIA and industry held standards (Bice et al., 2017). Biodiversity offsetting as a way to deliver against aims of NNL has become representative of "*best practice*" in environmental management and integral components of both public (e.g. EIA) and private standards (ten Kate et al., 2004).

The final and last step of the mitigation hierarchy (McKenney and Kiesecker, 2010), biodiversity offsetting, is defined as "*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*" (BBOP, 2012). Essential to this is the need for "*demonstrably quantifiable equivalence between what is lost and gained*" (Bull et al., 2016) which sets the standard for what can be considered as an appropriate offset and what would be considered a misuse of the approach. Biodiversity offsets need to avoid displacing existing motivations and commitments, including those based on intrinsic reasons and legal requirements, to biodiversity conservation (Baron and Leshner, 2000; Spash, 2015). Further, an analysis of the counterfactual scenario, which is that most likely to have occurred in the absence of either impact or compensatory intervention (Ferraro and Pattanayak, 2006), is necessary to prove that offsets offer 'new and additional' biodiversity and are not misrepresenting what should be considered to be net losses. These requirements have proven difficult for a range of reasons, including the need to effectively encompass these challenges within policy (Clare and Krogman, 2013). Accordingly, there is limited evidence detailing the success of biodiversity offsets in realising NNL. As biodiversity offsetting becomes a more prevalent tool for managing environmental impacts, concerns exist as to consequent outcomes for biodiversity (Apostolopoulou and Adams, 2015; Maron et al., 2015b, 2018).

The overarching aim of this thesis is to improve upon currently limited understanding of marine biodiversity offsetting in practice. Although initially developed for aquatic (freshwater) systems the approach has a terrestrial focus and there has been little consideration of whether marine application requires specific and detailed translation. Many of the challenges posed by biodiversity offset application in general are suspected to apply to marine environment, yet the complexity and remote nature of marine environments is suspected to be poorly provided for in existing policy. Research is required to understand how translation of biodiversity offsetting policy to marine contexts is being undertaken and how this aligns with the intentions of the policy. Given that marine biodiversity is also in decline and pressures on the ecosystem services it provides are set to increase (Le et al., 2017; OECD, 2016b; Worm et al., 2006), it is important to understand how marine application of biodiversity offsetting might contribute to efforts to meet marine sustainability targets. Through a comprehensive review of the literature in the field of biodiversity offsetting the following Chapter considers the challenges posed by the marine application of the approach and the current status of knowledge relating to its use in theory and practice.

## 1.4. **Thesis structure**

The research presented in this thesis contributes to the limited yet growing body of literature examining the administration and governance of biodiversity offsetting in practice. It follows a logical progression, mapping global policy support for marine biodiversity offsetting down to the implications of applying this in practice. Based on the outcomes of Chapter 4 and documentation of the use of biodiversity offsets in marine environments (Bos et al., 2014; Brodie, 2014), I draw on Australia as a case study for exploring the practice of marine biodiversity offsetting. In improving understanding of the current state of marine biodiversity offsetting through these research questions I aim to provide insight into the current performance of the marine application of the approach and how policy might be improved to better support those implementing it in practice. This is explored through the following Chapters:

Chapter 2 considers what is currently understood about biodiversity offsetting in marine environments through a comprehensive literature review in the field of NNL. To date research has focussed predominately on the ecological complexity of establishing the measurable equivalence required to successfully meet aims of NNL. There is a growing body of literature documenting the ethical and administrative issues relating to biodiversity offsets. Yet there has been little academic exploration as to how institutional engagement with biodiversity offsetting policy might lead to the documented challenges. Existing literature suggests that many of the challenges posed by biodiversity offsetting are likely to be similar across terrestrial and marine environments. However, there is a limited academic basis considering marine application and to explore how terrestrial challenges and potential solutions raised in the literature may apply to marine contexts, particularly in relation to policy translation. I find indications that biodiversity offsetting is likely being applied in the absence of consistent strategies and that it may not adhere to the principles required for policy success. Available literature does not currently address the state of current policy support for marine biodiversity offsetting and implementation of the approach in practice. As such, I conclude by presenting research questions to address these gaps in knowledge.

Chapter 3 provides an overview of the methods selected to interrogate the research questions posed in this thesis. I introduce a rationale for method selection including the use of a case study to inform against the research questions explored within this thesis. This thesis adopts a mixed-method approach including a systematic document review and analysis of policy and planning documentation. This is augmented by a qualitative analysis of marine biodiversity offsetting policy development and implementation. This qualitative analysis is informed by in-depth interviews, the semi-structured approach adopted is introduced followed by an overview of the sampling strategy employed and a critique of avenues for data bias. The analytical approach adopted for interrogation of that data arising from the interview transcripts is presented. The Chapter follows with a brief introduction to the specific frameworks applied for the purposes of both Chapter 6, which focuses on the interpretation of biodiversity offsetting in marine contexts, and Chapter 7, which looks at stakeholder engagement with the policy at the point of implementation. To conclude I discuss issues of research governance including the ethical considerations and approval required to support the research presented.

Chapter 4 presents a global review and analysis of marine biodiversity offsetting policy**.** The detail of this policy support is analysed in terms of the adoption of the key principles for biodiversity offsetting success. This review indicates that there is little specific guidance for the transposition of terrestrially developed biodiversity offsetting policy for marine application. The Chapter also highlights that Australia has a relatively mature policy basis for marine biodiversity offsetting and is influencing policy development elsewhere.

Chapter 5 introduces the main case study, Australia, used to inform research questions 3-5 and analyses how biodiversity offsetting is being applied in marine settings in development consent processes. This is done through a review of development consent documentation where projects have associated marine biodiversity offset requirements and looks at whether processes and offset design align with the key principles for biodiversity offsetting success.

Chapter 6 uses in-depth interviewing techniques to explore the perspectives of stakeholders actively engaged with marine biodiversity offsetting in Australia to examine how the approach is being applied in practice. Analysis uses a boundary object framework to interpret perceptions relating to the definition and the factors controlling current implementation practice. I find that in the absence of policy support to account for the specific challenges posed by marine application, the approach is being used for purposes beyond normative aims of environmental protection.

Chapter 7 builds upon the results presented in Chapter 6 and considers how the factors leading current ambiguous modes of biodiversity offsetting implementation are perpetuated. This is undertaken through an analysis of perceived risk around the social, legal and political licences associated with the use of biodiversity offsetting. Through this analysis I consider the possible consequences of an aim of marine NNL for development control and environmental protection.

Chapter 8 syntheses the research presented within this thesis and discusses the findings in relation to the current challenges and outcomes of applying biodiversity offsetting in marine contexts. This is followed by an exploration of the potential opportunities and reflections of the relevance of these results for international application of biodiversity offsetting in marine environments. Finally, recommendations are provided as to the governance structures required to support biodiversity protection through development consent frameworks in marine environments.

Chapter 9 discusses the main conclusions reached in the thesis and outlines possible direction for further research.

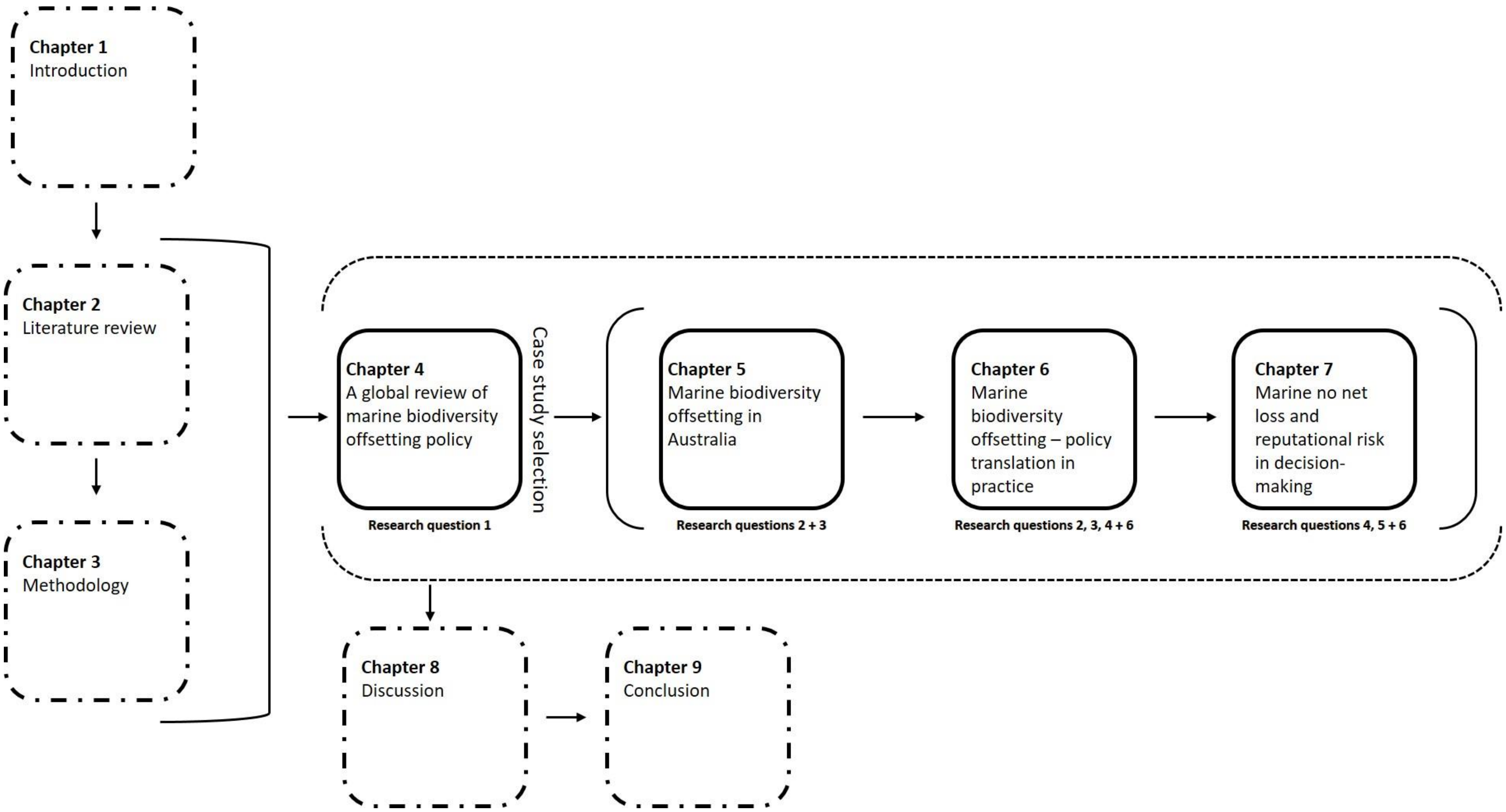


**Figure 1.2.** Conceptual diagram of thesis. Actual titles have been amended to give a summary of the chapter focus.

# 2. Literature review – the application of biodiversity offsetting in marine environments

## 2.1. Introduction

This Chapter examines the literature on the topic of biodiversity offsetting and associated aims of NNL and considers how this literature applies to marine environments. In Section 2.2. I track the themes of academic interest in biodiversity offsetting, this is followed in Section 2.3. by a brief introduction to the principles widely accepted as necessary for the successful use of the approach. Section 2.4. explores the difficulties in applying these principles and evidence of current practice and Section 2.5. describes the institutional complexity of NNL policy implementation. Section 2.6. analyses how these challenges apply to marine environmental systems and finally, Section 2.7 summarises the current state of knowledge in relation to marine biodiversity offsetting. Knowledge gaps relate to how biodiversity offsetting policy is being translated for marine application, how policy is implemented and the consequences for NNL and policy success. The Chapter concludes by detailing the research questions addressed in this thesis in Section 2.8.

## 2.2. Charting interest in biodiversity offsetting

Decisions relating to the economic use of environmental resources have historically been perceived as incompatible with environmental protection. Biodiversity offsetting and associated aims of NNL, in theory, addresses this issue through aligning the objectives of biodiversity protection and economic development (Bull et al., 2013). Despite the ecological and administrative complexity of realising an aim of NNL, biodiversity offsetting has proved politically popular as indicated by a rapid policy uptake (Bull et al., 2013; Madsen et al., 2011). The motivations for the popularity of biodiversity offsetting and NNL appear to lie with a need to improve environmental protection practices and to demonstrate commitment to improving the sustainability of development (ten Kate et al., 2004). Review of both offsetting policy and academic literature indicate that the ecological science to underpin the approach lags behind its practical application (Calvet et al., 2015) and the outcomes of this practice remain largely unknown (Gibbons et al., 2017).

Biodiversity offsetting and NNL, was developed as an approach to address the problem of post-war habitat degradation in the US and gained widespread traction during George Bush's presidential campaign in 1988 (Robertson, 2000). Reflecting these political origins in a systematic review of literature on the topic of biodiversity offsetting Calvet et al. (2015) show that its origins lie with practitioners and policy, with early academic literature on the topic dominated by non-peer reviewed material. The authors describe the evolution of academic interest shifting towards the technical and ecological aspects required to underpin an aim of NNL and biodiversity offsetting, and an accompanying "*economisation of the BO [biodiversity offsetting] lexicon*" (Calvet et al., 2015). Economists contest the representation of biodiversity offsets as market-based instruments (MBIs) (Boisvert, 2015; Dauguet, 2015; Hrabanski, 2015; Vatn, 2014). Critiques of this trend suggest that this economisation has been driven by those whose expertise lies outside of the field of economics such as conservation biologists, environmental NGOs and others seeking ways to address the degradation of biodiversity accompanying trends of land use change and urbanisation (Boisvert, 2015; Hrabanski, 2015; Hrabanski et al., 2013). They explain that the approach does not exhibit the characteristics of an MBI and that such a description is a misrepresentation and an oversimplification of a complex situation (Boisvert, 2015; Lapeyre et al., 2014).

In their review of the evolution of academic interest in biodiversity offsetting Calvet et al. (2015) show that in the last decade there has been a focus on the ecological and administrative challenges posed by the approach. The primary ecological challenge posed by biodiversity offsetting relates to the definition of an exchangeable or fungible unit that appropriately captures biodiversity and allows for an equivalent trade-off (Morris et al., 2014; Purvis and Hector, 2000). Further to this, current knowledge and experience in restoration ecology is limited and as such we have little demonstrated ability to restore ecological systems to a fully functioning and self-sustaining state (Kentula, 2000; Wiegleb et al., 2013). Other issues relate to the potential for the misuse of the approach to mask biodiversity losses, divert or reduce conservation funding (Gordon et al., 2015; Pilgrim and Bennun, 2014) and alter the ethical basis on which decisions relating to environmental impacts are taken (Ives and Bekessy, 2015; Spash, 2013). These concerns have been distilled into a number of criteria widely accepted as necessary to realise aims of NNL through the use of biodiversity offsetting (BBOP, 2012; Bos et al., 2014; Bull et al., 2013).

## 2.3. Key principles for biodiversity offset success

*No net loss (NNL) & equivalence*

The concept of NNL underpins the use of biodiversity offsets, however, the detail to support interpretation and application of this is seldom provided in policy (Bull et al., 2013). NNL sets out the need for biodiversity losses permitted, such as a result of impacts attributed to a development project, on the premise that they are to be counterbalanced by the provision of *new* biodiversity at another site. These biodiversity benefits should be equivalent to those lost and should be measured against an established counterfactual scenario outlining the likely trajectory that would have taken place in the absence of any impact or offsetting activity (Maron et al., 2015a). Aims of NNL should be measurable and demonstrable (Bull et al., 2016) which can be challenging as a result of the complexity of most ecological systems and the wide range of ways in which the term biodiversity can be interpreted (Morris et al., 2014; Purvis and Hector, 2000). Accordingly, qualification of NNL is required in order to operationalise the concept, i.e. to define the units involved in the trade to allow for an appraisal of equivalence (Maron et al., 2018).

*Feasibility, thresholds & time lags*

It is widely accepted, and outlined within the Business and biodiversity offsets programme (BBOP) Standard on Biodiversity Offsets (2012) that non-offsettable impacts exist. These include impacts to biodiversity components considered to be highly irreplaceable and vulnerable, such as those that are endemic to a small area and those that provide essential community benefits (Pilgrim et al., 2013a, 2013b). Assessment of offsettability is an essential factor in deciding whether NNL is feasible with the actions and associated impacts under consideration. The offsettability of an impact provides an indicator that the first two steps of the mitigation hierarchy require further investigation. Offsettability could be affected by the crossing of tipping points or thresholds, for example if a species is pushed beyond the point of viability and is set on an irreversible trajectory of extirpation (Gibbons and Lindenmayer, 2007; Pilgrim et al., 2013b). Another example would be the cumulative effects of removal of available foraging ground for a species because of several developments. It is important that these cumulative effects and tipping points are considered and that any associated time-lag with the delivery of biodiversity benefit is included in the assessment of offset feasibility and/or offsettability (Bekessy et al., 2010; Gibbons and Lindenmayer, 2007; Pilgrim et al., 2013b).

*Additionality*

Offset activity needs to be considered as additional to the counterfactual scenarios and leading to benefits beyond those that would occur in the absence of the offset project. This is to ensure that biodiversity offsets do not displace or discourage existing or planned efforts or commitments towards biodiversity protection. This context is essential to ensure that the counterfactual scenario and baseline against which biodiversity gains are measured is accurate and also to avoid misuse, 'cost-shifting' and the displacement of existing or future marine conservation finance (Gordon et al., 2015; Maron et al., 2015b; Pilgrim and Bennun, 2014).

*Compliance success*

The mitigation hierarchy is common to many EIA frameworks globally and is based on the premise that avoiding and reducing impacts is the most effective and efficient way of protecting biodiversity (Figure 1.1). It stipulates that the potential impacts of a project, plan or activity be first avoided, mitigated and then remediated before biodiversity offsets are considered to account for residual losses as a last resort (Kiesecker et al., 2010). Subverting this hierarchy and applying biodiversity offsetting at any other stage other than as a very last resort is thought to be a misuse of the approach. Any 'short-circuiting' of the mitigation hierarchy, reduces the need to optimise measures that could reduce the occurrence of impacts, such as project redesign or the adaptation of technology, and facilitates the idea of offsets forming some sort of transaction and effectively acting as a 'licence to trash' (ten Kate et al., 2004). The original intention of biodiversity offsetting and NNL aimed to promote the use of the precautionary principle and focus on the preventative measures presented in the mitigation hierarchy (avoid, minimise) as opposed to those of remediation and offset seeking to rectify losses (Ekstrom et al., 2015; UNEP-WCMC, 2016). The CBD outlines the need for a precautionary approach whereby *"Where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat"* and that the precautionary principle will be incorporated explicitly to address issues of conservation and sustainable use (CBD, 1992b).

Effective governance measures are essential to secure not only the appropriate use of biodiversity offsetting in decision-making, but also the implementation and ongoing delivery of offset projects (Brown et al., 2013; May et al., 2017). For these to be effective, indicators of success need to be identified and progress towards should be informed by monitoring. Compliance frameworks may also need to account for flexibility so that actions can be taken in relation to the information provided through such monitoring. This should allow for adaptive management and increases in the ecological success rates of the offset project. Flexibility within compliance regimes would also support the precautionary approach often cited as necessary to account for uncertainties in predictions of the counterfactual scenarios (Bull et al., 2015). Compliance is also required to align the temporal delivery of the biodiversity benefits provided by the offsetting project with the losses associated with the damaging action (Bekessy et al., 2010; Gibbons and Lindenmayer, 2007). In order to be equivalent the benefits should be realised for the full duration over which impacts (losses) last (Bull et al., 2013). In many cases this could be considered to be a long-term commitment such as 'in perpetuity' (the definition of which depends on that provided in policy (Bull et al., 2013)) or indefinitely, and finance for this should be secured for the full duration of the offset life (Carvalho, 2017; Lamb et al., 2015).

*Acceptability & Equity*

Biodiversity is essential for the continued and reliable provision of ecosystem services, particularly in response to changing environmental conditions (Mace et al., 2014; Steffen et al., 2015). As such, losses of biodiversity should be analysed from a human perspective in relation to the ecosystem services arising from the biodiversity in question to encompass any associated cultural and intrinsic values, that may be lost (Ives and Bekessy, 2015; Soulé, 1985). These values, to include understanding incorporated from traditional knowledge sources (BBOP, 2012), should be incorporated into appraisals of acceptability to understand the full suite of impacts associated with the proposed trade-off. Many of these values are strongly associated with a specific location, given that offsets commonly involve a spatial exchange of biodiversity (BenDor et al., 2007; Maron et al., 2016a) but also relate to the temporal distribution of the benefits arising from a healthy, functioning and biodiverse environment (Lukey et al., 2016; Van Dover et al., 2017). Ultimately the acceptability of biodiversity offsets needs to be established through a transparent and consultative process whereby all stakeholders understand the trade-offs and risks implicated by the proposal (BBOP, 2012).

## 2.4. Challenges and controversy

The principles described in Section 2.1. distilled from policy and literature based on biodiversity offsetting and including the BBOP Standard (2012) have been widely accepted as necessary to realise an aim of NNL and to avoid the misuse of the approach. However, in practice the principles are difficult to implement and there has been little documented offset success (Gibbons et al., 2017). Major concerns relate to the misuse of the approach, not only in relation to its role within decision making but also to the implementation of offsets and our ability to restore ecological systems (Gordon et al., 2015; Maron et al., 2016a). The wide-spread absence of post-consent monitoring, and the historical tendency to refer and apply offsets in a broad sense with little contextual definition, fuels concerns that the approach could, contrary to stated aims of NNL, be facilitating and thereby contributing to biodiversity losses (Burgin, 2011; von Hase and ten Kate, 2017).

*Issues of equivalence*

Reviews of compensatory habitat creation or restoration have consistently found that 'new' biodiversity does not deliver the full suite of functions and benefits as compared to natural systems (Ambrose, 2000; Burgin, 2009; Kentula, 2000; Moreno-Mateos et al., 2012; Quigley and Harper, 2006b). This complicates the requirement of biodiversity offsetting to demonstrate equivalence between biodiversity lost and the benefits arising through the counterbalancing compensatory action (Bull et al., 2013). One of the key reasons identified for this poor performance is the current limited understanding and experience in the relatively new discipline of ecological restoration that arose in the nineties (Calvet et al., 2015; Hobbs and Norton, 1996). Hobbs et al. (2011) following Hilderbrand et al. (2005) argue that the limitations of restoration to end points equal to a naturally occurring previous state are such that an aim of equivalence is likely to be unrealistic. They go as far as to suggest that the term 'restoration' is misleading, leads to false expectations and that ecological complexity is such that replication is not possible. A major obstacle to equivalence is presented by a need to establish identical biodiversity through restoration effort across two different spatial locations, which are unlikely to exhibit the same ecological connections or values (Drechsler and Wätzold, 2009).

Defining a currency across which equivalence can be assessed is also essential (Salzman and Ruhl, 2000). This is challenged by the likely disparity across the natural and restored systems across which equivalence is to be sought and the need to establish a relationship between losses and gains through a single unit (Dauguet, 2015; Walker et al., 2009). Further, definitions of biodiversity can vary depending on the context and scale applied. For example NNL of ecosystem function or functional diversity, as opposed to species richness, would allow an indicator of success to include the restoration of a full suite of functions which may or may not require that all original species have returned (Van Andel et al., 2012). As summarised by Hilderbrand et al. (2005) the "*over-application of over-simplified concepts to complex systems*" has led to the restoration failure that has been commonly reported. They outline that this simplification is undertaken to reduce the variability and uncertainty inherent to complex ecological systems to allow for the (perceived) management of these systems. Simplification is also raised as a concern in relation to the definition and assessment of equivalence required by biodiversity offsetting. Often a proxy is selected that is easy to measure, such as ecological communities which can be evaluated relatively simply and on broad scales, as opposed to more complex aspects of biodiversity like ecosystem services (Burgin, 2008, 2009). Proxy selection can include attributes of function or relate to the occurrence of specific species and genetic diversity (Bruggeman et al., 2005, 2009; Cadotte et al., 2011; McCarthy et al., 2004) and to allow accountable assessments of equivalence, metrics are used to calculate a surrogate for biodiversity (Burgin, 2008; Dunford et al., 2004; Maron et al., 2015a; Salzman and Ruhl, 2000).

The metrics developed thus far range in complexity from simple habitat area (Race and Fonseca, 1996) through to compound metrics that incorporate information about the condition of the habitat and its context within the landscape (Bas et al., 2016; Bruggeman, 2015; McCarthy et al., 2004). This context is essential to understand the relative importance of the habitat to be effective and the required characteristics of the consequent offset (Bekessy et al., 2010). Whilst metrics are deemed essential to allow for transparent and robust assessments of biodiversity offset requirements, they are criticised again for the over-simplification of complex systems and debate as to how they should best be applied is ongoing. Hanford et al. (2017) conclude that metrics involving flora species as a surrogate for total biodiversity do not perform adequately to realise an aim of NNL. Complicating metrics to better represent ecological networks is often viewed as undesirable as the costs of data collection are high and delaying project initiation unfavourable. This view point has been addressed by Bruggeman (2015) who found that by reducing the uncertainty of offset outcomes by delaying losses and improving understanding may lead to better and more cost-effective conservation outcomes. However, others have found that the increased costs of delay and data acquisition to reduce the uncertainty with more complicated metrics rarely results in altered management decisions (Grantham et al., 2009).

While metrics are criticised in their ability to manage assessments of ecological equivalence, they can to some degree account for the risk posed by an offsetting activity. These risks arise from restoration uncertainty and also other factors relating to compliance and they can be managed through the application of multipliers which increase the size of the offset requirements (Gibbons et al., 2016; Laitila et al., 2014; Moilanen et al., 2009; Pilgrim and Ekstrom, 2014). Multipliers are thought to be important given the definite nature of losses as compared to the very uncertain gains presented by biodiversity offsets and numerous studies have found that they are likely to be very large to achieve equivalence (Gibbons et al., 2016; Laitila et al., 2014). This has also been suggested as a way to manage trade-offs across biodiversity type where 'like for like' transactions are not possible or available, with multipliers or ratios applied to balance the significance or relative 'value' across biodiversity type (Bull et al., 2015). This has been termed 'trading-up', where losses of one type of biodiversity are accepted in lieu of gains of a different but more highly valued type (e.g. more threatened or rare) (Quétier and Lavorel, 2011; Sochi and Kiesecker, 2016; Wilcox and Donlan, 2007). Trading-up has been proposed by some as a way to focus efforts on the biggest conservation challenges. However, these 'out of kind' exchanges are not commonly supported by policy, which more commonly describes a preference for 'like for like' exchanges involving similar ecosystems and ideally in the same locality such as watershed (Bull et al., 2015). Some argue that in such cases where equivalence is unachievable or the risks too high, such as for very rare habitats or those that with extremely long recovery timescales such as deep-sea habitats or ancient woodlands, assessments of offsettability should indicate that further application of the steps of avoidance or mitigation is required (Pilgrim et al., 2013a; Van Dover et al., 2017).

To ensure that biodiversity offsetting requirements are sufficient to meet the requirement of equivalence, an appropriate baseline should be defined against which assessments are made. Studies have shown that the baseline selected is highly influential over the outcomes of biodiversity offset policies (Bull et al., 2014; Gordon et al., 2011, 2015). Specification of this baseline is often not provided within offsetting policy and in a review of crediting baselines used in offset policies in Australia Maron and colleagues (2015a) found that where information was available all assumed declining baselines at greater rates than recent rates of vegetation loss. This is significant because applying these baselines under an aim of NNL effectively sets the target outcome from offsets at this steadily declining rate as opposed to a more aspirational target (Gordon et al., 2015; Maron et al., 2015a). This situation is exacerbated by the lack of offset success observed to date (Curran et al., 2013; Lindenmayer et al., 2017; Maron et al., 2012). To avoid this situation it is advised that crediting baselines are subject to regular review to reflect the current situation under widespread international commitments to improving biodiversity (Angelsen, 2008). This situation, that details the scenario which was expected to occur in the absence of impact or offsetting action is commonly referred to as the counterfactual scenario (Maron et al., 2015a; Virah-Sawmy et al., 2014). The counterfactual scenario should also be used to inform assessments of additionality to ensure that baselines include outcomes of current commitments, perhaps even towards constant or increasing baselines of biodiversity, so that NNL does not displace or undermine external conservation efforts (Gordon et al., 2015; Maron et al., 2015c).

*Issues of compliance*

Compliance frameworks have been found to be instrumental in the delivery of offsets. Experience in the US and Australia among other countries has found that very little post implementation monitoring and enforcement has been undertaken of offsets and this has been commonly attributed to poorly constructed licencing conditions and insufficient regulatory capacity (Brown et al., 2014; Brown and Lant, 1999; Brownlie et al., 2017; Burgin, 2009; Gibbons et al., 2017; Kentula, 2000; Lindenmayer et al., 2017; May et al., 2017; Pickett et al., 2013). Issues of compliance identified with respect to offsets range from the failure to initiate the implementation of offsets, poor offset design, the absence of offset definition or indicators of success and the absence of required adaptive monitoring over ecologically relevant time periods (Brown et al., 2014; Brown and Veneman, 2001; Kentula, 2000; Lindenmayer et al., 2017). The general absence of detail within conditions appended to planning permissions (development consent, licences) is attributed as the root cause (Brown et al., 2013; Brown and Veneman, 2001). Low levels of capacity within regulatory bodies have also been identified as being detrimental to the scrutiny of post-consent activity (Brown and Veneman, 2001). To address the issue of non-compliance, prescriptive detail within planning conditions coupled with increased regulatory capacity has been highlighted as necessary. Third-party involvement is also commonly cited as a way to manage this, through independent auditing and evaluation of offset projects (Martin et al., 2016; Pickett et al., 2013), for the clearing of funds (such as through regulation of a habitat bank) (Pawliczek and Sullivan, 2011) or for the delivery of biodiversity benefits as independent restoration specialists (Bos et al., 2014). Government centred offsetting schemes, whereby the government receives offset funds, are expected to lead to the identification of priority projects. However, this mode of organisation presents the risk of regulatory capture where those making decisions permitting biodiversity loss, are also the direct beneficiaries of the offsetting requirements being set (Grech et al., 2013).

Effective compliance is commonly cited as essential for biodiversity offsetting success, influential at all stages of biodiversity offsetting from quantification of impact through to design and implementation. The first stage of impact quantification requires that the mitigation hierarchy is robustly implemented, to optimise the first two steps of avoidance and minimisation and only allow for high risk act of offsetting as a last resort (Bull et al., 2013). Compliance is required to ensure that this is adhered to, however, few guidelines exist as to how to interpret the qualifier 'reasonably practicable' as commonly included in biodiversity offset policies (Arlidge et al., 2018; McKenney and Kiesecker, 2010) or sufficient avoidance and minimisation (Ekstrom et al., 2015) and how this should be evidenced (Bos et al., 2014; Jacob et al., 2016a). This detail is essential for enforcing the application of the mitigation hierarchy and to ensure that EIA is undertaken robustly so that offsets are based on identified unavoidable impacts only.

At the point of offset design evidence should be provided to enable an assessment of additionality (BBOP, 2012). There is little evaluation or guidance within available academic or grey literature detailing how and whether this is currently being undertaken. Pilgrim and Bennun (2014) in discussing the relationship of biodiversity offsets and protected areas provide examples where additionality is not being considered. These examples include the use of the approach as a source of conservation finance to meet previously held international conservation commitments such as those in relation to protected areas and the restoration of degraded ecosystems under the Convention on Biological Diversity (CBD) (Maron et al., 2015b). Further examples provided relate to the use of biodiversity offset finance to free up funds for core activity in sectors outside of the environment such as the military, health and education, all of which cannot be considered to create additional biodiversity benefit. The authors suggest that such approaches might be acceptable for low-income countries to contribute to the development of a protected area network but with the caveat that this would be on a temporary basis, only justifiable until the point that a government can assume its core responsibilities (Pilgrim and Bennun, 2014). Another example discussed within literature relates to using offsets that avert future or existing damaging activities thus 'protecting' an area and allowing it to recover (Gibbons and Lindenmayer, 2007). Challenges of appropriately and transparently evidencing this are raised as key issues for compliance (Gibbons and Lindenmayer, 2007; Pilgrim and Bennun, 2014).

Compliance regimes should also ensure that the issue of ‘leakage’ from biodiversity offsets is fully addressed at the point of offset design. Leakage relates to the continued or increased loss of biodiversity elsewhere as a consequence of the implementation of an offset and can manifest in a number of forms (Moilanen and Laitila, 2016). These include the direct displacement of a damaging activity to another spatial location or diffusely through an increase in market demand of a commodity through the removal of access to a resource once it is incorporated into an offset. This increased market demand could drive increased resource extraction in another administrative area again, leading to biodiversity losses such that NNL is not achieved (Aukland et al., 2003). Moilanen and Laitila (2016) describe how the issue is well-documented in relation to protected area management and particularly difficult when the problem manifests as indirect leakage where the damaging action and biodiversity losses spill into other administrative areas. Offsetting policy and guidance provides little advice in how to account for indirect leakage when implementing biodiversity offsets, tending to focus on the issues posed by direct leakage that is local and to some extent controllable (Moilanen and Laitila, 2016). Multipliers, that is increasing the size of the offset required by a factor set in relation to the risk of leakage, have been proposed to address this issue to account for a degree of leakage when calculating NNL. However, if leakage is occurring across administrative areas then, beyond applying a regional ‘fix’ such as a reduction in effort across an industry exerting the same type of pressure on a system,  Moilanen and Laitila (2016) conclude that averted loss is unlikely to achieve NNL.

Post-consent monitoring or compliance assessment of biodiversity offsets has been shown to be poor (Brown and Veneman, 2001; Bull et al., 2013; Kentula, 2000; Maron et al., 2016a; May et al., 2017). This is attributed to a lack of resources or capacity to evaluate policies (Brown et al., 2013), political disincentives where increased scrutiny could be financially or reputationally damaging (Keene and Pullin, 2011) and poorly designed conditions (Lindenmayer et al., 2017). A review of offset effectiveness in Western Australia by May et al. (2017) illustrates that offset effectiveness (or success) is often not a requisite for compliance success. Their findings support those of Sudol and Ambrose (2002) who report that the absence of appropriate and measurable targets within regulatory conditions are preventing the ecological success of offsets and meeting aims of NNL. Guidance is currently unavailable on how to design evaluation programs at individual project and policy levels (Lindenmayer et al., 2017; Maron et al., 2016a) despite wide recognition of this issue and a key aim of transparency in the use of the approach (BBOP, 2012). Suggestions as to how this can be addressed commonly relate to increased definition and prescription within development consent conditions (Lindenmayer et al., 2017), increased public participation and also other outcomes-based contractual incentives, including the use of financial bonds (Maron et al., 2016a) or, for highly risky projects, through staged development consent (Tinch and van den Hove, 2016).

Compliance regimes also need to establish the relative responsibilities for the duration of the biodiversity offset to ensure that sufficient resources are in place for the duration of the commitment. With recovery of ecosystems shown to take decades to thousands of years, the durations of management, monitoring and financial commitments of offset projects necessary to realise equivalence an aim of NNL are significant (Curran et al., 2013; Hilderbrand et al., 2005; Moreno-Mateos et al., 2015). Further, many offsets are required to be in place in perpetuity, which in many cases is likely to last beyond the contractual agreements (e.g. mine-life) that a regulator may have with a proponent. Lamb et al. (2015) report that the long durations over which offsets are required to provide biodiversity benefit has proven to be a regulatory problem in relation to the management of the remediation of terrestrial mine sites as required by development consent conditions. In these cases, where remediation is required at the end of mining operations, the issue of responsibility arises, where at this point the concession may have been sold off to smaller, less financially stable companies. These smaller companies are less likely to possess the required expertise, experience and financial resources to manage the long-term requirement of remediation (Lamb et al., 2015). In such cases, the responsibility either passes to the appropriate regulator or the remediation is foregone, and it is argued that these requirements should not be able to be transferred without strict control for managing offsets for their full lifetime to account for future adaptive management requirements and to ensure NNL.

*Ethical issues*

Apostolopoulou and Adams (2015) among others suggest that biodiversity offsetting has altered the basis on which decisions are made in relation to environmentally damaging activity. They claim that the use of offsets is often undertaken out of context and based on broad, and often inappropriate, ecological assumptions so that the mitigation hierarchy is short circuited. They describe a reduction in the scrutiny of possible avoidance measures and similar concerns are raised by others that suggest that an overestimation of the conservation benefits of an offsetting action may occur to facilitate such transactions (Gordon et al., 2015; Maron et al., 2015b). In addition, Ives and Bekessey (2015) express concern that biodiversity offsetting alters moral boundaries previously held by society which previously acted as a barrier to some environmentally damaging activities. Gordon et al. (2015), in an account of the potential perverse incentives associated with biodiversity offsets, outline one of the key risks as the miscommunication of our abilities to achieve NNL through restoration and other means and also a true account of exactly what these risks might mean to society. This false marketing or 'green washing' engenders public confidence further eroding the societal boundary associated with the approval of environmental damages through development (Apostolopoulou and Adams, 2015; Büscher, 2012).

Numerous studies have identified a risk of biodiversity offsetting to be the temporal (Lukey et al., 2016; Niner et al., 2018; Van Dover et al., 2017) and spatial redistribution or removal of benefits arising from natural habitat (Levrel et al., 2017). A well-studied example relating to the issue posed by changing the spatial distribution of biodiversity and ecosystem services is that of wetlands in the US where their destruction has led to the creation of man-made wetlands to satisfy legislative requirements for NNL (BenDor et al., 2007; Robertson and Hayden, 2008). Ruhl and Salzman (2006) have shown a similar trend in Florida, where wetland mitigation has led to a shift from urban to rural distribution of these habitats and associated benefits. This is attributed to the relative costs of land, with those centred in urban settings being initially more expensive than those in rural areas. This shift is documents to conversely lead to an associated reduction in value of urban areas left devoid of green space (BenDor et al., 2008; Kaza and BenDor, 2013; Wolch et al., 2014). BenDor et al. (2007) also raise the socio-economic consequences of such a redistribution of natural areas. These include the further disadvantaging of low-income inner-city populations through both diminished values of the areas in which they live but also by further limiting access and receipt of the benefits and associated well-being associated with natural systems. The authors suggests that it is not clear that these concerns or consequences are fully incorporated into decisions relating to biodiversity offsetting (BenDor et al., 2007).

The commodification of nature through biodiversity offsetting is raised as a common concern across literature critiquing the approach (Maron et al., 2012; Robertson, 2000, 2006; Spash, 2015). As described by Robertson (2012) the root of these concerns lies with the reduction of complex systems to fit into fungible units that are unlikely to encompass the many and complex ways that biodiversity is valued. This simplification of the science of measurement to a manageable scale to identify tradeable units is described as reducing assessment labelled as being neither "*scientifically or ethically justifiable*" (Van Dover et al., 2017), but often little attention is paid to the poor ways in which human values are considered within simplified assessments of trade-offs (Apostolopoulou and Adams, 2015). The well-described tragedy of the commons highlights the societal tendency to undervalue biodiversity in relation to wider ecosystem services, with a short-term preference for immediate gains being exhibited (Hardin, 1968). However, decision-making relating to impacts on biodiversity has historically been based on foundations that prohibit certain damaging actions (e.g. endangered species protection). Given there is very little evidence as to how the approach is performing and that the limited evaluations undertaken indicate that NNL is not being achieved (Gibbons et al., 2017), coupled with current concerns as to the degree of biodiversity loss globally (Butchart et al., 2010), a transparent assessment of risk with a lens on social and intergenerational equity in terms of the ecosystem service provision is recognised as essential.

## 2.5. **Uptake and implementation of biodiversity offsetting policy**

The challenges described are increasingly recognised, and strategies to avoid them are being developed and adopted alongside biodiversity offsetting policy. These strategies include the application of metrics and guidance to set the boundaries for the application of biodiversity offsets (Maron et al., 2015c; Vaissière et al., 2016). Further, high-level initiatives for centrally-governed biodiversity offset delivery are being adopted to overcome the inefficiencies of smaller scale offsetting activity. Beyond these actions it is unclear how the criteria understood and accepted as necessary to meet aims of NNL are supported by existing policy at the point of implementation. Environmental management is commonly described as a 'wicked' problem (Rittel and Webber, 1973) which is inherently subjective and often controversial (Jentoft and Chuenpagdee, 2009; Lockwood et al., 2010). Accordingly, the application of biodiversity offsetting policy is well-understood as being undertaken under uncertain and contested terms. Whilst non-compliance and biodiversity offset failure is described within literature (Brown et al., 2014; Brown and Lant, 1999; Brownlie et al., 2017; Burgin, 2009; Gibbons et al., 2017; Kentula, 2000; Lindenmayer et al., 2017; May et al., 2017; Pickett et al., 2013; Salzman and Ruhl, 2000; Walker et al., 2009) there has been limited attention paid to the institutional relationships that have allowed this to occur (Clare et al., 2013; Clare and Krogman, 2013). Clare and Krogman (2013) examine how offset policies have varied in implementation from their stated aims in Alberta and conclude that agency capture driven by policy ambiguity was the root cause of the policy failure observed. This finding bolsters the theory proposed by Lipsky (2010) in his work on policy implementation that it is the decisions and strategies employed by those at the coal-face to "*cope with uncertainties and work pressures*" that define policies in practice.

A common rationale for policy failure within offsetting literature is a political bias towards economic development, with biodiversity offsets being applied to facilitate development (ten Kate et al., 2004). However, a more nuanced analysis such as that provided by Clare and Krogman (2013) is required to understand whether such a bias exists and if so what factors are allowing it to pervade policy implementation. In an account of the contested development of biodiversity offsetting policy in the UK, Ferreira (2017) describes how the concerns of environmental activists and NGOs over biodiversity offsetting led to the coalition of an opposition to the approach. This opposition ultimately led to the withdrawal of efforts to "*institute a market*" driven by biodiversity offsetting (Ferreira, 2017). This example highlights the influence of various stakeholders on both policy development and implementation. It also serves to highlight how biodiversity offsetting with an associated aim of NNL may be too simplistic a representation of the wide-range of societal norms and desires. For example, aims of NNL assume a societal preference for environmental protection over biodiversity loss at all costs. However, it could be the case that society or relevant community might prefer a different 'balance' which may entail biodiversity loss in exchange for economic gain (Ferreira, 2017; Milne, 1996). In contrast, institutional critique of biodiversity offsetting policy leads Apostolopoulou and Adams (2015) to argue that the approach weakens conservation. They describe how through smoothing the conflict between the conservation movement and economic development that has always been prevalent has altered the political landscape to one that more readily accepts business as usual relationships based on trends of biodiversity decline (Apostolopoulou and Adams, 2015; Dempsey and Collard, 2016). In response, Dempsey and Collard (2016) propose that it is not the adoption of NNL that has redefined these relationships but the acquiescence of environmental activists and NGOs to the inadequate implementation of such policies. The authors submit that the traditional opposition of NGOs against economic development should be maintained and coordinated to enforce a meaningful interpretation of NNL that does not implicate "*sacrifice [of] human or non-human bodies*". The range of arguments put forward as to the risks and reasons for failure of NNL and biodiversity offsetting policy indicate a susceptibility to ambiguity and subjective interpretation. However, there is little documentation or discussion available within the associated body of literature as to how the policy is being used by stakeholders within development consent and to what end.

## 2.6. **Biodiversity offsetting in marine contexts**

There is little evidence available to indicate that biodiversity offsetting is successfully achieving or contributing to aims of NNL in terrestrial environments for which the approach has been developed (Gibbons et al., 2017). There is even less information available that documents and evaluates the marine application of the approach. This is despite indications that marine biodiversity offsets are being used in marine development consent processes (Brodie, 2014). Accordingly, it is not understood how marine application compares to experience in terrestrial environments and whether best practice aligns or differs for both contexts. Offsetting policy does not commonly address the specific use of the approach in marine environments and as such it is assumed that in most cases ad-hoc translation is occurring (Bell et al., 2014; Jacob et al., 2016a). Many of the concerns, challenges and controversies that relate to biodiversity offsetting in terrestrial environments are also common to marine environments (UNEP-WCMC, 2016). However, there are some issues that are exacerbated or specific to the marine application of the approach. These include, our current limited knowledge of marine ecosystem function and ecological restoration techniques, the very high costs of operation and complicated governance structures that do not allow for the control of an area by a single entity (Bos et al., 2014; UNEP-WCMC, 2016).

*Issues of equivalence*

The quantification of impact and the determination of counterfactual baselines that are needed to establish equivalence and realise an aim of NNL (Maron et al., 2015a) are challenged in a marine context by a relative paucity of data and ecological understanding in many environments. This is attributed to the complexity of marine systems that are highly connected, with diffuse relationships occurring over widely ranging temporal and spatial scales (Crowder and Norse, 2008), the high degree of biological, chemical and physical heterogeneity (Douvere et al., 2007) and the high costs of data collection at the scales required for assessment in remote and inaccessible environments. Some of these characteristics, such as those relating to the connected and diverse nature of marine environments might present opportunities for biodiversity offsets. For example, opportunities may exist to reduce the overall mortality of wide-ranging pelagic species through the protection of areas critical to important lifecycle phases (Game et al., 2009). However, challenging to any approach is the fundamental lack of information, which extends to that of ecosystem function and the relationships that support the provision of essential ecosystem services (Palumbi et al., 2009). This situation is characterised by that of many deep-sea environments where there are a large number of unsampled and undescribed species (both microbial and animal) which are likely implicated in important but as yet unknown ecological processes (Higgs and Attrill, 2015; Shulse et al., 2017; Sinniger et al., 2016). As a result of current limited knowledge, marine EIA is often subject to a high degree of uncertainty which complicates assessments of risk and significance and decision-making processes.

Review of marine EIA practice in Europe indicates that a strict adherence to the mitigation hierarchy is prevented by inabilities to predict and quantify the potential impacts arising from development (Jacob et al., 2016a; Vaissière et al., 2014). Statistical models and remote sensing are sometimes used to address deficiencies in knowledge and to reduce uncertainty but both are limited in their application (Tulloch et al., 2017). The absence of high-resolution information can lead to scenarios where EIA and assessment of equivalence occur at a coarser level, whereby requirements for equivalence might be met at a high level when in reality referring to very different ecological systems. The results of such an exchange could foreseeably include and therefore mask local and regional extinctions and an associated loss of ecosystem resilience (Donohue et al., 2016). The relationships between marine ecological variables is poorly understood which further increases the uncertainty attributed to predictions of biodiversity change (Sutcliffe et al., 2015; Tulloch et al., 2017). This uncertainty is further increased by the need to use surrogates to measure counterfactual scenarios. Again, surrogate selection is challenged by our poor knowledge basis for the understanding of ecological dependencies in marine systems.

Another concern raised by the high degree of uncertainty associated with marine EIA predictions relates to the potential for subjectivity and misrepresentation of risk which can lead to the seemingly arbitrary use of offsets and the mitigation hierarchy (Barker and Jones, 2013; Barker and Wood, 1999; Bos et al., 2014; Jacob et al., 2016a; Middle and Middle, 2010; Vaissière et al., 2014). High levels of uncertainty associated with impact assessment are suggested to lead to increased subjectivity in appraisals of significance and an increased reliance on expert opinion and descriptive accounts (Jacob et al., 2016a). Barker and Jones., (2013) support this observation in a critique of EIA of oil and gas projects, where confusion as to how to assess significance, a lack of justification of the value judgements presented and poor consideration of secondary and cumulative impacts are described. Another finding discussed, similar to that of other studies, is a tendency to downplay the significance of impacts unless relating to a specific and quantifiable effect to a contentious species or habitat, such as protected bird species (Barker and Jones, 2013; Jacob et al., 2016a; Regnery et al., 2013; Vaissière et al., 2014). This is a problem widely attributed to EIA frameworks whereby impacts leading to action (e.g. compensation or project denial) relate only to keystone species, whereas broader, diffuse (and often sub-lethal) impacts are seldom included in such assessments (Heery et al., 2017; Jacob et al., 2016a; Vaissière et al., 2014).

The often-subjective nature of assessment of significance within marine EIA has been seen to support the positively biased communication of impacts, such as describing the introduction of a hard surface (such as rock armouring, wall or jetty) in an area of soft sediment as a beneficial increase in biodiversity. Vaissière et al., (2014) in their review of EIA of marine renewable energy projects in Europe, provide an example of this bias when describing how these unquantified 'benefits' can be presented as offsets for unquantified impacts occurring via diffuse pathways. This subjectivity within EIA can lead to misunderstanding of the risks associated with an action and is of particular significance when seeking consultation with non-scientific audiences or stakeholders such as the general public (Gordon et al., 2015). Further, the reviews of Vaissière et al. (2014) and Jacob et al. (2016a) both indicate that it is common for marine EIA to reach the conclusion, through the means described, that impacts are minimal and 'insignificant' and consequently do not lead to biodiversity offsetting requirements. The authors conclude that this is one reason that there is limited documentation of the application of biodiversity offsets in marine contexts.

Reviews of the potential for habitat restoration to create biodiversity benefit for offsetting purposes make reference to the current limited abilities of marine techniques (Bas et al., 2016; Jacob et al., 2017; Vaissière et al., 2014; Van Dover et al., 2014). This relates not only to the lack of experience in certain habitats but also to the absence of observation of the long-term success of restoration projects. In a global review of restoration projects relating to coral reefs, seagrass, mangroves, salt-marshes and oyster reefs, Bayraktarov et al., (2016) found that while success rates for most habitat types included in the review were relatively high, this was predominately based on extremely short monitoring periods (in the majority of cases less than two years). These short periods do not align with the ecological time scales required to assess the long-term persistence of habitats and associated functioning and as such information as to the long-term success of restoration projects is limited (Bayraktarov et al., 2016; Harper and Quigley, 2005b, 2005a; Jacob et al., 2016a; Quigley and Harper, 2006b). For some habitats such as some in the deep-sea likely to be targeted for mining activity, restoration techniques have not yet been developed and are predicted to require timescales on the scales of decades to hundreds of years (Niner et al., 2018; Van Dover et al., 2017). Further, many of the techniques present for marine habitat restoration are expensive as compared to terrestrial environments, and this cost likely increases with the distance from shore (Bayraktarov et al., 2016; de Groot et al., 2010; Paling et al., 2009; Van Dover et al., 2014). While such techniques remain untested and unproven it has been suggested that a precautionary approach to allowing damaging activity in sensitive or highly unknown environments should be adopted if the industry is to progress (Niner et al., 2018; Tinch and van den Hove, 2016; Van Dover et al., 2017).

Misunderstandings of the varying modes of resilience of a habitat can lead to the "*common mistake in site selection*" described by Paling et al (2009). Using the example of seagrass restoration, the authors refer to the potential to select sub-optimal sites for restoration which can lead to project failure or even further loss of biodiversity. Habitats such as seagrass can present difficulties when attempting to identify sites for restoration, because they exist in both transitory and enduring forms depending on the species, with both forms contributing to ecosystem function (Kilminster et al., 2015). The varying forms and modes of resilience that a species may feature must be considered when selecting a site, so that sites of potential seagrass habitat are considered correctly within counterfactual assessments (Kilminster et al., 2015). As Paling et al (2009) report, the success of a seagrass restoration project is likely limited given that the absence of seagrass in these 'bare' areas is likely to be indicative of unfavourable conditions for the habitat. In addition, establishing equivalence is likely to be challenging given that fragmented seagrass bed support different communities to those with more continuous cover (Fonseca et al., 2000). What classifies as potential habitat for those that are transitional and how these areas are considered in assessments of impact and as potential areas for restoration requires agreement to prevent an overall loss of biodiversity. It is not clear whether it would be appropriate to include these potential areas for restoration, as it is likely that this habitat could occur without any intervention and as such could not be considered additional.

Another issue complicating the use of restoration for biodiversity offsetting is the identification and availability of sites that could support the habitat in question, such that equivalence can be established. The authors of an investigation into using habitat equivalency approaches to apply offsets against impacts to coastal wetlands in the Yellow River Delta in China found a deficiency in available degraded land of a suitable type to fulfil offsetting requirements (Yu et al., 2017). Similar issues are reported from experience with seagrass in the US (Fonseca et al., 2000) and also in relation to deep-sea habitats, which in many cases could be considered to be pristine, challenging the identification of an equivalent amount of degraded habitat (Niner et al., 2018). The identification of potential restoration sites that are no longer subject to the injurious activities that led to their degraded state is another challenge posed by marine environments. An understanding of the disturbance regime of a location is essential to understand what efforts may be required to improve the health of the ecosystem. However, in the marine environment diffuse disturbance, such as through disturbance from an increased use of an area (e.g. lighting or noisy activities such as seismic exploration or piling) or increased turbidity or reduced water quality as a result of land-based activities can all reduce the effectiveness of an offset, and this needs to be considered when establishing equivalence (Heery et al., 2017; Van Dover et al., 2014).

*Issues of compliance*

Property rights are not commonly available in marine environments, with most marine areas and resources considered to be commons (Pardo, 1967). The ways in which an area is used are often varied and overlapping, for example use of an area for commercial fishing does not always preclude recreational use or the installation of infrastructure such as pipelines (Boyes and Elliott, 2014). Accordingly, isolating an area for restoration or protection from current or future damaging activities is not easy in a marine context, where, the rights to an area of land for offsetting purposes can be bought and access restricted relatively easily in terrestrial environments. Restrictions in the use of a marine area can only be granted through legislative means where a binding agreement across damaging sectors and stakeholders is reached (Freestone et al., 2014). This limits the options available for securing offsets and other private conservation efforts without government intervention and complicates private conservation efforts. This issue is exemplified by the difficulties posed in the implementation and management of marine protected areas (MPAs) undertaken without state support (Bottema and Bush, 2012). An example of where this challenge has been addressed to create lasting benefits has been the use of territorial user rights for fisheries (TURFs), through which a government can assign exclusive access rights to an individual or group (Castilla et al., 1998; Gelcich and Donlan, 2015). In Chile, these rights have been awarded to artisanal fishing organisations and it is expected that, in line with the theory of the commons, that this access will contribute to sustainable use and management of the area incentivised by this ‘ownership’ (Dietz et al., 2016). Following on from this, initial steps have been taken to examine the potential of these arrangements with Chilean fishers to provide biodiversity credits that might be used as offsets in certain circumstances and also supplement the management activities within the TURFs (Gelcich et al., 2012; Gelcich and Donlan, 2015). Despite indications of the potential of such an approach, it remains largely untested and its large-scale application is likely to be limited.

*Ethical issues*

Common to terrestrial area-based conservation measures, biodiversity offsetting in marine environments can have associated social and cultural costs that need to be considered to achieve the equitable aim of NNL (BBOP, 2012). Many cultural values ascribed to environmental resources are inherently place-based (Altman and Low, 1992). These include access to specific resources such as fishing grounds, diving locations and historic or sacred areas, but also relate to the condition of a resource, such as 'clean' beaches, water or seascape (Gee and Burkhard, 2010). At a local scale these values are considered to be unique, not fungible and therefore not offsettable (Ives and Bekessy, 2015; Maron et al., 2016a). However, many attributes of cultural importance in the marine environment are dependent on attributes that are spatially and temporally transient and with viability dependent on access to a range of habitats that can cover an enormous area (Crowder and Norse, 2008), e.g., wide-ranging mobile species such as marine mammals or sea birds. As such, impacts at a single location may affect a wide-range of stakeholders which could be extremely difficult to robustly assess in order to integrate the full social-implications of an action. Further complicating stakeholder participation and social impact assessment, particularly for marine EIA where values are held over many diffuse pathways, is the issue of power (Glucker et al., 2013; O'Faircheallaigh, 2010; Shackeroff et al., 2009), whereby the interests of established and organised sectors or groups may be more easily accessed than those of other minority groups and thus afforded a greater weight in decision-making processes. This issue is highlighted in a study of participation in marine spatial planning processes in the US, where Flannery et al., (2018) found that the complexity of socio-spatial relationships is essential for participatory equity and robust assessment.

Another issue relates to the potential for the restriction of human access to an area and the consequent displacement and dispossession of traditional and currently-held territories as a result of an offsetting project. St Martin and Hall-Arber (2008) identify the social landscape of the marine environment as a "*missing layer*" in decision-making and describe displacement and forced competition of fishing communities as a result of poorly informed fisheries management closures. These concerns extend to other culturally held values, where access to an area or resource may be altered by the implementation of a biodiversity offset, particularly given the potential for more pressured coastal (and more easily accessible) sites to be used as offsets. This low level of understanding is not only important to inform offset design and potential site selection but can also influence decision-making processes. For example, examinations of impact assessment have shown that for those receptors that are less well known, measured or observed, as is frequently the case for marine biodiversity (Crowder and Norse, 2008) and cultural ecosystem services (Gee and Burkhard, 2010), there is an associated diminished value placed within decision frameworks (Barker and Jones, 2013; Fonseca et al., 2000; Gee and Burkhard, 2010; Vaissière et al., 2014).

**Table 2.1.** The scientific and administrative challenges of biodiversity offsetting in marine environments.

| Issue type | Detail | References |
|---|---|---|
| **Equivalence** | | |
| High costs of data collection and operation | – Large data requirements to capture high heterogeneity across a range of scales.<br>– Remote nature of many marine environments can mean data collection and other activities (e.g. development, rehabilitation projects) is complicated and costly. | (Crowder and Norse, 2008; Douvere et al., 2007)<br>(Niner et al., 2018) |
| Limited knowledge of marine ecosystem function | – Lack of available data capturing complex, highly variable relationships operating at a range of scales.<br>– Leads to high uncertainty in impact assessment and the use of simplified surrogates that do not robustly capture ecosystem function. | (Higgs and Attrill, 2015; Palumbi et al., 2009; Shulse et al., 2017; Sinniger et al., 2016)<br>(Donohue et al., 2016; Sutcliffe et al., 2015; Tulloch et al., 2017) |
| Subjectivity in assessment of significance | – High uncertainty in impact assessment reduces the weight of predictions within decision-making frameworks. | (Heery et al., 2017; Jacob et al., 2016a; Vaissière et al., 2014) |
| Limited knowledge and experience of marine restoration science | – Current techniques are expensive and have not been tested over appropriate timescales. | (Bas et al., 2016; Bayraktarov et al., 2016; de Groot et al., 2010; Jacob et al., 2017; Paling et al., 2009; Vaissière et al., 2014; Van Dover et al., 2014) |
| Difficulties in identifying additional and sufficient areas to create biodiversity gains | – Many marine habitats remain unknown (e.g. the deep sea) so identifying an equivalent habitat is difficult.<br>– Limited locations in which habitats can occur e.g. limited coastline, available locations above a certain depth or of a certain salinity range etc.<br>– Disturbance regime of an area is hard to control or understand, which can challenge efforts to recreate biodiversity. | (Niner et al., 2018; Van Dover et al., 2017)<br>(Fonseca et al., 2000; Kilminster et al., 2015; Paling et al., 2009; Yu et al., 2017)<br>(Heery et al., 2017; Niner et al., 2018; Paling et al., 2009; Van Dover et al., 2014) |
| **Compliance** | | |
| Absence of property rights | – Challenges restriction of access to an area. | (Freestone et al., 2014; Pardo, 1967) |

| Issue type | Detail | References |
|---|---|---|
| **Ethics** | | |
| Cultural values often uniquely tied to a specific location | – Challenges the exchange of biodiversity in one area for another. | (Altman and Low, 1992; Gee and Burkhard, 2010) |
| Values depend on ecological relationships on a range of scales | – The cultural and spiritual values arise from a healthy environment which arise from complex ecological relationships acting on a range of scales e.g. presence of marine mammals. | (Crowder and Norse, 2008) |
| Difficult to evaluate cultural values of marine systems | – Values are diffuse and may be remote, identifying stakeholders is challenged.<br>– Intrinsic values difficult to capture.<br>– Power relations can bias assessment of values. | (Glucker et al., 2013; O'Faircheallaigh, 2010; Shackeroff et al., 2009)<br>(Ives and Bekessy, 2015; Soulé, 1985)<br>(Flannery et al., 2018) |
| The value of marine biodiversity not represented in decision frameworks | – Owing to less well known, observed and understood biodiversity. | (Barker and Jones, 2013; Crowder and Norse, 2008; Fonseca et al., 2000; Gee and Burkhard, 2010; Vaissière et al., 2014) |
| Biodiversity offsets can displace human access | – The protection of an area to create biodiversity benefit may restrict user access to a culturally important resource. | (St. Martin and Hall-Arber, 2008) |

## 2.7. Uptake and implementation in marine environments

There are many controversies and challenges that indicate that biodiversity offsetting and aims of NNL are likely to be difficult in a marine context (see Table 2.1.) Despite this and suggestions that activities considered to be potentially damaging to biodiversity should be progressed with caution, biodiversity offsets continue to be proposed as solutions to this consenting risk (Niner et al., 2018; Van Dover et al., 2017). Given the predicted future growth of marine economies (OECD, 2016a) which is likely to be accompanied by an increased pressure on marine systems, use of biodiversity offsets in such environments can be predicted to follow the rapid increase observed in terrestrial environments (Madsen et al., 2011). As described, current documentation indicates that there is little consistency or standardisation in the translation and implementation of biodiversity offsetting policy in marine contexts. Given that policy interpretation at the point of implementation is understood to effectively control policy-outcomes (Lipsky, 2010) it is important to understand how a policy is being used in practice. This knowledge is not currently available for the marine application of biodiversity offsetting. Further, there has been no academic attention as to how stakeholders are interacting with this process of translation and what the consequences of this interaction are in terms of policy performance. Further information is required to evaluate the state of current practice and to consider whether and how biodiversity offsetting is influencing decision-making and marine environmental management in practice.

## 2.8. Research questions

To address the research gaps identified and summarised in Section 2.7. the questions posed in this thesis are:

1. What policy support exists for marine biodiversity offsetting globally?
2. Does existing policy address the existing controversies of biodiversity offsetting and support the marine application of the principals identified as necessary for NNL?
3. Does current marine biodiversity offsetting practice apply the principals identified as necessary for NNL and biodiversity offsetting success?
4. What are stakeholder perspectives relating to the development and implementation of marine biodiversity offsetting policy?
5. What role is marine biodiversity offsetting performing within development consent frameworks?
6. What are the influences driving current marine biodiversity offsetting practice?

# 3. Methodology

## 3.1. Introduction

This Chapter describes the approach selected as the most appropriate for investigating the research questions identified in Chapter 2. The questions seek to further understanding of the current application of biodiversity offsetting in marine environments as an approach to manage the biodiversity impacts of development. The Chapter proceeds with a description and justification of the use of a case study and mixed-methods approach to inform against the research questions addressed. Subsequently, the methodologies followed to undertake the systematic reviews of policy and documentation presented in Chapters 5 and 6 are described. The rationale for the selection of the qualitative approach outlined and applied in Chapters 6 and 7 then follows. This includes a discussion of the positionality of the selected procedure and the researcher. An introduction to the analytical frameworks used to explore data and provide insight into the relationships and perceptions governing the use of biodiversity offsets in marine environments is then provided. The Chapter concludes with a discussion of the ethical considerations associated with the research presented within this thesis.

## 3.2. Overarching methodology

*Case study selection*

Information of where biodiversity offsetting is being undertaken in a marine context and the ways in which this is taking place is limited. Australia is known to have a relatively mature offsetting policy (Madsen et al., 2011; Miller et al., 2015) and it is also known that this is being applied in marine environments (Bell et al., 2014; Bos et al., 2014; Brodie, 2014). Furthermore the approach and its application, in the vast majority with a terrestrial focus, has been subject to a relatively high degree of academic scrutiny (Calvet et al., 2015). Australia and its associated offsetting policy present a good opportunity to inform the research questions outlined in Chapter 2 as a case study with a view to providing insights to applications of the approach in other marine contexts and jurisdictions.

Case studies allow for the investigation of a "*contemporary phenomenon within its real-life context*" (Yin, 1994) and whilst criticised for the limitations of applicability to wider situations and scientific rigour (Castree, 2005; Flyvbjerg, 2013; Stake, 1995), provide opportunity to obtain rich insights into complex problems or relationships. Using Australian experience of applying biodiversity offsetting policy in marine contexts allows for an exploration of the challenges and opportunities of this in addition to the key factors influencing the outcomes of this practice. Whilst the case study may not be directly applicable to other examples in other jurisdictions the knowledge gained is predicted to contribute to a wider understanding of the issues surrounding marine biodiversity offsetting and is thus considered to be transferable (Flyvbjerg, 2013). Accessibility of information is an essential consideration when selecting a case study (Flyvbjerg, 2013), and Australia not only has a history of promoting 'transparent and accountable government' (Parliament of Australia, 2010) but also has a strong online presence across society (OII, 2015). The use of the Australian experience seeks to maximise the breadth of perceptions across all sectors and organisations. For exploratory research such as that presented here this approach will provide a more widely relevant appraisal of the topic as opposed to focussing on specific projects in which very limited numbers of individuals may have been involved.

*Mixed method approach*

The mixed-method approach I have selected allows for an in-depth understanding of current marine biodiversity offsetting practice to be developed. Mixed-method approaches can be applied to identify and limit bias through triangulation (Blaikie, 1991) and can also provide insight to complex phenomena through repeated investigations through various means (Flick, 2014). Recognising that very few observations or interpretations are exactly replicable a mixed method allows for appraisal of the varying ways in which phenomena may be experienced or observed and such an approach is particularly useful for exploratory research, such as the questions under examination in this thesis. Whilst it is unlikely that the 'truth' will be obtained through any mixed-method approach, employing various approaches to investigate the depth and breadth of a question is likely to achieve a deeper and richer understanding (Bryman, 2016; Fielding and Fielding, 1986; Oppermann, 2000). The methods selected here which encompass both systematic review and qualitative approaches, not only promote validity in interpretation but also provide detail and depth to support a contextual analysis in terms of applying case study based knowledge to other, wider and more general, situations (Bernard, 2011; Bradshaw and Stratford, 2010; Bryman, 2016). Systematic reviews are used to appraise current trends in the use and uptake of marine biodiversity offsetting at a global and Australian level. The trends identified in systematic reviews are then investigated in detail using a different qualitative approach to explore the perspectives of stakeholders involved I marine biodiversity offsetting in Australia.

## 3.3. Methodology for systematic reviews

The exploratory research presented in this thesis requires a spatially tiered and iterative approach to understand how the case study of Australian practice relates to the global use of marine biodiversity offsets. To do this a coarse-grained global review of existing offsetting policy and practice and its applicability to marine environments was first undertaken and is presented in Chapter 4. This involved analysis of policy documentation and academic literature in relation to the principles that have been identified and widely accepted as being essential for biodiversity offsetting success and NNL (BBOP, 2012; Bull et al., 2013). This review confirmed that marine biodiversity offsetting, whilst lagging behind uptake of the approach in terrestrial scenarios, is occurring and that Australia has a relatively established policy basis applicable to marine contexts. Following from this and presented in Chapter 5, a systematic review of available planning documentation in Australia identified development projects where marine biodiversity offsets were applied. This systematic review uses planning documentation to appraise how the principles identified as essential for biodiversity offsetting success (BBOP, 2012; Bull et al., 2013) and also explored in Chapter 4 are applied at a development project level. Additional information relating to the type of impact and offsetting activity implicated and the processes followed to reach decisions as to offset definition was also retrieved and analysed. These extensive reviews provide an indication as to how marine biodiversity offsetting is being applied in practice. They indicate that practice deviates from the accepted standard procedure outlined in literature and corporate guidance (BBOP, 2012; Bull et al., 2013) and as such is unlikely to be meeting the aims set out by Australian governments. Given that marine biodiversity offsetting, based on the reviews presented in Chapters 4 and 5, does not appear to be conforming to the standardised process commonly promoted further detail as to how it is being applied within development consent processes is required, leading to the analysis of stakeholder perspectives in Chapters 6 and 7.

*Chapter 4 – Mapping global marine biodiversity offsetting policy*

Chapter 4 presents a snapshot as of December 2016 of the current policy application of biodiversity offsetting principles in a marine context.

*Sample selection*

Relevant data were obtained through a systematic review of available web-based documents evidencing the application or inclusion of the principles widely accepted as necessary for biodiversity offsetting success. These principles include the robust and full application of the mitigation hierarchy, equivalence, additionality of offsets, continuity of biodiversity and compliance success (see Table 4.1). Information has been sourced from both academic and grey literature including relevant web-based material and media reports. In the review of academic literature, search terms *( ( marine OR "fish habitat" ) AND ( offset* OR biodiversity offset* OR compensat* ) )* were used to interrogate the Scopus and Web of Science databases and web-based searches. The source material was limited to documents published in French, Spanish or English, with search terms based in English. It is important to note that the approaches recorded here focus on ex-ante approaches to environmental compensation and do not include requirements for rectifying unforeseen impacts or for rehabilitation of a site at the point of decommissioning. Source material was also filtered to include those policies that included reference to marine species and habitats beyond wetland habitats such as mangrove and saltmarsh.

Articles were screened and filtered against the principles presented in Table 4.1 and based on the content of their abstracts. A similar protocol was applied for a search of grey literature, using web-based search engines as a starting point. These systematic reviews were complemented by handsearching of literature and building on the country profiles within the Ecosystems Marketplace review (Armstrong et al., 2005; Madsen et al., 2010). The National Reports produced by the 156 coastal States Parties to the Convention on Biological Diversity (CBD) in addition to information available from the Organisation for Economic Co-operation and Development (OECD) and the Global Environment Facility (GEF) for all coastal nations were also reviewed.

*Analysis*

Information relating to the application of the key biodiversity offsetting principles (Table 4.1) has been gathered from the source material. A total of 124 documents were identified that provide evidence of the uptake and application of these principles (Appendix A). Using these principles as criteria, evidence of the application of the mitigation hierarchy in addition to any other of the principles has been documented. The mitigation hierarchy is often promoted through EIA frameworks and biodiversity offsetting builds on this and increases the rigour of its application through assessments of equivalence, additionality, continuity of biodiversity provision and compliance monitoring requirements (Table 4.1). Given the lack of available information relating to marine biodiversity offsets it is likely that such strategies are at varying stages of development or operating on an informal basis and are unlikely to incorporate all the key principles. Accordingly, evidence of the uptake of any number of the key principles (in addition to the mitigation hierarchy) with explicit reference to supporting the use of marine biodiversity offsets is presented as an indication of emergent public policy or strategy.

*Chapter 5 – The marine application of biodiversity offsetting policy in Australia*

Chapter 5 examines how biodiversity offsetting is being implemented in practice in Australia, through a systematic review of marine and coastal development projects.

*Data sources*

Information was sourced through a systematic review of planning applications available on Australian government planning websites for development projects that involved predicted residual marine environmental impacts. The review is limited to those projects listed on government planning portals, the availability and the type of information available varies between states both in terms of temporal coverage, ranging from eight to over forty years (Table 3.1). Source material includes environmental impact statements and associated evidence, government assessments of this information and recommendation reports and submissions from stakeholders relating to the EIA process. Where available, this material has been supplemented by further information sourced from project proponent websites.

**Table 3.1.** Government online planning portals interrogated for listings of projects where marine offsets have been applied integral to associated development consent and associated date from which information is available (information correct at point of review, January 2017).

| State | Website | Earliest record |
|---|---|---|
| **NSW** | New South Wales Government: Planning & Environment | 2000 |
| **NT** | Northern Territory Environmental Protection Authority | 1981 |
| **QLD** | Queensland Government Department of State Development | 2000 |
| **SA** | Government of South Australia: Department of Planning, Transport and Infrastructure | 2003 |
| **TAS** | Environment Protection Authority Tasmania | 2008 |
| **VIC** | Victoria State Government: Department of Environment, Land, Water and Planning | 2006 |
| **WA** | The Government of Western Australia: Environmental Protection Authority | 1974 |
| **EPBC** | Australian Government: Department of the Environment and Energy | 2002 |

*Sample selection*

Inclusion of projects in this review was based on the presence of biodiversity offsetting requirements within consenting documentation. For the purposes of this review marine biodiversity offsets were defined as *ex-ante* approaches to environmental compensation, where requirements for compensatory action have been stipulated in planning decisions in response to identified impacts to sub-tidal marine ecological receptors (including sub-tidal habitat and species dependent on sub-tidal habitat). As such, this review excludes impacts to inter-tidal habitats such as mangrove and saltmarsh. Post-consent agreements for rectifying unforeseen impacts or site-rehabilitation at the point of decommissioning were not included within this review.

A total of 43 projects were identified where marine biodiversity offsets were stipulated as part of their consent. One project comprised a strategic assessment for a proposed development plan where offsets were likely to be integral to any planning consent granted underneath the proposed strategy. However, given the absence of specific offsetting requirements at this strategic stage, this project has not been included in the analysis. Seven of the remaining 42 projects, all located in Queensland, were not included in assessment of the offsetting mechanisms applied owing to insufficient available information for analysis (Section 5.4. Definition of offsets). While those seven projects had associated offsetting requirements, specific definition of these were still pending at the point of decision owing to outstanding project design finalisation (Appendix B). A further two projects were progressing through the consenting process at the point of review (in Queensland and South Australia), but were included in the analysis because clear commitments to offsets were identified in the documentation available.

*Criteria for analysis*

Project documentation was analysed for information relating to impact identification, including the ecological receptors (species or habitat) affected and the actions that led to their degradation or loss (impact pathway e.g. dredging, port development). Impact pathways could be considered to be direct, such as the removal of habitat by the installation of a structure, or indirect, such as a decrease in foraging or breeding habitat availability for a species because of recreational disturbance or use of an area. Further detail on biodiversity offsetting requirements was also recorded. This detail included the mechanism used to implement the offset (Bull et al., 2013; Madsen et al., 2010) (Table 3.2), and the decision process followed when agreeing the form of the offset (Table 3.3). The criteria used to analyse decision processes were based on the principles identified as essential for biodiversity offsetting success, specifically the application of the mitigation hierarchy, equivalence and compliance (BBOP, 2012; Bos et al., 2014). Explicit documentation of the process by which the mitigation hierarchy is followed is not often included in detail within planning documentation, beyond detailing the use of best practice to minimise impacts. As such, information relating to the process of the definition of offset requirements was recorded. This information was recorded as the presence/absence of information against the following criteria: offset definition at the point of consent; assessments of offset equivalence (with impact); assessment of offset feasibility; and associated compliance arrangements (Table 3.3).

**Table 3.2.** Definitions of marine biodiversity offset mechanisms.

| Offset mechanism | Definition |
|---|---|
| **Rehabilitation** | Habitat or species populations are to be created or enhanced. |
| **Management** | Measures to improve biodiversity outcomes can include management of - activities such as boating, shipping, fishing, and recreational use; feral predator and weed control; or land-use change most commonly focusing on agricultural practice. The implementation of a ranger programme through the employment of individuals to undertake conservation activity is also considered a management action. In this case management excludes efforts to directly create or rehabilitate habitat. |
| **Protection** | Area of habitat or populations to be protected, through designation or other means. |
| **Research** | Research programme to be developed and funded or contributions paid if already in existence. Research is often linked to the ecological receptor at risk and associated impact pathways with a view to improve future understanding and management. |
| **Education** | Environmental education programme to be developed and funded or contributions paid if already in existence. Often linked to ecological receptor at risk or wider local ecosystem. |
| **In-lieu fee (ILF)** | Contributions to a wider fund that may or may not be in existence at the point of consent, to deliver a specific aim such as research or management. |
| **Offset package** | A commitment to deliver a range of discrete offsetting projects through various mechanisms. |

**Table 3.3.** Terms and criteria used to analyse how marine biodiversity offset requirements were defined.

| Process assessment criteria | Definition |
|---|---|
| **Impact quantification** | Impacts are explicitly identified and expressed in numerical terms either in relation to the spatial extent of habitat or in terms of species numbers. This quantification may or may not relate to the quality of habitat or the health of a population and the significance of the impact on wider population viability. |
| **Offset definition** | Offsetting requirements are confirmed or detailed at the point of consent. Definition includes consideration of the location of the offset and the timescale and means by which it will be implemented. |
| **Assessment of equivalence** | Evidence of consideration of the relative values of the biodiversity losses or impacts against the offset, relating to areas and quality of habitat for direct offsets and biodiversity gains (or otherwise) for indirect offsets. E.g. application of a metric to calculate losses and gains. |
| **Insurance** | Evidence of the application of measures of success of offsets, relating but not limited to monitoring against indicators of success, adaptive management and bonds against achieving aims of project. |
| **Compliance** | Evidence of consideration of the relative responsibilities for implementation or success of an offset and enforcement procedures. |

## 3.4. **Qualitative methodology**

Biodiversity offsets are most commonly embedded within EIA frameworks applied to aid decision-making in relation to the environmental impacts arising from development (Cashmore, 2004; McKenney and Kiesecker, 2010). Decisions within environmental development are frequently referred to as 'wicked' problems (Rittel and Webber, 1973) where both definition and solution are controversial as a result of being based on different values and perspectives (Jentoft and Chuenpagdee, 2009; Lockwood et al., 2010). This theory is supported by the work of Funtowicz and Ravetz (1993) who acknowledged that the sustainable use of the environment is one where the "*facts are uncertain, values in dispute, stakes high and decisions urgent*". Therefore, the context within which biodiversity offsetting is being applied is rarely based on a clear-cut appraisal of the costs and benefits of an action. Instead they are more commonly highly political and driven by the priorities of stakeholders and the frameworks by which they are regulated. Such appraisals are further complicated in marine systems where the levels of uncertainty attributed to ecological predictions are extremely high (Bos et al., 2014; Jacob et al., 2016a). Accordingly, to understand how marine biodiversity offsetting is being applied an analysis of the relationships and governing influences is required. The application of qualitative research techniques lends itself best for such an analysis where the problem is difficult to neatly frame and is unlikely to lead to a distinct and statistically defensible conclusion (Ormston et al., 2014). Delicate interpretation of varying perspectives to assist in making the problem "*visible*" and "*…to make sense of or interpret phenomena in terms of the meanings people bring…*" is required to provide the insight to inform such an analysis (Denzin and Lincoln, 2011; Ormston et al., 2014).

*Semi-structured interviews*

To explore the research questions identified, an understanding of the factors influencing processes governing offset application is required. Recognising the complexity of environmental decision making, structured techniques such as questionnaires, owing to their rigidity, are unlikely to provide the depth of insight required to inform research. The contextual information gained through a more flexible approach that allows for a nuanced analysis of the participants' experiences and beliefs is vital to inform complex questions, such as those that are the focus of this study (Brinkmann and Kvale, 2014). In depth interviews, also sometimes referred to as semi-structured, are well suited to the purpose of this investigation as they allow for a 'deep' and 'rich' picture of a phenomenon to be explored through interpretation of not only answers but also vocalisation, expressions and gestures (Burgess, 1984; Silverman, 1993; Valentine, 2005).

Being 'semi-structured' it is important to reflect on the purpose of the research to ensure that the knowledge or perspectives sought are elicited most effectively whilst providing sufficient space to enable participants to provide their own voice and experiences on the matter (Brinkmann and Kvale, 2014). A topic guide is devised as an outline for the interviewer to follow through the dialogue with the participant. The guide facilitates a constructive and 'loosely-focussed' conversation that covers the points stipulated by the research questions within the time periods available. This 'loose' structure grants freedom and that allows for a sensitive account to be revealed through a flexible and naturally flowing dialogue between interviewer and participant. The flexibility allows for questions to be re-visited in varying forms to explore issues thoroughly and for unforeseen topics to arise. Further, the process, as highlighted by Tennessee Williams when discussing the subject of interviewing, has been shown to allow for "*self-revelation*" and the development of ideas (Brinkmann and Kvale, 2014; Silvester, 2003).

The topic guide (Table 3.4) used for this study was developed based on the research questions, literature review and reviews mapping current trends in the uptake and use of marine biodiversity offsetting policy (Chapters 2, 4 and 5).

**Table 3.4.** Topic guide used for semi-structured interviews.

| |
|---|
| **Aims and objectives**<br>To understand how biodiversity offsetting is being applied in practice at all stages of the implementation of the policy and its contribution towards marine biodiversity protection. This will involve exploring:<br>• Current practice<br>• Drivers and barriers to current practice<br>• Perceptions of success<br>• Views on achieving NNL in the marine environment |
| **1. Introduction** |
| – Introduction of interviewer and project and participant selection<br>– Talk through key points – length of interview/like a focussed discussion/your experiences and views/voluntary and right to withdraw/recording so can analyse later/confidential and anonymous/data stored securely and will be included in thesis and scientific papers<br>– Any questions<br>– Start recording |
| **2. Background** |
| *Aim: to establish context of perspective and experiences* |
| – Contact with biodiversity offsetting and marine biodiversity offsetting<br>– Role when contact occurred |
| **3. Current practice** |
| *Aim: To establish the practicalities of implementing marine biodiversity offsets* |
| – Focus on marine biodiversity offsetting/do offsets represent a change in practice?<br>– What did it introduce to processes? Use of mitigation hierarchy, offset design, compliance monitoring, precautionary principle etc.<br>– Purpose/drivers for use of offsets – reasons for increased use<br>– Key actors involved – consultation/expertise – social equity |
| **4. Perceptions of success** |
| *Aim: To establish the role of offsets within consenting processes and investigate motivators/barriers in its application.* |
| – Benefits of practice<br>– Disadvantages/risks<br>– Environmental outcomes (NNL)?<br>– Australia as best practice? |
| **5. Practice in the marine environment** |
| *Aim: To explore participants' views on the challenges unique to operating in the marine environment.* |
| – Challenges/risks/opportunities<br>– Is NNL practicable in the marine environment? Coastal vs offshore, could it be achieved in another way?<br>– 'Unlimited' nature of biodiversity in marine environment<br>– Is a social licence required for marine operations? |
| **6. The future role of marine offsets** |
| *Aim: To explore views on how the use of marine offsetting may evolve, potential outcomes and improvements to practice.* |
| – Suggestions for improved performance<br>– Risks/opportunities of current practice. |

*Sampling strategy*

Research was undertaken between October 2016 and May 2017. Interviews were conducted in person (n= 22) and remotely via telephone (n=9; one interview involved two participants). Key informant participants (n=31) were purposively selected for their exposure to and/or experience with marine biodiversity offsetting. Participant selection aimed to provide representation across all groups types (regulator, industry, NGO, academia, consultant) (Table 3.5). Participants considered to be in regulatory roles were employed within government roles at the time of their exposure to marine biodiversity offsets and/or were involved in developing policy or implementing development control at a federal (national) or state level on behalf of government. Those identified as industry representatives worked either directly for a corporation or an industry body. Participants located within consultancy were employed by consulting firms and collectively along with industry representatives are referred to as practitioners involved in the application of biodiversity offsetting. Academic representatives are considered to be those participants working within a University and research settings. Participants described as representing NGOs hold positions within environmentally focussed NGOs that have had some interaction with biodiversity offsetting. Some participants described overlapping experience-types where experience was discussed from a previously held position. Identification and recruitment of participants was initially challenging, attributable to several factors, one of which is the relatively low-level of biodiversity offsetting activity that has been undertaken in marine environments to date. Another factor is attributable to the small number of people involved at the point of offset agreement and design, with these processes largely being limited to those in senior roles within both regulatory bodies and industry. Once key participants were identified, a snowballing sampling strategy based on the recommendations of key informants was successfully adopted (Reed et al., 2009). Sampling was assessed as complete when there were no further leads to pursue after all potential participants had been either recruited, refused to participate or had not responded to several attempts at communication through various means (email, telephone) over a prolonged period of time. Further to this, on initial analysis it was judged that thematic saturation meaning that "*no additional data are being found … [and] … similar instances [are seen] over and over again*" (Glaser and Strauss, 1967) had been reached to satisfy the requirements of the research questions posed (Bryman, 2016; Saunders et al., 2018).

*Logistics*

Participation in the study was arranged most commonly via email correspondence, the interview then being held in-person with both the researcher and participant in the same location. For several participants owing to the financial constraints of the study and the scheduling constraints of the participant, interviews were held remotely with the interview conducted over the telephone (Table 3.5). In-person interviews were preferred where possible as they allow for a more natural flow of conversation to be followed, using the cues and nuance imparted through non-verbal communication channels (James and Busher, 2009; Salmons, 2014). Further, remote interviewing techniques do not allow for a control of the setting within which an interview is taken place (e.g. a busy office or at home), which may result in interruption of dialogue and possibly self-censorship (Chiumento et al., 2018). In the case of this study the topic was based within the context of individuals' professional experience as opposed to their personal life which may reduce the need for censorship. However, remote interviewing prevents a full appraisal and documentation of the impact of interruptions that may occur during the interviewing process. When remote, interviews were undertaken over the telephone, a method preferred by participants owing to the ease of use and avoidance of the technical difficulties frequently experienced when using online video conferencing tools (Chiumento et al., 2018). Reducing the barriers to participation through the use of a perceived 'quick and easy' mode of communication was highlighted as being important by one participant who described the challenges posed by justifying the time required against other competing and paid demands. Whilst the use of the telephone removed the non-visual cues, all participants of the study were professionally-based in Australia and so not only used to discussing professional topics using this medium but were also working within the same culture of environmental management.

**Table 3.5.** The distribution of participants across profession type. *Industry and consultancy representatives are collectively referred to as practitioners. **One interview was conducted with two participants.

| **Participant type** | | **Total participants** | **No. interviews in person** | **No. remote interviews** |
|---|---|---|---|---|
| **Practitioner** | Industry* | 6** | 2 | 3 |
| | Consultancy* | 7 | 4 | 3 |
| **Regulator** | | 7 | 6 | 1 |
| **NGO** | | 6 | 5 | 1 |
| **Academia** | | 5 | 4 | 1 |
| Total | | **31** | **21** | **9** |

*Data bias – researcher position*

To collect and interpret data appropriately, particularly although not limited to those obtained through qualitative methods, it is important to fully consider the role and influence of the research. Relationships between the research and subject/s are influenced by a wide range of factors, including gender, class, race, nationality, politics, history and experience (Schoenberger, 1992; Valentine, 2005). These factors shape our interpretation of the world and can influence our research in numerous manners from inhibiting data collection, to focusing on a single strand of thought, to creating bias in the type of data collected. It is increasingly acknowledged that to ignore the positionality of the researcher is to cloud interpretations and restrict the depth and validity of data collection and analysis (Laurier and Parr, 2000; Valentine, 2005; Widdowfield, 2000). At all stages of research it is important to scrutinise how personal identity, emotions and restricted perspective shape the interactions between the researcher and participant in the interviewing process and how this is reflected in the data obtained (England, 1994; Valentine, 2005).

In considering my positionality and the influence that I could exert on the research in question I can identify two major factors that could present bias; namely my British nationality and my background in natural science and conservation. In being British, given the focus of selected case studies in Australia I could be classed as an 'outsider'. This could render both benefits in terms of a reduced perception of conflicts of interest and assumed knowledge and disadvantages in my perceived lack of understanding or 'buy in'. A further disadvantage could arise through my lack of understanding of the Australian ways of business in terms of limiting my ability to understand where information may lie, or perhaps more significant is my background and strong beliefs surrounding sustainability and environmental protection. It is this interest, coupled with previous work experience in marine management roles in NGOs, government and industry, closely involved in marine environmental consenting practice in the UK, that are major motivating factors leading me to pursue the research questions encompassed within this PhD projects. However, my strong beliefs in this area, and past career experience firmly within the conservation sector albeit with a focus at the industry and policy interface could serve to bias data collection and interpretation. I also have a working understanding of the pressures under which consenting frameworks are being implemented and the politics surrounding such processes from an industry, regulator and conservationist perspective. As such, I fully understand the need for pragmatism within conservation and the importance of recognising human use and social justice within environmental protection efforts. However, my background could undermine trust with developers and regulators who could perceive my interests and research as a risk to their reputation.

*Data analysis*

Analysis of interview data followed an iterative and step-wise process. This involved (1) the transcription of interviews; (2) familiarisation with the data; (3) code generation; (4) refinement of codes and identification of themes to interpret data; (5) presentation and discussion of research (adapted from Braun and Clarke, 2006). Transcription was undertaken using the NVivo transcription function, which supports easy navigation of the interview recording including the ability to slow the recording and to easily pause and rewind the audio when required. The transcripts also recorded the informal conversations outside of the interview itself and the non-verbal and paralinguistic features of speech, such as sighs or sounds of agreement e.g. "*Mmmmm*", that are prevalent in naturally flowing conversation. During transcription in NVivo, text was 'tagged' with analytical memos where ideas or themes arose to assist in analysis (Saldaña, 2016). The following step of familiarisation with the transcripts and data entailed the reading of the transcripts and double checking their accuracy. During this process notes were made to complement those taken during the interview process which included specific observations or ideas arising from the interaction with the participant. This process of familiarisation was a pre-cursor to developing a coding framework and was supported by the personal transcription of the interviews which allowed a 'closeness' to the data.

Coding of the transcripts was initiated using codes derived from both familiarisation with the data and research diaries and the topic guide used to steer interviews (Table 3.4.). Building on this with an inductive process through open coding undertaken within NVivo allowed for all data to be scrutinised independently to capture the range of perceptions described explicitly and implicitly by participants. Whilst coding, further annotations and analytical memos were recorded within NVivo as concepts and ideas arose through analysis. The purpose of this stage of analysis was to establish a framework to support the evolution of ideas and to identify potential lines of inquiry. Over 30 codes were identified through this process which on review were identified as overlapping. Using the cluster analysis tool within NVivo, similarities in codes and the text coded were examined to facilitate the refinement of the coding framework. Following this, transcripts were revisited to reduce overlap between codes and to identify overarching themes and sub-themes within the data (Braun and Clarke, 2006).

Once the coding and thematic framework was sufficiently distilled to reduce overlap and support interpretation of the data within NVivo, the coded text was exported to Microsoft Excel and sorted by theme and code. This allowed for easy 'access' and reading of the coded text and was augmented by cross-reference with the full transcripts within N-Vivo to confirm the context within which text was situated. Using Excel, coded text was further reduced as analysis of themes was followed using the frameworks applied in Chapters 6 and 7 to address the research questions of this thesis. Data was also sorted by participant 'profession type' (see Table 3.5) to explore the relationships and patterns within the perspectives illustrated by the selected text.

*Chapter 6 – Data analysis: Perceptions of practice*

Analysis involved a thematic analysis based on the use of a framework of a priori codes developed with reference to the topic guide (etic or deductive), combined with themes arising through the research (emic or inductive) (Fereday and Muir-Cochrane, 2006). The combined approach selected is commonly used for this type of analysis, where the exploratory nature of the research questions supports refinement of analysis to include emerging areas of interest (Fugard and Potts, 2016). Coded data was then revisited to map key themes of the processes and drivers influencing the application of biodiversity offsetting principles to reveal the role biodiversity offsetting is performing within decision-making processes for marine development projects (BBOP, 2012; Bull et al., 2013). Framing the analysis around the concept of biodiversity offsetting as a boundary object allowed for an interrogation of the differing ways that the approach is being used between actors involved with marine development consent. Boundary objects refer to an item or idea used for action (Star, 2010) and that facilitates integration and communication across scientific and political worlds (White et al., 2010). Boundary objects are described as having "*interpretative flexibility*" across different groups that allow these disparate groups to structure information and collaborate without consensus (Star, 2010; Star and Griesemer, 1989). Chapter 6 explores whether and how marine biodiversity offsetting is performing as a boundary object and what might be driving this.

*Chapter 7 – Data analysis: Relationships between stakeholders and the influence of biodiversity offsetting*

Similarly, to the analytical approach adopted in Chapter 6, both an inductive and deductive thematic process was followed. Building on the findings presented in Chapter 6, initial coding of transcribed interviews, using the data management program N-Vivo, focussed on the themes of risk, trust and sentiment perceived by actors implicated in the use of marine biodiversity offsetting. Based on initial analysis this was then expanded to focus and explore the relationships described between actors. Following the mapping of relationships, the Social, Actuarial and Political (SAP) model was applied (Bice et al., 2017) to refine analysis and to provide structure to understand the context and relational dynamics perpetuating current modes of marine biodiversity offsetting practice. The conceptual SAP model describes the various complex relationships between various stakeholder groups operating around a central concept of *"public interest"* (Bice et al., 2017) or for the purposes of this analysis, NNL of biodiversity to be achieved through biodiversity offsets. Framing analysis using the SAP model allowed for examination of the flows of interaction between stakeholder groups that are perpetuating the modes of use identified in Chapter 6.

## 3.5. **Research limitations**

Less is known about the marine application of biodiversity offsetting than for terrestrial applications (Chapter 2). This suggests that there is likely to have been less experience in its use in such environments and likely a lower number of people exposed to this experience. Accordingly, identifying participants to participate in this study was challenging. Despite this, participants were recruited within the fields of regulators (both within development control and policy development roles), academia (where individuals were also involved in academic consultancy projects working on developing policy and guidelines), industry, consultancy and environmental NGOs. The policy basis for the use of marine biodiversity offsetting was found to vary among jurisdictions in Australia (Chapters 4 and 5). Efforts were made to ensure the participant sample included representation across all jurisdictions, however for those with a limited policy basis recruitment was challenged. Further, the 'small world' of marine environmental consenting meant that individuals often had experience across a range of jurisdictions. It is also worth noting that participants engaged most likely self-identify as 'environmentally minded', it is unlikely that representation of those that actively seek to misuse, or disregard aims of NNL or biodiversity offsetting has been included within the participant sample. Several participants also had experience in the terrestrial application of biodiversity offsetting - which allowed for an informed discussion of the differences in applying the approach in a marine setting, but also meant that for some questions terrestrial examples inevitably inform perceptions and results. Further, the small number of individuals working in the field of marine environmental consenting also likely influenced results in that several of the participants are likely to have discussed the topic previously, particularly in relation to developing policy. However, given the small number of individuals working in the field avoiding this type of participant overlap and associated potential for bias would have presented a major limitation to the study. Recruiting NGO representatives was particularly challenging, recruitment was limited to those individuals who are engaged with developing marine biodiversity offset policy and guidance and politically engaged with decision-consent processes. As a result, representation is restricted to those overtly involved in processes and does not include any community-based beneficiaries of offset finance or the public.

Despite these potential limitations, the participant sample represents an accurate cross-section of those working on marine biodiversity offsetting policy development and implementation at the point of data collection from late 2016 to early 2017. As such, the sample robustly informs the analyses presented in Chapters 6 and 7 and the conclusions of this thesis. Further, the results obtained corroborate with the results triangulated through multiple sources including development consent documentation, policy and peer-reviewed literature. Additional limitations relate to the coding and analysis of the interview data which was undertaken by a single individual which could impart bias to the findings presented. Whilst such bias is unavoidable, efforts have been made to avoid anecdotal interpretation of results, this is demonstrated by the presentation of extended quotations to clearly illustrate each theme and to ensure that divergent views are reported accurately. It is worth reiterating the aim of the analysis undertaken was to capture the perceptions and experiences of participants not to gather verifiable 'facts' about what they know (Robson, 2011). As such, whilst analysis draws heavily on themes that are captured in specific quotations, the focus was to ensure that the communication of the perspective was conveyed accurately.

## 3.6. Research governance

*Ethics*

Ethical approval was obtained from University College London and all participants provided voluntary verbal and/or written consent prior to interviews. All interviews were digitally recorded, transcribed and anonymised. No incentives were offered for participation.

Interviewing as a form of data collection requires ethical consideration. The very nature of the technique, whereby knowledge is gleaned from the informant by the researcher, establishes a relationship through in-depth conversations tailored towards the purpose of the study highlighting the need for moral reflection. Whilst the informants of this study and the topic of focus are very unlikely to inflict harm, with much of the information exchanged being available in the public domain, it is important that consent is sought. Informed consent should include briefing and debriefing as to the purpose of the interview and research and should be obtained prior to data collection. The issue of confidentiality should be addressed within such discussions and arrangements made accordingly. In some instances participants may seek to remain anonymous, and whilst it is important to respect these wishes it is important to consider the impact of such requirements on consequent interpretation and to ensure that the participant's voice is appropriately included and not silenced (Brinkmann and Kvale, 2014; Dowling, 2010).

On analysis it is important to treat qualitative data no differently than how numerical data might be treated, with clear introductions and interpretations being offered by the researcher to provide for a transparent research process. Further, the context of data and particularly quotation need to be clearly illustrated in order to be "*ethically proficient*" (Brinkmann and Kvale, 2014). As alluded to previously, the selection of material in interpretation should be considered and contextual information provided as to why the voices of some participants are presented and others absent (Dowling, 2010).

# 4. A global review of biodiversity offsetting policy

*This Chapter presents the research published in Marine Policy in 2017 under the title "A global snapshot of marine biodiversity offsetting policy".*[6]

## 4.1. Introduction

Damage to natural environments and their widespread conversion for other uses are contributing to the accelerating decline of global biodiversity (MEA, 2005; UNEP, 2012). Biodiversity offsetting is one of many proposed approaches for mitigating losses of biodiversity associated with economic and infrastructure development projects (Bull et al., 2013). The underpinning principle of biodiversity offsetting is NNL – i.e. the counterbalancing of biodiversity losses with biodiversity gains (BBOP, 2012). These gains can be realised through various mechanisms including; restoration or rehabilitation of habitat in another location, averted loss e.g. through the protection of an area and education, and management to alleviate or avert pressures that would lead to biodiversity losses (Bull et al., 2013). Other mechanisms such as allocation of funds for research have also been characterised as biodiversity offsets in contexts where lack of knowledge is considered an impediment, but these are considered to be very 'out of kind' and difficult to reconcile with the principle of NNL (Gardner et al., 2013; McKenney and Kiesecker, 2010).

Conceptually, the implementation of biodiversity offsets can take one of three forms: (1) ad-hoc projects delivered directly by the proponent of development causing biodiversity loss; (2) third party habitat banks (also referred to as species, conservation or mitigation banks) where 'biodiversity credits' equivalent to meeting offsetting requirements can be purchased or otherwise exchanged; and, (3) in-lieu fees where financial compensation for biodiversity impacts is pooled for strategic level conservation projects (Bull et al., 2013; Wilkinson, 2008). To guide the appropriate application of biodiversity offsets a set of key principles have been widely accepted as necessary for the success of the approach (See Section 2.3. summarised in Table 4.1; BBOP 2012).

[6] Niner, H.J. et al., 2017. A global snapshot of marine biodiversity offsetting policy. Marine Policy, 81, pp.368–374

**Table 4.1.** Key principles for biodiversity offsetting success.

| Principle | Detail |
|---|---|
| **Mitigation hierarchy** | Biodiversity offsets should be considered only as a last resort for residual impacts after avoidance and mitigation has been explored (McKenney and Kiesecker, 2010). This exercise should be informed by a feasibility study of offsets (accounting for principles identified as essential for biodiversity offset success including equivalence, additionality, continuity and compliance monitoring) and an analysis of the ecological significance of the identified impact (Bos et al., 2014; McKenney and Kiesecker, 2010). |
| **Equivalence** | Demonstration of the balance between biodiversity losses and gains is required (BBOP, 2012; Bos et al., 2014; Maron et al., 2012). This should take account of the counterfactual baseline to ensure NNL is achieved (Maron et al., 2015a). |
| **Additionality** | Biodiversity offsets should not displace existing commitments or activity; they should deliver benefits beyond those that would occur in the absence of the offset project (BBOP, 2012; Quétier and Lavorel, 2011). Biodiversity offsets should be designed in context so as to complement existing conservation priorities and to prevent displacement of impact to other areas (leakage) (Moilanen and Laitila, 2016). |
| **Continuity** | Supply of biodiversity through offset projects requires consideration from a temporal and financial perspective. Temporal strategies should ensure that the point at which NNL of biodiversity is achieved is matched to the point of impact (Bekessy et al., 2010; Gordon et al., 2011; McKenney and Kiesecker, 2010; Moilanen et al., 2009) and that outcomes are delivered for the duration of the impact or in perpetuity (Gibbons and Lindenmayer, 2007; McKenney and Kiesecker, 2010). This should be managed through an associated adaptive monitoring program the finances of which should be fully accounted for within planning (Bos et al., 2014; Levrel et al., 2012). |
| **Compliance success** | Non-compliance with biodiversity offset requirements is a significant risk to achieving an aim of NNL. Whilst the legal responsibility for the success of the offset project lies with the project proponent or third-party delivering the offset, oversight of implementation (and monitoring) should be maintained by a third party or regulator to ensure compliance with the offsetting requirements (Brown and Veneman, 2001; Bull et al., 2013; Kentula, 2000; Matthews and Endress, 2008; Quigley and Harper, 2006b). These relative responsibilities should be clearly outlined and the mechanisms by which this oversight will be undertaken to ensure implementation occurs and is in line with that agreed. |

Political and professional discussion and use of biodiversity offsetting has rapidly increased over the last decade for a number of reasons (Calvet et al., 2015). One of the primary drivers of this increase has been identified as the political promotion of market-based instruments for conservation purposes (Calvet et al., 2015). This political push has outpaced the development of ecological foundations for the approach which are yet to be clearly defined (Calvet et al., 2015). Given the knowledge gaps in the underpinning ecological science, the outcomes of biodiversity offsetting in terms of environmental protection are unclear (Gibbons and Lindenmayer, 2007). The challenges of this approach include those concerning our fundamental ability to restore ecology (Kentula, 2000), inappropriate implementation and design of offsets (Maron et al., 2015a), the need to seek equivalence across ecological components and ineffectual compliance regimes (Bull et al., 2013, 2015; Quétier and Lavorel, 2011; UNEP-WCMC, 2016).

Biodiversity offsetting practice in terrestrial areas has been subject to a level of academic scrutiny but less attention has been devoted to the extension of the practice into marine environments (Bas et al., 2016). Given that increasing development pressures and impacts are not confined solely to terrestrial environments and with projections for the 'ocean economy' to more than double between 2010 and 2030, it follows that biodiversity offsets are likely being increasingly applied offshore (European Commission, 2012a; Halpern et al., 2015; OECD, 2016a; UNEP-WCMC, 2016). Current indications are that the challenges posed by the use of biodiversity offsetting policies in the marine environment are common to those faced in terrestrial applications (UNEP-WCMC, 2016). The marine environment, however, presents unique difficulties including the scale and degree of connectivity between and within ecological units operating in three dimensions (Crowder and Norse, 2008), high biological and physical heterogeneity of both habitats and species on widely varying spatial and temporal scales (Crowder and Norse, 2008), poorly defined property rights and the remote nature of governance relative to population centres (Bos et al., 2014; Douvere et al., 2007; Vaissière et al., 2014).

Available literature is limited to analysis of the marine application of existing and relatively mature national biodiversity offsetting policies in the US, Canada and Australia (Department of the Environment and Energy, 1999; Minister of Justice, 1985; US EPA, 2015a, 2015b). Efforts to identify marine practice in Europe have struggled to find evidence of the use of biodiversity offsetting owing to the way in which the mitigation hierarchy has been applied within impact assessment (Bas et al., 2016; Jacob et al., 2016a; Vaissière et al., 2014). Beyond this little is known about how and where biodiversity offsetting theory is being applied in a marine context (UNEP-WCMC, 2016; Vaissière et al., 2014).

This Chapter seeks to document how and where biodiversity offsetting is being applied in marine environments. It builds upon a similar exercise undertaken by the Ecosystem Marketplace in 2010 and updated in 2011 that mapped global uptake of biodiversity markets but found little evidence of marine application (Madsen et al., 2010, 2011).

## 4.2. **Methodological overview**

This Chapter presents a snapshot as of December 2016 of the current application of biodiversity offsetting principles in a marine context. The analysis comprises a systematic review of documents evidencing the application or inclusion of biodiversity offset principles in policy frameworks concerning the marine environment, and in marine development projects. A total of 124 documents were identified that provide evidence of the uptake and application of these principles in some form (Appendix A). These documents were analysed in relation to their uptake of the key principles widely accepted as necessary for biodiversity offsetting success introduced in Table 4.1. This review does not analyse the information gathered concerning the effectiveness of offsets to avert biodiversity losses, or the extent to which widely accepted standards for best practice are integrated into the approaches identified (BBOP, 2012). The aim here is to identify instances where biodiversity offsetting principles are being applied in marine environments, and what form this takes. A detailed methodology for this systematic review is provided in Chapter 3.

## 4.3. **Results**

The application or exploration of the potential to apply biodiversity offsetting principles in the marine environment was found in 45 countries. The mechanisms through which this is being undertaken vary – from being supported by established or emergent public policy at a national, supra- or sub-national level (Table 4.2) to being driven by various other means outside of public policy frameworks (Table 4.4). No evidence was found of the application of the principles in a marine context in Eastern Europe (Appendix B). Evidence was found of application in marine contexts in North America, Australia, Europe, Africa, Asia, Latin America and Oceania. The type of mechanisms being used to apply marine biodiversity offsets by country are presented in Table 4.2 and Table 4.4.

*Marine biodiversity offsetting supported by public policy*

Public policy refers to existing and active policy specifically supporting the application of biodiversity offsets or an aim of NNL (or net benefit, net gain etc.), operational at a national (or supranational in the case of the EU) level and applicable to marine environments. National (or supranational) policies exist in the US, Canada, Australia, the EU, France, Germany and Colombia (Australian Government, 2012; DoD and EPA, 1990; European Commission, 1992, 2010; Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2010; MEDDE, 2012, 2013, Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012b, 2012a, US EPA, 2015a, 2015b). These policies support the application of the five principles essential to biodiversity offsetting success with the exception of that in Colombia where detail relating to additionality was not found (Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012b, 2012a) (Table 4.1). Only one of these national policies, the Magnuson-Stevens Fishery Conservation and Management Act (NOAA, 2007), has been developed specifically for marine application and with the exception of French, German and Colombian policy, all have application restricted to 'listed' marine habitats, species or protected areas.

Sub-national offsetting public policy has similar aims to that of national public policy but is relevant to specific sub-national political jurisdictions only (e.g. state level). Sub-national policy in South Africa precedes national policy and whilst terrestrial in focus does not preclude application in marine environments (Jenner and Balmforth, 2015). In the US and Australia sub-national policy has been developed for specific marine application of biodiversity offsets in the instance of impacts to eelgrass in California, fish habitat in New South Wales (NSW) and specifically for the Great Barrier Reef (GBR) in Queensland (Dutson et al., 2015; Fairfull, 2013; NOAA Fisheries - West coast region, 2014; Queensland Government, 2016). In Australia, sub-national policy supporting the application of biodiversity offsetting exists in five of its six states. Marine application for most sub-national offsetting policy in Australia relates to the protection of native vegetation which includes marine habitats such as seagrass. Outside of the marine specific policies of NSW and for the GBR, limited guidance is provided as to how impacts to marine vegetation should be addressed (Department of Environment Water and Natural Resources, 2015; Victoria State Government, 2016).

**Table 4.2.** Types of public policy mechanism identified as supporting the application of biodiversity offsetting principles in a marine context by country. *Sectoral offsetting policies identified stem from private standards, these examples are also included in Table 4.4. **US policies also apply to five US territories (see Appendix B). ***Policies at a European Union (EU) level apply to all 23 coastal member states, however, several member states have moved ahead of the existing and tentatively emergent position. In addition, policy exists at an EU level that requires the comprehensive application of biodiversity offsetting principles but is restricted in application for impacts to designated sites only.

| | National or supranational offsetting policy | Sub-national offsetting policy | Emergent national or supranational offsetting policy | National policy applying partial application of offsetting principles | Sectoral offsetting policy* |
|---|---|---|---|---|---|
| **US**** | ✓ | ✓ | | | |
| **Canada** | ✓ | | | | |
| **Australia** | ✓ | ✓ | | | |
| **European Union (EU)***** | (✓) | | ✓ (on hold) | | |
| **France** | ✓ | | | | |
| **Germany** | ✓ | | | | |
| **Netherlands** | | | | ✓ | |
| **UK** | | | ✓ (on hold) | | |
| **Liberia** | | | | | ✓ |
| **Mozambique** | | | | | ✓ |
| **South Africa** | | ✓ | ✓ | | |
| **Argentina** | | | | ✓ | |
| **Belize** | | | ✓ | | |
| **Colombia** | ✓ | | | | |
| **Peru** | | | ✓ | | |
| **Korea** | | | | ✓ | |
| **New Zealand** | | ✓ | | | |

Emergent national or supranational offsetting public policy refers to those countries where evidence of progression towards the development of a national policy (as defined in this Chapter) and uptake of biodiversity offsetting principles has been identified. In addition to existing sub-national policy, South Africa is exploring the development of national policies and options that are applicable to marine environments but limited information is available as to the detail of these discussions (Jenner and Balmforth, 2015). In Peru, uptake of a NNL goal is gaining momentum, and with offsetting policy and guidance being recently agreed for Andean environments, it is expected that the reach of this will expand to include marine environments in coming years (Pilla, 2014). Further, an EU initiated project, currently on hold, considers how an aim of NNL might extend beyond currently existing biodiversity protection legislation that is limited to key habitats and species (European Commission, 2012b; McGillivray, 2012). The UK national position on biodiversity offsetting has been put on hold after an initial pilot project (DEFRA, 2013). However, there was significant interest in its marine application and the potential opportunities to generate revenue for organisations such as the UK Crown Estate (Cook and Clay, 2013; Dickie et al., 2013). Despite this national position, the UK is still subject to the requirements of the EU Birds and Habitats Directives and a government-led project has been tendered relating to the identification of habitats to assist with the compensation requirements arising through the consenting processes for marine development (MMO, 2016).

Threats posed to the coastal marine environment have been directly addressed in Belize through the development of a marine biodiversity offset framework which is hoped to progress to a more formal state. This has been developed through a partnership with the Australia-Caribbean coral reef collaboration and the Belize Coastal Zone Management Authority and Institute (Belize Coastal Zone Management Authority & Institute and Australia-Caribbean Coral Reef Collaboration, 2014). This framework explicitly identifies the need for compliance and continuity, though the application of biodiversity offsetting principles in Belize is dependent on the compliance regime to be put in place to support implementation once adoption progresses beyond the current emergent status.

Sectoral offsetting public policy relates to the existence of policy developed for a specific sector (such as mining) that supports the application of biodiversity offsetting principles in a marine context. In both Liberia and Mozambique, the standards applied through this public policy have not been developed by government and relate directly to private standards which are considered in more detail in Section 3.2.

National public policy requiring partial application of offsetting principles relates to other national policies that do not explicitly reference biodiversity offsetting but support the application of a number of biodiversity offsetting principles. These principles go beyond the application of the mitigation hierarchy and seek to improve the success of compensatory action (Table 4.3). Legislation in the Netherlands extends the remit of the EU Birds and Habitats Directive to include some marine habitats and species of national importance. Whilst offsetting is not specifically referenced within this additional legislation, the need for equivalence and continuity of biodiversity to be considered when defining compensation arrangements is detailed (Tucker et al., 2014). The Korean Act on the Conservation and the Use of Biodiversity requires that a bond be held as security against compensation success and discussions have been held as to how a NNL policy could be introduced (Kim, 2010; Lee, 2013; Ministry of Economic Affairs, 2014; Ministry of Environment of the Republic of Korea, 2014b, 2014a; Ministry of Land Transport and Maritime Affairs - Marine Environmental Policy Division, 2009; OECD, 2006). In Argentina legislation requires that impacts are remedied by the proponent causing biodiversity loss and establishes an environmental compensation fund as an option should restoration not be technically feasible (Republic of Argentina, 2002).

**Table 4.3.** The presence and absence of biodiversity offsetting principles embedded within public policy frameworks. Demarcation with an 'x' indicates the presence of the principle across all policies of that type, identified to support marine biodiversity offsetting and presented in Table 4.2. *The principles noted do not apply equally to all examples (countries) identified (see Appendix B).

| | National offsetting policy | Sub-national offsetting policy | Emergent national offsetting policy* | Sectoral offsetting policy | National policy requiring partial application of offsetting principles* |
|---|---|---|---|---|---|
| **Mitigation hierarchy**<br>Offsets as a last resort through avoiding, mitigating then compensating (offsetting) residual biodiversity impacts. | × | × | × | × | × |
| **Equivalence**<br>Balance is sought between biodiversity losses (impacts) and gains (offsets). | × | × | × | × | × |
| **Additionality**<br>Offsets deliver benefits beyond those that would occur in the absence of the offset project. | × | × | × | | |
| **Continuity**<br>Offsets deliver biodiversity benefits from the point of biodiversity loss and for the duration of impact. | × | × | × | | |
| **Compliance success**<br>Implementation and success of offset requirements should be overseen by a third party or regulator. | × | × | | × | × |

*Offsetting mechanisms not stemming from public policy*

Evidence also exists for uptake of biodiversity offsetting principles in marine environments outside of public policy frameworks. These mechanisms are usually used at a project or an activity level and vary widely in extent and mode. Of the eight instances identified, six are directly associated with financial controls where a degree of compliance success is imparted through associated processes (Table 4.4 and Table 4.5). The five types of mechanism promoting the application of biodiversity offsetting principles relating to finance include: (1) private standards levied by development banks such as the IFC (Equator Principles Association, 2013; IFC, 2012); (2) conservation funds promoting the pooling of funds for the strategic application of marine biodiversity offsets; (3) the application of a marine resource access charge (Rao et al., 2014); (4) the research and development of biodiversity markets through the local-level fisheries management frameworks as being trialled in Chile (Gelcich and Donlan, 2015); and, (5) corporate standards.

**Table 4.4.** The types of mechanism through which biodiversity offsetting principles are being applied in a marine context outside of policy frameworks. Application of these mechanisms is not always at a national level with many focussed at a sub-national or project level (Gabon, Yemen, PNG). *Private standards in Liberia and Mozambique have been incorporated into sectoral policy.

| | **Private standards (finance)** | **Independent conservation fund** | **Resource access fee** | **Biodiversity markets** | **Corporate standards** |
|---|---|---|---|---|---|
| **Liberia** | ✓* | | | | |
| **Mozambique** | ✓* | ✓ | | | |
| **Gabon** | | | | | ✓ |
| **China** | | | ✓ | | |
| **Yemen** | | | | | ✓ |
| **Papua New Guinea (PNG)** | ✓ | | | | |
| **Chile** | | | | ✓ | |

The final type of mechanism identified relates to the practical application of corporate standards, for which evidence has been found at a project rather than national level. There has been an increased recognition of the need to address the environmental impacts of corporations as major contributors to current trends of declining biodiversity (Rainey et al., 2014). In response, a growing number of corporations have identified or articulated a business case for improving their environmental practices – e.g. in order to secure access to essential environmental assets, and to gain an SLO and use these resources (Calvet et al., 2015; Rainey et al., 2014). One example of this is Tullow Oil's joint project with the Wildlife Conservation Society (WCS) in Gabon which seeks to improve marine ecological knowledge to improve the application of the mitigation hierarchy in offshore environments (Le Gabon, 2012; Madsen et al., 2010; Tullow Oil, 2013).

For the purposes of this review the private standards imposed by the International Finance Corporation (IFC) and other development banks have been considered separate to corporate standards adopted by private industry. Finance provided through the IFC and other development banks requires recipient adherence to a number of biodiversity offsetting principles (IFC, 2012; Villarroya et al., 2014). For example, the IFC's Performance Standard 6 specifically requires private sector clients receiving investment to implement a policy of NNL which is then enforced by the financial body subject to the conditions of agreement. These standards are commonly applied at a project level and evidence of this occurring in a marine context has been observed in Papua New Guinea (PNG) (Table 4.4). Private standards have also influenced uptake of biodiversity offsetting principles through public policy. Evidence of where this has occurred and is applicable to marine environments has been identified in Liberia and Mozambique. In Liberia, sectoral policy exists for the mining industry, outlining requirements to follow the IFC's Performance Standard 6 (Johnson, 2015; Ministry of Foreign Affairs, 2002). In Mozambique, Article 23 of the Petroleum Laws requires operations to adhere to *"internationally accepted standards"* in relation to inevitable ecological damage and the associated mitigation of impacts (Republic of Mozambique, 2014). Whilst the reference to biodiversity offsetting is not explicit, this implies the need to meet common standards such as that outlined in the IFC's Performance Standard 6 (IFC, 2012).

**Table 4.5.** The presence and absence of biodiversity offsetting principles applied in a marine context through mechanisms outside of policy frameworks. Demarcation with an 'x' indicates the presence of the principle across all policies of that type, identified to support marine biodiversity offsetting and presented in Table 4.2.

| | Private standards | Conservation fund | Resource access fee | Biodiversity markets | Corporate standards |
|---|---|---|---|---|---|
| **Mitigation hierarchy**<br>Offsets as a last resort through avoiding, mitigating then compensating (offsetting) residual biodiversity impacts. | × | | | | × |
| **Equivalence**<br>Balance is sought between biodiversity losses (impacts) and gains (offsets). | × | | | × | × |
| **Additionality**<br>Offsets deliver benefits beyond those that would occur in the absence of the offset project. | | | | | |
| **Continuity**<br>Offsets deliver biodiversity benefits from the point of biodiversity loss and for the duration of impact. | | | | × | |
| **Compliance success**<br>Implementation and success of offset requirements should be overseen by a third party or regulator. | × | × | × | × | |

## 4.4. **Discussion**

*Biodiversity offsetting in a marine context*

Biodiversity offsetting policy has largely been developed for terrestrial application (Madsen et al., 2010, 2011). This review indicates that translation and application of this policy to marine environments has commonly taken place with little consideration of the challenges specific to these environments. The guiding principles for the success of biodiversity offsets in marine environments are almost identical to those required in terrestrial environments (Bos et al., 2014; UNEP-WCMC, 2016). However even in terrestrial environments, success of the approach to counter biodiversity losses and the application of these principles has proved to be challenging and there are concerns that it's misuse may be contributing to declining trends of biodiversity (Maron et al., 2015c). The difficulties faced in the terrestrial environment include; the accounting of biodiversity (often across biodiversity types) to ensure that an aim of NNL is met; our ability to restore ecological components and habitats (Bull et al., 2013); those relating to compliance, such as the appropriate application of the mitigation hierarchy and post-consent monitoring; and the avoidance of the perverse application of the approach (Maron et al., 2015b). These challenges all apply to the marine application of biodiversity offsetting but are further exacerbated by three key factors; (1) the high level of uncertainty within marine impact assessment owing to the highly variable and connected nature of the environment (Bas et al., 2016; Crowder and Norse, 2008); (2) the limited evidence of ecological restoration success in a marine context (Bas et al., 2016); (3) the diffuse, complicated and at times remote governance arrangements managing the resource (Bos et al., 2014).

*Marine offsets required by public policy*

Public policy relating specifically to offsetting and its application in marine environments was found to exist at a national (or supranational) level or a sub-national level in 30 countries and at a developmental stage in three countries (Table 4.2). In each of these countries impacts to marine habitats and species identified as ecologically important are required to be offset in line with the five key principles for biodiversity offsetting success (Table 4.1 and Table 4.3). Public policy under development cannot incorporate measures for compliance success given that consenting regimes are to be established. All policy identified applies directly to marine environmental impacts and seeks to protect against losses of marine biodiversity. However, translation of this policy has only been considered in detail in relation to a very limited range of ecological components, e.g. – the highly spatially managed GBR (Dutson et al., 2015; Maron et al., 2016b) and fish habitat (Fairfull, 2013; NOAA, 2007; Queensland Government, 2016). Little guidance is available relating to the consideration of mobile species, such as seabirds and marine mammals, or wider issues, such as the social values attributed to marine parks. The uncertainty in impact prediction and ecological restoration is acknowledged in these 'marine-specific' policies, with greater flexibility allowed in the application of the principles. For example, the definition of equivalence in some cases is applied much more loosely to allow for interpretation beyond 'like for like' replacement of habitat (Appendix B). In situations where rehabilitation of habitat is difficult, as is the case with most fish habitat (Fairfull, 2013), metrics are applied to calculate a financial equivalent to be applied by the regulator to create biodiversity gains to equal losses.

*Uptake outside of public policy*

Private standards formally regulate biodiversity offsetting on a project by project basis through financial agreements and these can apply to projects leading to impacts on marine biodiversity. Despite private standards commonly applying at a project level, there is evidence of their incorporation into public policy. An example of this is the Liberian Mining Act which specifically references the private standards of the IFC relating to biodiversity offsetting (IFC, 2012; Ministry of Foreign Affairs, 2002). Biodiversity offsetting requirements from these sectoral public policies stem from the existence of these privately developed standards and have not been developed by government.

In addition to the more formally regulated private standards, other less formal approaches are driving the application of biodiversity offsetting in marine environments. These mechanisms are usually used at a project or activity level in the absence of national or sub-national policies and in most cases are applicable to marine environments but have not been developed specifically for this purpose. The exception to this is the work being piloted in Chile to develop biodiversity markets through local fisheries-based management, where issues relating to tenure of spatial areas of the fishery are overcome through the application of territorial user rights for fisheries (Gelcich and Donlan, 2015). The authors of the study outlining the progress of this pilot cite the need to develop new conservation instruments to support underfunded international targets such as those under the Convention on Biological Diversity as drivers for this work (CBD, 2013). Other indications exist that marine biodiversity offsetting is being used to raise revenue where central funding does not exist or is insufficient to meet wide conservation commitments, such as in Mozambique, where the development of a conservation trust fund specifically states the *“consolidation of the national Protected Areas system”* as part of its mission (BIOFUND, 2016). It is widely accepted that funding for marine conservation is not sufficient to support the activity required to protect marine environmental resources (Bos et al., 2015). However, cautious management is required if offsets are to be used in this manner to ensure true additionality and to avoid ‘cost-shifting’ and the displacement of existing or future sources of marine conservation finance (Maron et al., 2015b; Pilgrim and Bennun, 2014).

Corporate standards are another mechanism driving uptake of biodiversity offsetting principles in the marine environment. An increased appreciation of the business relevance of environmental impacts and the maintenance of an SLO has led to a recent increase in uptake of corporate goals or standards relating to biodiversity (Rainey et al., 2014). Some of these standards relate specifically to a company-level commitment to NNL of biodiversity (Rainey et al., 2014). However, despite evidence of marine application at a project level being available, no evidence was found of strategic policy level consideration of what might be required for successful application in marine environments. Corporate standards are not necessarily subject to third party oversight and no information was found that allowed for an assessment of the influence or success of such aims. In contrast, private standards such as those required by the IFC and other sources of development finance are subject to third party oversight. This increases the rigour of environmental management in countries that do not currently have marine biodiversity offsetting requirements incorporated into public policy. For those mechanisms being applied outside of public policy compliance is the principle most commonly addressed. Independent third-party oversight (private standards), the upfront payment into a conservation fund or of a resource access fee, or the purchase of credits from a biodiversity bank (biodiversity markets) increases the likelihood of compensation taking place. However, ensuring compliance does not provide the assurance that associated action will lead to a balance of marine biodiversity losses and gains that other principles such as equivalence, additionality and continuity could.

### 4.5. **Conclusion**

This review presents a first attempt at documenting the current global status of application of biodiversity offsetting in a marine context. Results highlight that the approach is being applied in diverse policy contexts and the principles identified as essential for offsetting success are being subject to both partial and comprehensive adoption. National biodiversity offsetting policies applicable to the marine environment were identified in six countries with at least 27 others actively pursuing similar approaches. However, existing policy has not, with the exception of a very low number of sub-national and fisheries specific policies, been developed specifically for marine application. Furthermore, little detail is available as to how the key challenges presented by the marine environment might be addressed in existing non-marine specific biodiversity offsetting policy. Where frameworks have been developed specifically for marine application, a common suggestion appears to be pooling financial contributions to apply to strategic projects for wider biodiversity benefit. This review does not include an analysis of the success of the policies and other approaches in achieving or contributing to an aim of NNL of biodiversity. Further understanding of how the approach is being used to manage biodiversity losses is required to better understand the risks posed by the application of biodiversity offsets in marine environments.

# 5. The marine application of biodiversity offsetting policy in Australia

*This Chapter presents the research published in Ocean and Coastal Management in 2017 under the title "Realising a vision of no net loss through marine biodiversity offsetting in Australia".*[7]

## 5.1. Introduction

In line with trends in terrestrial environments (Bull et al., 2013; Madsen et al., 2010; Maron et al., 2015b), there are indications that biodiversity offsetting has been increasingly used to manage environmental impacts from development (Chapter 4). The concept builds on the principle of the mitigation hierarchy, which underpins EIA processes and consequent decision-making that are used globally in many planning and consenting frameworks. The mitigation hierarchy stipulates that impacts should first be avoided, mitigated and then, as a last resort, any residual effects compensated (BenDor, 2009; Corps and EPA, 1990; Madsen et al., 2010) (Figure 5.1). In theory, biodiversity offsets through an aim of NNL reduce the flexibility in how compensation agreements are reached. Assessments of the feasibility of offsets should address the application of the mitigation hierarchy in a strict hierarchical process and stipulate that the steps of avoidance and mitigation are revisited where offsets present greater uncertainty of success (Bull et al., 2013; Gibbons and Lindenmayer, 2007; Maron et al., 2012; McKenney and Kiesecker, 2010; Moilanen et al., 2009) (Figure 5.1b). For example, it is commonly accepted that NNL is best achieved through direct offsetting mechanisms that achieve measurable biodiversity gains such as 'like for like' habitat restoration (Maron et al., 2012). Many biodiversity offsetting policies stipulate a clear preference that direct and like-for-like measures are first explored as options, in preference to the use of indirect and 'out of kind' measures such as research and education programmes (Bos et al., 2014; Bull et al., 2013; Maron et al., 2012).

[7] Niner, H.J. et al., 2017. Realising a vision of no net loss through marine biodiversity offsetting in Australia. Ocean & Coastal Management, 148, pp.22–30.

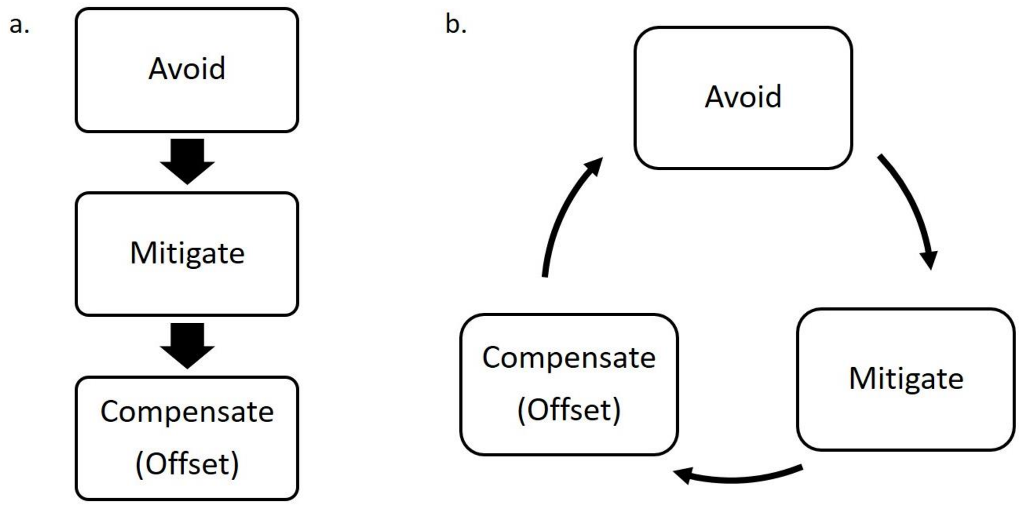


**Figure 5.1.** The mitigation hierarchy as (a) applied in a linear process and as (b) applied through an iterative process as promoted by the robust assessment of biodiversity offset feasibility. Offsets should only be applied as a last resort as a form of compensation.

The key principles underpinning biodiversity offsetting and identified as essential to achieve NNL are the same for both terrestrial and marine environments. They can be distilled into three distinct themes relating to equivalence, compliance, and the application of the mitigation hierarchy (Crowder and Norse, 2008; Day and Dobbs, 2013; UNEP-WCMC, 2016). Whilst there are common challenges to the implementation of biodiversity offsets across terrestrial and marine environments, there are some difficulties unique to the marine environment (Bos et al., 2014; Crowder and Norse, 2008; Day and Dobbs, 2013; UNEP-WCMC, 2016). Impact quantification and attribution is difficult in marine contexts given baseline data for such environments is often scarce and consequently ecological understanding of these systems and impact pathways is often poor. Furthermore, improving our current understanding to support better impact prediction is complicated and costly in marine environments, where ecological function is dependent on a range of highly variable physical, chemical and biological controls, operating on a massive range of temporal and spatial scales (Bos et al., 2014). A possible consequence of this is that impact quantification has been found to be absent or simplified in reviews of EIA documentation for marine projects (Soulé, 1985; Vaissière et al., 2014).

Offset success has also been shown to be contingent on the implementation of an effective compliance regime (Brown and Veneman, 2001; Kentula, 2000; Robertson and Hayden, 2008). In marine contexts, compliance is complicated not only by the diffuse nature of impact pathways and connectivity between ecological components but also often by the "*horrendogram*" of existing laws and policies governing environmental protection in many countries, and the absence of clearly defined property rights (Boyes and Elliott, 2014).

This Chapter presents a review of current biodiversity offsetting practice in the marine environment in Australia, based on an analysis of the Australian policy context and online planning documentation associated with major coastal development dating from the 1970s. By reviewing the development types, actions and impact pathways triggering biodiversity offsetting requirements within consents, current practice in relation to an aim of NNL is assessed.

## 5.2. **Legal and policy context in Australia**

Australia is one of six countries including Canada, Colombia, France, Germany and the US that currently have national biodiversity offsetting policies in place (Chapter 4; Australian Government 2012). Five of Australia's six states have also established biodiversity offsetting policies that are applicable to marine environments (Chapter 5). Despite its relatively advanced policy basis supporting biodiversity offsetting, Australia has only recently started to develop policy specifically applicable to marine environments (Maron et al., 2016b).

Australia is custodian to just under four percent of the global ocean, this jurisdiction is governed by the Offshore Constitutional Settlement (OCS) which was released in 1979 after the Australian Federal Government (or Commonwealth) was granted sovereignty over the offshore (Attorney-General's Department, 2019; Haward, 1989). This agreement, reached after negotiations, eased tensions between the Commonwealth and States over how to manage marine natural resources, such as offshore oil and gas reserves. It provides the States (and territory) with jurisdiction from the low water mark (with the exception of where closing lines are applied across bays that extend this offshore) to three nautical miles offshore and the Australian Government from this limit of state waters out to the edge of national jurisdiction at 200 nautical miles (Haward, 1989; Haward and Vince, 2009). However, Australian state jurisdictions arising from these baselines are not simple, as demonstrated in South Australia where the baseline for state waters encloses the Spencer gulf and the Gulf of St. Vincent extending around the low water mark of Kangaroo Island (see Kaye, 2009). This arrangement leaves an area of internal waters, the Investigator Strait between Kangaroo Island and mainland South Australia not including the Gulfs, which would normally be considered to fall under state jurisdiction but which legal precedent has determined are not part of South Australia (Kaye, 2009). The settlement also describes the arrangements on managing specific issues and sectors including oil, gas and other seabed minerals, marine pollution, fishing and the marine parks including the GBR. This arrangement, although 'resolving' the tensions that peaked in the second half of the twentieth century over jurisdictional boundaries and claims over marine resources, is reported as insufficient in effectively managing the relationship between the state and federal Australia government (Vince, 2018). These divisions across jurisdiction and sectors have led to an array of management approaches for marine biodiversity (Haward, 1989, 2014).

Environmental impacts in Australia are managed across three levels of government - Commonwealth, State or Territory and local. Impacts to matters of national environmental significance are managed under the Commonwealth Environment Protection and Biodiversity Conservation Act (EPBC Act). In the marine area these apply to a range of receptors against which environmental impact can be assessed, including world heritage properties, listed threatened species and ecological communities, Commonwealth marine areas, and the Great Barrier Reef Marine Park (Department of the Environment and Energy, 1999). At a state level, there a range of matters for which impacts may trigger offsetting requirements, in particular those relating to fish habitat and native vegetation (Chapter 4). Bilateral agreements are in place to avoid duplication of EIA processes at a Commonwealth and State/Territory level and within the Great Barrier Reef Marine Park (ANEDO, 2014; Australian Government, 2017). Other legislation and policies influence how tests of significance are applied and the options available for offsetting. For example, in some jurisdictions local policy classifying an area as being of 'urban use' allows for loss of some habitat such as seagrass, which prevents the realisation of an aim of NNL in these areas (Kilminster et al., 2015). Furthermore, establishing marine offset projects is complicated by the overlapping use of an area by different sectors and activities such as shipping and both commercial and recreational fishing. The absence of clearly defined property rights and overlapping use of marine environments and resources prevents the easy isolation and protection of an area for habitat restoration.

At a national level, guidance within Australia's EPBC Act Environmental Offsets Policy is in line with accepted best practice for biodiversity offsets in most areas, and outlines the need for a robust and transparent application of the mitigation hierarchy (Australian Government, 2012; BBOP, 2012). However, the requirement for direct effort to form 90% of all offsetting measures is not applied in a marine context where uncertainty is acknowledged as being *"so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter"* (Australian Government, 2012). The aims of the EPBC Act Environmental Offsets Policy are echoed in state-level policy, where the challenges of marine application (when explicitly considered) are addressed through flexibility in the implementation of indirect (and 'out of kind') offsetting measures (Fairfull, 2013; Queensland Government, 2016; WAMSI, 2014). For example, current practice in Queensland, New South Wales and Western Australia is to accommodate the challenges presented by the application of marine biodiversity offsets by pooling financial offsets for strategic conservation effort (Fairfull, 2013; Queensland Government, 2016; WAMSI, 2014). This flexibility allows the uncertainty of specific marine impact assessments to be managed, particularly to assist where direct measures are challenging and there is inherent difficulty in achieving biodiversity gains of a similar type to that lost (Miller et al., 2015). Australian policy does not support 'trading up' across ecological components to benefit biodiversity of greater conservation value as compared to that lost (Australian Government, 2012; Bull et al., 2015). This further complicates the use of indirect offsets through removing the option to invest in biodiversity of a higher perceived value. Here the ways in which the flexibility of relevant policy frameworks in Australia influences the application of biodiversity offsets in the marine environment are investigated, followed by an appraisal of the outcomes this presents for biodiversity.

## 5.3. Methodological overview

Information was sourced through a systematic review of planning applications available on Australian government planning websites for development projects that involved predicted residual marine environmental impacts. A total of 43 projects were identified where marine biodiversity offsets were stipulated as part of their consent. Project documentation was analysed for information relating to impact identification, including the ecological receptors (species or habitat) affected and the actions that led to their degradation or loss. Further detail included the mechanism used to implement the offset (Table 3.2; Bull et al. 2013; Madsen et al. 2010), and the decision process followed when agreeing the form of the offset (Table 3.3). The criteria selected for assessment were based on the key principles for biodiversity success outlined in Table 4.1.

## 5.4. Results

*Spatial and temporal patterns in the use of marine offsets*

In line with trends in the number of EPBC referrals, the use of biodiversity offsets within marine development consenting has increased over the last decade (Figure 5.2) with a peak between 2009 and 2013 (Harvey and Clarke, 2012). The earliest marine biodiversity offsetting requirement was issued in 1994 for an aggregate dredging project in Western Australia. While explicit use of the terms 'biodiversity offset' or 'NNL' was not made in that project's documentation, commitments to research on, and the rehabilitation of seagrass habitat in the area were clearly linked to the risk of loss of seagrass habitat. Furthermore, in subsequent extensions of this consent the offsetting project was expanded and then specifically referred to as an offset.

The greatest numbers of projects with associated marine biodiversity offsets were identified in Queensland (18) and Western Australia (14), with fewer in New South Wales (5), South Australia (3) and the Northern Territory (2). No projects with marine biodiversity offset requirements were found in Tasmania or Victoria.

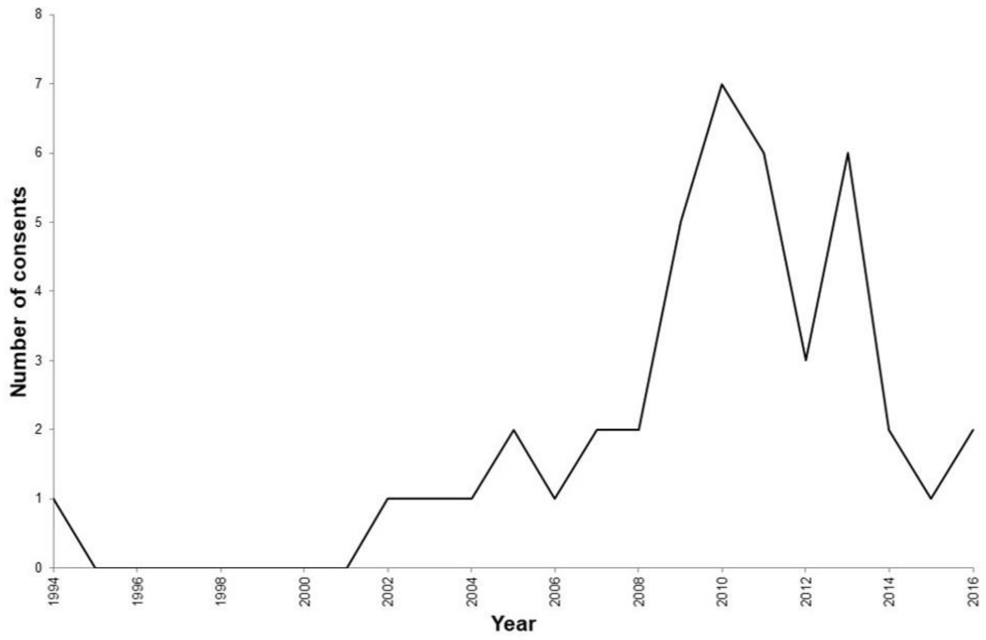


**Figure 5.2.** Number of major project consents stipulating marine biodiversity offsets by year (n=42).

Over half of the 42 projects included within the review involved commercial port development and associated works, such as capital and maintenance dredging (Table 5.1). The majority of these port development projects were associated with liquefied natural gas (LNG) production and export facilities, along with ports for other resource commodity exports such as iron ore and coal. There was a single case relating to an increase in port capacity to support cruise shipping (in Queensland). Marina development for recreational vessels, ancillary commercial activity relating to fishing, often including a residential or entertainment precinct, was the second most common class of development to trigger marine offsetting requirements (eight projects). Aggregate dredging triggered four requirements for marine offsets within associated consents, although three of these related to the same project; each stage of expansion was assessed independently and effectively issued on three occasions and so, in this analysis, have been considered as three separate projects. Pipeline installation triggered two instances of marine offsets within associated consents. Increased pressures associated with shipping, cable laying, aquaculture, desalination plants and the development of a landing facility for terrestrial infrastructure also led to offsetting requirements for impacts to the marine environment (Table 5.1).

**Table 5.1.** The type of development project that triggered the application of marine biodiversity offsets within development consents and the frequency of occurrence within the review sample (n=42). *includes smaller-scale commercial use such as fishing, **relates to development of a 'landing facility' as opposed to full port development activity.

| Type of development | NSW | NT | QLD | SA | WA | Total |
|---|---|---|---|---|---|---|
| **Commercial port and associated works** | 1 | 2 | 10 | 1 | 9 | **23** |
| **Marina and associated works*** | - | - | 5 | 1 | 2 | **8** |
| **Aggregates dredging** | - | - | - | - | 3 | **3** |
| **Pipeline installation** | - | - | 2 | - | - | **2** |
| **Aquaculture** | 1 | - | - | - | - | **1** |
| **Cable laying** | 1 | - | - | - | - | **1** |
| **Desalination plants** | 1 | - | - | - | - | **1** |
| **Increased shipping** | - | - | 1 | - | - | **1** |
| **Terrestrial infrastructure** | 1 | - | - | - | - | **1** |
| **Other**** | - | - | - | 1 | - | **1** |

*Impact pathways as triggers for marine offsets*

The impact pathways triggering marine biodiversity offsetting requirements were almost equally distributed between direct and indirect impact pathways (Figure 5.3). Over a quarter of all marine biodiversity offset triggers can be attributed to direct impacts to seagrass habitat (27%). However, over ninety percent of direct marine biodiversity offset triggers (92%) can be attributed to impacts to marine habitat with only 6% relating to impacts to marine species and 2% to undefined receptors (Figure 5.3).

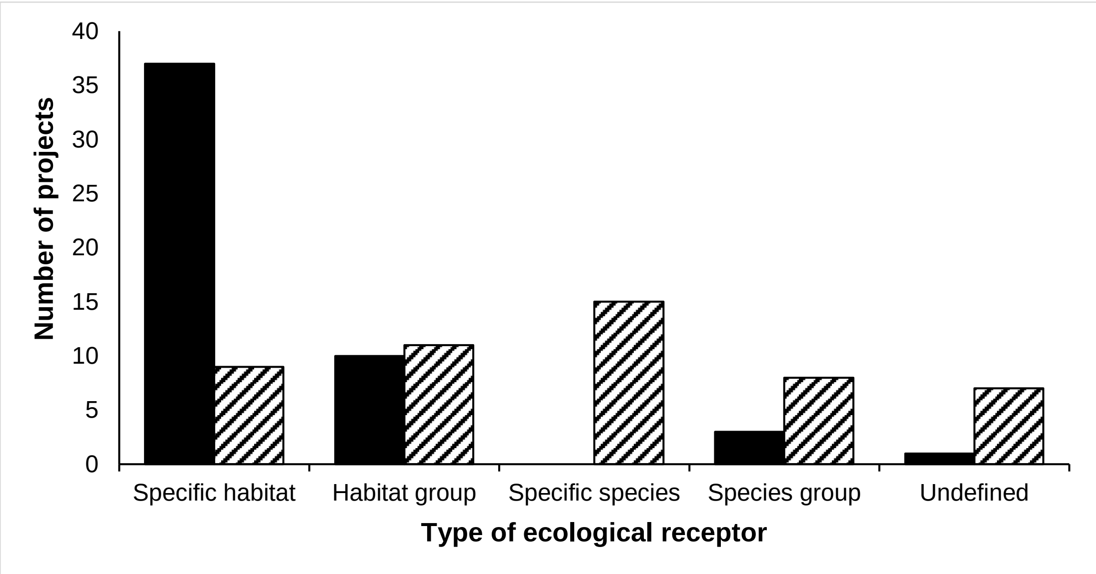


**Figure 5.3.** Impact pathways leading to marine biodiversity offset requirements in Australian development consent (n=42). The number of projects indicates the count of offset triggers by ecological receptor through direct (solid fill) and indirect (hatched) impact pathways. Direct impact pathways include dredging, dredge disposal, land reclamation, structure installation and trenching. Indirect pathways include increased shipping, recreational pressure, marine noise and light disturbance. Specific habitats include seagrass, algae and reef. Specific species include marine mammals, turtles, birds and fish. Habitat groups relate to descriptors including marine habitat and benthos. Species groups relate to the descriptor marine species. Undefined ecological receptor refers to absence of impact quantification and encompasses the descriptor ‘sensitive area’. The number of projects is greater than the total sample size as many marine biodiversity offsets are triggered by impacts to multiple ecological receptors.

In contrast, nearly half of triggers linked to indirect impact pathways related to impacts to marine species (46%), with 40% relating to marine habitats and 14% to undefined receptors (Figure 5.3). The specific ecological receptors most commonly affected through indirect impact pathways, such as through disturbance by lighting or use of an area, were turtles (12%) and marine mammals (12%). Not all ecological receptors that triggered offsets were identified to a particular species or taxon but were instead listed more broadly in groupings (16%). Impacts to undefined ecological receptors, such as operating in a sensitive area, accounted for over 6% of all triggers for marine biodiversity offsets.

*Definition of offsets*

Limited information relating to the definition of offsets for seven projects reduces the sample size to 35 for this section of the analysis (n=35). Only 17% of these projects provided information relating to ecological indicators of success (e.g. area of habitat required to be rehabilitated) and the consideration of the required finances for this success to be realised. No information relating to marine biodiversity offset definition was provided in documentation for projects in Queensland and the Northern Territory. Impacts triggering biodiversity offsetting requirements were quantified in full in only 54% of projects. Whilst a degree of impact quantification was present in 86% of projects, the remaining 14% of projects included offsets against unquantified impacts. Only 49% of projects used this information to inform assessments of equivalence between impacts (losses) and offsets (gains) and only 14% of projects could clearly link all marine biodiversity offsetting requirements to quantified impacts.

Rehabilitation of habitat, including enhancement or creation of habitat, was required in 54% of the projects reviewed, with only 43% of all project consents stipulating rehabilitation of a similar type of habitat in line with the concept of 'like for like'. Over three quarters of the sample (77%) included management offset requirements, often related to additional commitments to research. Commitments to research as part of the offset, often to inform baseline assessment and improve future impact assessment, were found in 69% of the sample. There was a strong overlap between management and research commitments, with 60% of the sample triggering offsets through management that were to be informed by associated research programmes. Marine biodiversity offsets delivered through averted loss or protection effort and educational measures were applied in 23% and 17% of projects respectively but these mechanisms were only ever stipulated in combination with other measures, as components of an offset package. Offset packages that involved a range of mechanisms were applied in 49% of projects. In over half of all projects (51%) offsets were to be delivered through contributions to in-lieu funds.

*Compliance monitoring*

Information relating to the timescales over which biodiversity offset outcomes should be delivered was identified in 3% of projects reviewed, where information relating to the offsetting mechanism was available (n=35). In addition, detail outlining how compliance or success might be ensured, such as through adaptive management or financial bonds, was limited to 11% of the review sample. Discussion of post-consent compliance monitoring was absent from all project documentation reviewed but has been inferred by the identification of detail relating to the timescales of offset delivery. Similarly, there was no information outlining whether the steps of the mitigation hierarchy were followed sequentially and/or the degree to which avoidance and mitigation were explored in any of the projects.

## 5.5. Discussion

In line with a similar global trend in terrestrial environments (Maron et al., 2015b), the use of marine biodiversity offsets as a regulatory tool has increased across the last decade in Australia (Figure 5.2). The use of marine biodiversity offsets in Australia appears to be closely correlated with macroeconomic trends, being more frequent between 2009 and 2013 at a time when export commodity prices and their extraction rose to unprecedented levels (Harvey and Clarke, 2012). Given the importance of exports for Australia's economy and the subsequent demand this creates for increased port capacity and other coastal development, the use of marine biodiversity offsets within infrastructure consenting frameworks could be expected to continue (Australian Government, 2015). However, this review of the implementation of marine biodiversity offsets to date suggests that practice may not always support biodiversity protection and it is not clear that they are consistently meeting the standards required by Australia's biodiversity offsetting policy frameworks.

*Application of the mitigation hierarchy*

Evidence explicitly outlining how the mitigation hierarchy was followed or led to the identification of biodiversity offsetting requirements was not found in any of the projects reviewed. It is likely that a level of process was followed in most cases, yet the policy aim of transparency is clearly not being met in relation to how decisions are being reached. Capturing this information is essential to understand offsetting policy success.

Despite the lack of information, the processes followed can be inferred from other available information, for example concerning the feasibility of biodiversity offsets, and whether biodiversity gains equivalent to the relevant losses were sought. Evidence was not found of the assessment of offset feasibility in any of the project documentation reviewed. A common requirement was for biodiversity offsetting strategies or plans to be developed after the point of consent and submitted to be signed off by the respective regulator or minister without further public scrutiny. The absence of detail of feasibility studies attached to even those offsets which relate to direct rehabilitation of habitat suggest that there may be a degree of assumed success attributed to such efforts. Such assumptions are likely overestimating our ability to recreate marine biodiversity given the challenges presented by ecological restoration, particularly in relation to sub-tidal habitat and our current lack of proven expertise in ecological engineering methods (Bayraktarov et al., 2016; Harper and Quigley, 2005b; Jacob et al., 2016a; Kentula, 2000). Furthermore, this apparent assumed success could indicate an inappropriate application of the mitigation hierarchy with offsets being applied without full exploration of impact avoidance and mitigation opportunities.

*Quantification of impact and the equivalence of biodiversity offsets*

Quantification of all triggers for biodiversity offsets was recorded in only 54% of projects and 14% of projects required offsets against unquantified impacts (n=42). This suggests that for most projects it is the risk of impact that has triggered offsetting requirements, rather than a formal quantification of how much residual impact needed to be offset. Without this quantification, it is difficult to plan direct offsetting mechanisms and consider other aspects such as equivalence. It also raises questions as to how an aim of NNL might be achieved or measured in the absence of a robust understanding of what is being lost.

Overall, 43% of identified projects stipulated direct rehabilitation of a similar type of habitat to that lost, and only 14% of projects used an assessment of equivalence to inform definition of what and how much rehabilitation was required (n=35). Direct impact to seagrass (seagrass habitat removal) was the most frequent trigger for marine offsets and these impacts were quantified in most projects. Approximately half (48%, n=35) of projects presenting impacts to seagrass considered the issue of equivalence and the majority of those led to habitat restoration or 'like for like' biodiversity offsets. Seagrass habitat is afforded protection in all Australian states (Kilminster et al., 2015; Kirkman, 1997), ranging from direct protection of habitat or indirectly through the protection of fish productivity or water quality targets (Kilminster et al., 2015). Well documented and extensive losses of seagrass habitat across much of Australia's coastline have also led to guidelines in a number of states that mandate the mitigation hierarchy when assessing impacts on seagrass (Kilminster et al., 2015). Perhaps uniquely among receptors, seagrass often has relatively well understood baselines, likely a result of the relative ease of data collection, and techniques for seagrass restoration have been subject to considerable scientific attention (Paling et al., 2009).

In contrast, mobile species such as turtles and marine mammals were the ecological receptors for which offsets were most commonly based on unquantified residual impacts. This is perhaps not surprising given that impacts to such species are more difficult to measure and predict because of the large and variable ranges across their lifecycles (Butler et al., 2010; Crowder and Norse, 2008). Consequently, quantifying impact on these receptors to a degree of certainty needed for decision-making within EIA is extremely difficult (Robertson, 2006). Indirect impact pathways, such as the loss of foraging opportunity through disturbance, account for the majority of offset triggers for such species. Quantifying these indirect impacts and pairing them with an offset action to realise an aim of NNL is challenging. This may be why risks posed to these species are frequently unquantified in the documentation reviewed and for potential impacts to result in a broader approach to offsetting, to improve baseline data or to better manage the relevant area as a whole. Indeed, over three quarters (82%, n=35) of the offsets identified related to broader 'out of kind' mechanisms where biodiversity gains are less easily calculated, including often undefined management, research and education, with over half of all projects requiring such measures included in a 'package' of offsets.

*Compliance monitoring*

Discussion of post-consent compliance monitoring of biodiversity offset projects within the project documentation reviewed was not identified, and only 11% of projects (n=35) set out measures to assure success of offset projects, such as adaptive management or financial bonds. This apparent lack of planning to review the success or otherwise of offsets is unsurprising given the low levels of impact quantification and definitions of biodiversity offset success. Clearly, setting measurable compliance targets is challenging without being able to specify what impacts need to be offset. Even where such targets are available, direct offsetting mechanisms, such as habitat restoration, can be a difficult exercise, and are associated with significant financial commitments over prolonged time periods (Brown and Lant, 1999; Kentula, 2000). Where an option for 'out of kind' offsetting exists as part of policy, this might be an attractive option for project proponents and/or regulators, in particular if it also alleviates the costs of monitoring and adaptive management and the risks of non-compliance.

Broad measures such as offset packages were applied in nearly half of the projects and almost always included 'out of kind' offsetting mechanisms, such as research or education. Over half of projects surveyed involved financial offsets to be paid into *in lieu* funds. In some circumstances this might mean an opportunity to pool funds and prioritise conservation effort on larger scales to greater benefit than on a per project basis (Dutson et al., 2015), but this again can lead to challenges in reconciling the biodiversity benefits with the specific impacts incurred. Broader measures such as offset packages and the pooling of financial contributions across several projects require careful accounting if they are to contribute to an aim of NNL.

These approaches represent a shift away from ecological measures of success, such as hectares of habitat to be rehabilitated, for the project proponent. Indicators of success for research and education programmes appear to relate to the measurement of investment rather than ecological gains. This passes the responsibility of delivering biodiversity gains to the government or recipient of the investment and away from the project proponent. Understandably, this might be attractive to both project proponents and regulators because it reduces the uncertainty and risk of compliance failure associated with a less flexible definition of the requirements for biodiversity offsets. However, using these proxies cannot be reconciled with aims of NNL which requires measurable equivalence of biodiversity losses and gains, and as such these efforts cannot be considered as offsets.

*How close to NNL is current marine practice?*

The review presented here suggests that in Australia's marine environments, biodiversity offsetting may not be achieving an aim of NNL of biodiversity – or at the very least it is difficult to assess from project documentation whether such aims are being met. Whilst offsetting policies in Australia generally state a preference for direct and 'like for like' offsetting measures, there is explicit flexibility available within them to accept 'out of kind' measures for marine environments (Australian Government, 2012). However, this flexibility does not negate the need for the application of principles relating to the application of the mitigation hierarchy, effective compliance or equivalence (Bos et al., 2014). Strict accounting should be required in the application of 'out of kind' biodiversity offsets, to allow for an appraisal of the performance of offsets in terms of meeting an aim of NNL.

Limited explicit written evidence was identified describing the application of the key principles for biodiversity offsetting success – equivalence, compliance, and the application of the mitigation hierarchy within marine development consent processes. This could suggest that these guiding principles are not being considered within the current implementation of marine biodiversity offsets in Australia. An alternative explanation for the apparent absence of consideration of these key principles could be that they are not easily applied or feasible when faced with the challenges specific to marine environments.

A final issue this review highlights is the absence of a transparent process outlined in biodiversity offsetting policies and guidelines as to how these principles should be explored and through which offsetting requirements can be agreed and evidence presented. Current practice does not capture the true success of biodiversity offsetting policy, whereby offset feasibility drives the iterative application of the mitigation hierarchy and the avoidance and mitigation of impacts to levels where offsets are not required (Figure 5.1b). The processes followed to determine biodiversity offset requirements are important to understand whether biodiversity offsetting in marine environments is being applied, with a view to protecting biodiversity or to manage the challenges of marine EIA. Transparency is one of the key aims of existing biodiversity offsetting policy in Australia (Australian Government, 2012) and is particularly important where 'out of kind' offsetting mechanisms have been applied that may be unlikely to provide direct biodiversity gains. Better documentation on how offsets are being determined could help allay concerns that offsets are serving to shortcut processes within EIA in order to streamline the environmental consenting process (Jacob et al., 2016a).

## 5.6. Conclusion

Contrary to evidence in Europe (Vaissière et al., 2014), marine biodiversity offsets have been applied often within the consenting of marine developments in Australia, particularly in the states of Queensland and Western Australia. While some offsets have been direct (such as seagrass habitat restoration), far more have been through ‘out of kind’, indirect mechanisms – often involving packages of education, management and research and/or contributions to larger *in lieu* funds. The application of biodiversity offsets in a marine context has to account for the large amount of uncertainty in ecological outcomes both through impacts and proposed offsets (Crowder and Norse, 2008). Offsetting policies in Australia do this by explicitly allowing flexibility in the amount of indirect offsetting in marine contexts (Australian Government, 2012). The application of this flexibility requires careful documentation and accounting to avoid misuse and ensure that biodiversity losses are truly offset. In the public documentation reviewed it was not possible to follow how decisions were made about biodiversity offsetting requirements. It is plausible that many of the issues identified within this review are common to both terrestrial and marine environments, particularly in relation to issues of transparency, the inappropriate application of the mitigation hierarchy, and ineffective compliance monitoring (i.e. accountability). The limited evidence available could also be interpreted as an indication that the challenges associated with the marine application of offsets are preventing the rigorous application of key offsetting principles. Obstacles to the comprehensive application of biodiversity offsetting principles in Australia include the absence of clearly defined property rights and associated issues of competing policy drivers for management of marine areas; and in some cases, a restricted understanding of impact pathways. These challenges could be leading to a ‘short circuiting’ of processes to avoid the difficult task of defining ‘like for like’ biodiversity offsets and a bias towards ‘out of kind’ mechanisms. It is more difficult to establish equivalence between biodiversity gains and losses with ‘out of kind’ mechanisms, as such careful accounting is required to achieve an aim of NNL.

With current global trends pointing towards intensifying development of ocean-based economies and a corresponding increase in development pressures on marine biodiversity (OECD, 2016a), offsetting could become increasingly integral to effective management of marine environments. Despite the growing popularity of biodiversity offsets globally, very few policies provide specifically for their application in marine contexts (Chapter 4). Australia has one of the most developed policy frameworks for biodiversity offsetting in the world, and has only recently started the process of developing its first marine-specific offsetting policy (Maron et al., 2016b). The Australian experience is illustrative of the challenges associated with marine application of biodiversity offsetting, in particular the challenge of reconciling the need for practical flexibility with the fundamental objective of NNL. Addressing these challenges in the context of intensifying ocean-based developments is likely to require both focused effort to address outstanding scientific and technical challenges, and the possible re-interpretation of the concept of NNL, for example by allowing 'trading up' of biodiversity losses for gains of greater conservation value (Habib et al., 2013). Whilst this is currently unsupported by Australian offsetting policy, there have been preliminary indications that there may be societal support for such an increase in flexibility (Rogers and Burton, 2017).

# 6. The challenges of biodiversity offsetting in marine environments – policy translation in practice

## 6.1. Introduction

Biodiversity offsets are a relatively recent and increasingly widely adopted policy approach used, in theory, to manage the competing societal aims of environmental protection and economic growth (Bull et al., 2013). Policy support for the approach has focussed on terrestrial application, yet it is being transposed to marine environments with limited consideration of key differences between the jurisdictions (Chapter 4). Biodiversity offsets are implemented to ensure that, at worst, a neutral outcome for ecological targets affected by development projects or natural resource use is met. They require "*demonstrably quantifiable equivalence*" (Bull et al., 2016) between what is lost and gained and are often associated with aims of NNL or net gain. Creating biodiversity gains is widely acknowledged as more difficult, less certain and less preferable than avoiding losses in the first instance (Pouzols et al., 2012). Accordingly, biodiversity offsets are commonly referred to as the 'last resort' of the mitigation hierarchy which is embedded into EIA frameworks used to guide development consent decision making (Morgan, 2012). This requires that identified impacts are first avoided and then minimised as far as possible before considering all potential remediation options prior to compensating residual impacts using offsets (Arlidge et al., 2018; McKenney and Kiesecker, 2010).

Optimisation of the first two stages of the mitigation hierarchy (avoid, minimise) is described as essential in marine environments (Niner et al., 2018; UNEP-WCMC, 2016; Van Dover et al., 2017). This is attributed to the many challenges posed by quantifying biodiversity losses, the high costs of operating and complex administrative arrangements inherent to marine environments (Chapter 2). Cumulatively, these challenges lead to extremely high uncertainty in current abilities to create marine biodiversity gains. In line with this, a precautionary approach to the use of biodiversity offsets is increasingly being advised (Van Dover et al., 2017). Where marine biodiversity offsetting is being used to manage residual losses remaining after the full implementation of avoidance and minimisation measures, it is also advised that the uncertainty implicit to such transactions is fully considered (Chapter 5).

*The proliferation of biodiversity offsetting*

The challenges of realising NNL through biodiversity offsets are not limited to marine environments, with little evidence available to suggest terrestrial application is successful in neutralising biodiversity losses arising from development (Gibbons et al., 2017; Lindenmayer et al., 2017). Despite this, biodiversity offsets and NNL approaches (policy, private standards) are proliferating. There are indications that this is a result of the need to meet increasingly complex agendas of financially constrained governments (Ferraro and Pattanayak, 2006; Gordon et al., 2015; Reid, 2011) through efficient means such as market based instruments (MBIs) (Calvet et al., 2015). MBIs refer to a range of policy instruments that conceptualise an ideological vision of biodiversity conservation that does not required the use of resource intensive "*command and control*" regulation (Boisvert, 2015; Calvet et al., 2015). Despite the frequent reference to biodiversity offsets as an MBI there is a lack of evidence that it is performing as such (Boisvert, 2015). One of the reasons for this is the need to encompass a wide range of values of which many are not easily captured or quantified sufficiently to assist in decision-making (Boisvert, 2015; Calvet et al., 2015; Hrabanski, 2015). To demonstrate equivalence, biodiversity offsetting requires the quantification of losses and gains. Quantification necessitates an understanding of not only how to measure but what it is that is being measured. The uncertainty in our knowledge relating to how ecological relationships interact to deliver essential ecosystem services that are valued by society complicates this (Hrabanski, 2015; Spash, 2015). All these challenges are further complicated in marine contexts where offsetting is most commonly applied through the transposition of terrestrially focussed policy frameworks. Notwithstanding these difficulties, marine biodiversity offsetting is being used to manage environmental degradation through development projects (Bos et al., 2014; Brodie, 2014). Outcomes of this practice and how this transposition is being undertaken and influencing decision consent processes for marine development are unknown (Chapter 5).

The key concepts required to manage economic development and natural resource use so that it is environmentally benign or even beneficial are subject to broad interpretation. It is uncommon for policy to state precisely what is meant by NNL of biodiversity and the baselines against which this should be measured (Maron et al., 2015a, 2016a). Furthermore, the term biodiversity offset, which in itself implies an exchange of biodiversity of some form, may in fact refer to a number of exchanges that may or may not involve the creation of biodiversity benefit (Bull et al., 2016). Indeed, some interpretations may signal the opposite and be "*locking in loss*" of biodiversity by using decreasing baselines (Maron et al., 2015a) or even in their flexibility allow for a displacement of conservation funding (Gordon et al., 2015). As such, there is limited evidence to support claims of environmental protection through use of biodiversity offsets or that it has changed practice from previous strategies that led to compensation. One of the founding drivers for biodiversity offsets was to encourage the exploration of avoidance and minimisation measures by sending a signal that biodiversity offsetting and achieving NNL was likely to be difficult and costly (Pilgrim et al., 2013a). However, if NNL and biodiversity offsetting is not interpreted and applied along the lines described by Bull et al., (2016) and in Chapters 1 and 2, it is not clear what purpose biodiversity offsets are serving or whether they are simply meeting prophecies of providing a 'licence to trash' (ten Kate et al., 2004). This purpose is particularly unclear in marine environments which presents numerous barriers to the established principles of implementation required to achieve NNL.

*Marine biodiversity offset implementation*

In their review of biodiversity offsetting performance in Alberta, US, Clare and Krogman (2013) find that policy failure has arisen as a result of goal ambiguity. They describe how this allows for subjectivity in the interpretation and implementation of policy and how this in turn can lead to the use of biodiversity offsets as a "*political device*" for government. In such situations, the ambiguity of policy goals allows for the interpretation of regulations that can favour certain actors such as those industries regulated by the policy (Clare and Krogman, 2013). The conclusions presented in Chapter 5 suggest that biodiversity offsetting in Australian marine contexts is not following standards widely accepted as necessary to meet aims of NNL or similar. As such, the intent and role of the approach within marine development consent decision-making is unclear. Following the work of Lipksy (2010) who describes how it is the interpretation and implementation of policy in practice that lead to the true definition of a policy, this Chapter explores marine biodiversity offsetting practice in detail. An in-depth analysis of the perceptions of actors involved in the development and implementation of marine biodiversity offsetting policy allows for a real-world understanding of how biodiversity offsetting is operationally defined by those using the approach.

There is a relative absence of explicit policy consideration for the marine application of biodiversity offsets, and the absence of a clear and consistent strategy for their application (Chapter 5; Vaissière et al. 2017). As such, there are indications that the policy aim presented by the use of the approach in response to marine impacts is subject to ambiguity and subjectivity in interpretation. To explore this, I consider that aims of marine NNL or biodiversity offsetting may be acting as a boundary object or boundary infrastructure where the approach is subject to varying definitions across actors to suit their own purposes.

## 6.2. **Methodological overview**

With a relatively established biodiversity offsetting policy operating at several levels of government and with documented use of biodiversity offsetting in the marine environment (Brodie, 2014), Australia presents an opportunity to explore the dynamics of current marine biodiversity offsetting practice. In-depth semi-structured interviews were used to explore experiences and perceptions of those exposed to marine biodiversity offsets and analyse how decisions are reached in order to understand the role of the approach in marine development consent processes. The qualitative approach selected for this purpose is detailed in Chapter 3. In summary, analysis was structured around the concept of biodiversity offsetting as a boundary object - an item or idea that facilitates integration and communication across scientific and political worlds (Star, 2010; White et al., 2010). This Chapter explores whether and how marine biodiversity offsetting is performing as a boundary object and what might be driving this.

*Conceptual framing – boundary objects*

Boundary objects allow for varying interpretations or definitions to shift from an agreed level of understanding to a more stakeholder-specific niche where required that allows them to be powerful tools to bridge disciplines and facilitate decision-making (Star, 2010; Steger et al., 2018). If we consider biodiversity offsets or NNL as a boundary object, then the common focus necessary for them to perform as such is a desire for good environmental performance arising from development consent processes and EIA. This aim is common across the many actors implicated in the use of biodiversity offsetting including - regulators, academics, industry and environmental NGOs, through the definitions applied in practice and the reasons behind this aim are likely to vary. Using an analysis framework focusing on boundary objects will provide a lens through which to view the ways that the challenges posed by marine environments are influencing the practice of biodiversity offsetting in such contexts. This framework will also allow further insight into what is preventing the uptake of the standards accepted for meeting NNL aims in terrestrial settings as observed in Chapter 5.

Boundary objects are not static in time and are subject to a dynamic 'life cycle' (Figure 6.1) where they are created in a vague form which can present difficulties in operationalisation (Steger et al., 2018) and which can then lead to efforts to standardise processes through the development of regulations and/or methodologies to reduce uncertainty in application (Bowker and Star, 1999; Star, 2010). The process of standardisation can be iterative and lead to a shift to and fro between standards and boundary object whilst the final form of policy infrastructure is defined (Bowker and Star, 1999; Steger et al., 2018). Residual concepts that do not fit the standardised form of policy infrastructure may form new boundary objects and be subject to further efforts of standardisation (Steger et al., 2018). However, it is also possible that an object may continue to exist as a boundary object without standardisation if users accept the ambiguity presented by multiple interpretations and associated methodologies (Steger et al., 2018). Further, the process of standardisation does not always lead to perfect solutions and can result in ill-structured policy infrastructure influenced by a range of socio-political factors (Apostolopoulou and Adams, 2015; Spash, 2015) which may in turn lead to this infrastructure reverting back to a boundary object. Accordingly, under some circumstances these cycles can aid an adaptive or evolutionary development of infrastructure or policy.

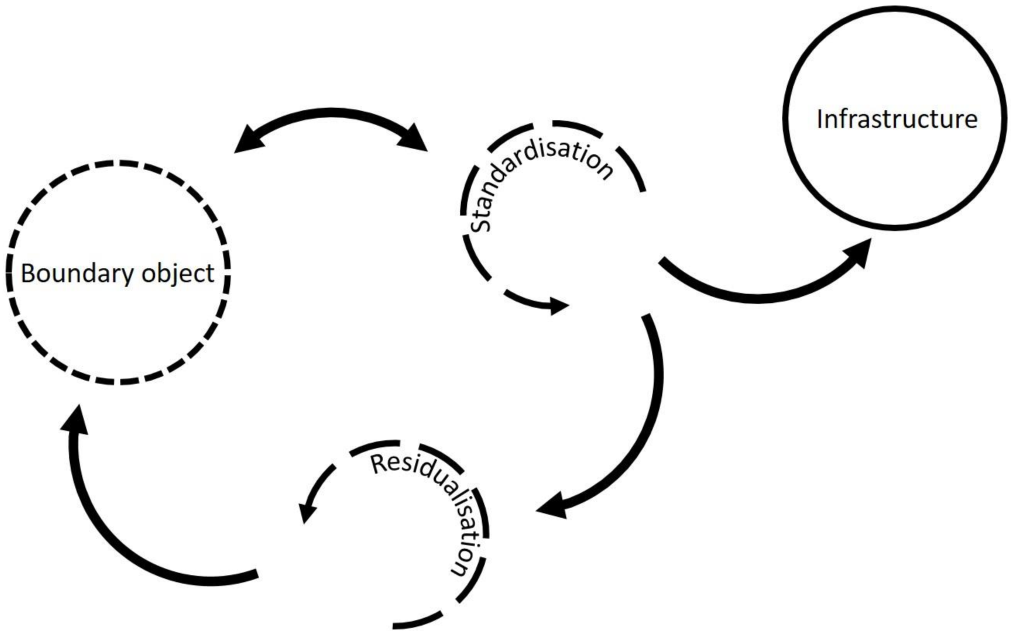


**Figure 6.1.** The life cycle of a boundary object adapted from (Star, 2010; Steger et al., 2018). Boundary objects are subject to pressure to standardise to assist in operationalisation, through the development of infrastructure (e.g. tools, standards, guidance or policy). A boundary object may resist this process and in turn form new boundary objects.

Observing marine biodiversity offsetting practice through the lens of a boundary object can provide insight into how varying groups with differing agendas are managing uncertainty to reach decisions (Star, 2010). This in turn supports an exploration of how marine biodiversity offsetting is being used in practice. The analysis presented focusses on the life-cycle of a boundary object (Figure 6.1) to understand how the approach is operating as a formalised or standardised 'infrastructure' or policy. This is undertaken through an analysis of the varying definitions given to biodiversity offsetting in practice. Further consideration is then paid to what might be supporting or undermining this standardisation and the reasons behind current modes of marine biodiversity offsetting practice.

## 6.3. **Results**

*Defining marine biodiversity offsetting*

There was ambiguity evident in how participants defined what is considered a marine biodiversity offset, as illustrated by the acceptance of a range of interpretations.

> **CON4:** *… I guess an offset is generally something people call an offset rather than being more specific…*

Examples of marine offsets provided by participants rarely fit with accepted definitions of biodiversity offsets (Bull et al., 2016), such as the use of financial contributions of industry towards an improved scientific basis for EIA, the salary of environmental regulators or insurance against future risk.

> **NGO6:** *…where someone was going to offset the risk of an oil spill, and like, if you think about it, that's not something that's offsettable, that's an insurance, an assurance process, that's not an offset…*

A common perception held by several participants was that offsets are used as a negotiating tool to maintain trends of development by presenting a way *"around those developments"* (NGO1). Despite the absence of a common definition of what biodiversity offsetting is in the marine environment, the approach has been increasingly accepted as a *"cornerstone … [or a] … key regulatory tool … [for] … compensation"* (REG3). Common acceptance within development consent frameworks was indicated by the absence of discussion of substitutes or alternatives.

> **NGO5:** *…but what's the alternative to not having offsets?*

*Lack of process*

Despite formal requirements to adhere to the mitigation hierarchy in project planning there is no formal or consistent control mechanism by which its application can be monitored or controlled. This is reflected by the *"ad-hoc"* (REG1) and *"case by case"* (REG6) approach described based on case officer interrogation of information provided by project proponents. Perceptions as to how effective current practices are in marine EIA were mixed across jurisdiction and participant sector. Some participants, particularly those in regulatory roles, expressed a high degree of confidence in its effectiveness, but accepted that monitoring this performance is difficult and not happening within current management frameworks.

> **REG3:** *…it flies under the radar, but the incentivising of avoidance measures as a result of our offset policy is something that is real and definitely happens, it's [the avoidance of impact as a result of biodiversity offsetting] just so hard to quantify...*

Others, such as those participants in practitioner roles who have full sight of the project design process, describe a contrasting perception as to how the mitigation hierarchy (and biodiversity offsetting) is being applied within marine consenting frameworks.

> **CON4:** *…typically what you find in a project is the engineers will do the feasibility study and come up with a design and the location, and the environment people will be asked to retrofit the environment to that and tell them why it was the best environmental location, and so, if they're fairly fixed on that, then they'll just pay offsets. If there are bits which are fairly cost neutral that they can change, then they would probably change them rather than pay offsets…*

In addition to lack of process for capturing how the mitigation hierarchy is applied, the metrics that have been developed to assist in the definition of biodiversity offsets for terrestrial environments do not exist or are in development for marine areas (Dutson et al., 2015; Maron et al., 2016b). Participants described how metrics formalise previously ad hoc and *"fluffy fluffy"* (CON1) negotiations to define compensation or offset requirements and also influence the application of the mitigation hierarchy through project design.

> **CON1:** *…in the impact assessment space people are much more conscious about what their offset liability might be up front and factor that into sort of design. But that's more in the terrestrial space because it's easier, because there are calculators…*

Development of metrics for marine application has been challenged by the complexity and connectedness of marine ecological systems in addition to administrative challenges of implementing physical marine offsetting projects (Freestone et al., 2014; Van Dover et al., 2017). Participants indicated that marine offsetting has *"…always been one of those things that people have stayed away from"* (ACA1) because of these challenges and that where it has been applied physical offsets are accepted as being unfeasible.

> **REG5:** *…our research to date and our trial of rehabilitation techniques has basically led to a position that we don't provide for physical offsetting of seagrass. It's just too difficult … it just has failed…*

This has led to a focus on the use of funds to channel financial offsets towards bigger, 'strategic' offsets on the principle that they will offer *"better bang for buck"* (IND5). However, this mode of offsetting does not remove the challenges of marine implementation with the value or financial amount of an offset requiring calculation. Despite the unanimous support across participants for large-scale strategically coordinated conservation projects there is little evidence discussed relating to the practicalities of meeting the requirements associated with biodiversity offsets or the success of an offsetting project. Instead, participants described situations where processes for ensuring the principle of equivalence are met remain outstanding. The lack of established procedure raises participants' concerns that strategic funds are currently operating as little more than *"a bank account"* (REG2) with no demonstrated capacity to meet the requirements of biodiversity offsets.

One of the major issues presented by a widespread acceptance of a financial exchange for marine damages is a lack of agreement on how to value biodiversity loss and to ensure the principle of equivalence and hence NNL is met. Financial offsetting is currently determined based on ad-hoc and rudimentary methods *"it's a proxy that they've [government] developed … when you look at it there's not much science or anything behind that and they sort of readily agree 'look we picked the number'"* (IND3). It is also a process that is felt to currently be unable to represent the broad range of values of biodiversity such as *"ecosystem services, intrinsic value all those sort things [that are] incredibly difficult to get a handle on"* (REG5). Further, a lack of a common agreement how to place a consistent financial value on marine biodiversity is described as leading to the current situation where *"the perception is that this [offsetting] is the least cost option because no one knows how to calculate it, no one knows how to achieve the outcome…"* (REG4).

*Siloed regulation and knowledge sharing*

In addition to the absence of a formalised process or standard for agreeing how to define marine biodiversity offsets, there are indications that current practice is not viewed as being credible, salient and legitimate (Cash et al., 2003; Van Enst, 2017; White et al., 2010). This is observed in the frustration of a practitioner at the perceived insufficiency of government support for decision-making and the needs of industry to effectively use biodiversity offsets.

> **CON8:** *…federal government can't even tell you where all of its' offsets are … now that is outrageous…*

Participants raise further concerns relating to the capacity or marine expertise within regulatory agencies to manage the challenges of applying biodiversity offsets in marine environments.

> **REG1:** …*we don't have anyone with any marine expertise whatsoever, so I honestly couldn't answer that with any real confidence because I just don't know, I don't know the marine environment and we don't have anyone here that does…*

A general concern as to how information is applied is also described as undermining "*confidence in the department to be able to put a good filter on what comes to them"* (CON1). This hints at the siloed nature in which policy infrastructure is being developed, where another common concern expressed across practitioners is the absence of *"real world perspective"* or *"experience"* (CON1) of both academics and regulators involved.

> **IND4:** *…there is a bit of a disconnect between industry and the government and them understanding what is feasible, and sometimes, you know, you can talk until the cows come home but, you're not going to get anywhere in terms of trying to convince governments otherwise of what they put on a piece of paper. So, we definitely do our best in terms of trying to put something that is feasible on the table, but it doesn't always work out.*

*Maintaining the boundary*

Marine biodiversity offsetting and its component parts (NNL, equivalence and the mitigation hierarchy) are being used to reach decisions of acceptable environmental performance through EIA frameworks in the absence of a clear strategy or aim.

> **IND3:** *…there's no sort of real strategy or plan around what you're trying to achieve. So what's been my experience is that people don't really understand the process, and I think in fairness I'm not sure that all the regulators really understand the process and what they're trying to achieve...*

Without standardisation the majority of participants acknowledged that NNL or equivalence is not being realised through marine biodiversity offsets. Despite this, the use of biodiversity offsets is widely accepted within literature and by participants as a necessary step towards the demonstration of a common desire for good environmental governance. Participants indicated that there are several factors preventing the standardisation of marine biodiversity offsetting, perpetuating its use as a boundary object within development consent decision frameworks. These influences can be distilled to two themes: that of political will for environmental protection and an SLO.

*The political landscape for sustainable decision-making*

Several participants reference the low level of finance available for conservation or environment-focussed work. This is attributed to reductions due to a *"very strong downward trend"* (NGO6) in core environmental funding but also that available for industry *"to do good stuff"* (CON1). The absence of this is described as limiting the capacity *"to improve our understanding of these systems and how they operate"* (REG5) and is also leading to a prioritisation of finance where the environment is placed below social and economic requirements. This is described by NGO2 where effective traditional owner management of marine environments is viewed as a *"financial burden to taxpayers"* where the benefits or values of this work are not appreciated or understood.

Biodiversity offsets are described as arising as a response to these increased financial constraints and governments *"looking at the private sector to see how they can then contribute into, I guess, what would have traditionally been a sole government responsibility"* (CON7). Some indicate that the practice is not new but represents a more *"overt"* (REG2) way to accrue finance for specific environmental activity. However, concerns are raised that decreasing core government funding is not being matched by investment through biodiversity offsets.

> **NGO6:** *… so you're having a loss of overall biodiversity and a loss, or even barely a stabilisation of investment. And I'd argue, it's still a loss of investment because we're not seeing the level of offset dollars going into the system as we are seeing government revenue coming out of it…*

Participants' perceptions also suggest that biodiversity offsets are shifting core responsibility for capacity development and express concern that their application is being driven by the opportunity to increase revenue rather than protect biodiversity.

> **CON8:** *… because regulators go, 'well if we don't capture them we don't get to get the offset' … so we've got to put you through a process just so we can get to the offset…*

Situations described by participants provide insights into the difficult position of environmental regulators when subject to pressure from other governmental sectors with alternative agendas that embrace the idea of the easily communicable solutions of NNL and biodiversity offsets.

> **REG1:** *…the department for planning and transport … saying … 'why can't they just do some work on the adjoining park' and 'isn't that a fantastic offset' - everyone thinks they're an environmental expert, everyone thinks they know what they're talking about but, I wouldn't tell a planning guy how to build a bridge, but they can tell us ecologically that we have no idea what we're talking about…*

Current marine biodiversity offsetting practice has arisen through this conflicted position where regulators are required to uphold environmental protection targets without being perceived to be being unreasonable or obstructive to economic development. Acknowledging these constraints, several participants described how the approach is being used without a strict interpretation of NNL to leverage biodiversity benefit in situations where accepted biodiversity loss through economic development is a fait accompli.

> **NGO6:** *…the reality is that economic development is the overarching government priority … what that means is this project has to go ahead … you know, your job as a regulator is to ensure that no harm comes from the development … so you then seek to do the best job you can … and that involves going 'alright what outcomes can we leverage from this' and that's where offsets come into play. So, this has to go ahead. OK, well we're going to make you pay for it and we're going to make you do this and that and you know all these other things…*

Other participants were more cynical and described the use of marine biodiversity offsets as *"part of a punishment"* (CON1) for big industrial development projects, which are perceived as damaging by society. This is echoed by others working in practitioner roles that indicate perceptions held that it is used as *"a political tool to justify an approval*" (CON8) and to overtly show that they are meeting expectations of environmental protection. Participants in roles within academia and NGOs indicate a more openly critical stance and suggest that biodiversity offsets allow for a *"really good selling job"* (ACA3) for projects consented with associated environmental impacts and go as far to describe their use as *"electoral bribery"* (NGO4). The uneven distribution of power within the application of marine offsets is described by several participants, with industry's ability to leverage political favour highlighting one of the constraints with which environmental regulators are working.

> **NGO6:** *…and you're a person who needs to dredge a channel for a port development and you go 'well, we could pay 100 million dollars to actually meaningfully offset that impact, or we could donate 20 million dollars to you know, our lobby group, the political party and peddle influence to make sure that that doesn't happen in policy space'…*

*Social licence to operate*

Marine biodiversity offsetting and its role in the maintenance of an SLO was referenced by the majority of participants interviewed. The concept was discussed predominantly in relation to a company, sector or project. However, it was also raised, albeit less frequently, in association with requirements for regulatory approval. The concept of an SLO developed within industry (Gunningham et al., 2004; Moffat et al., 2016) and is commonly accepted as an industry requirement, or attribute, necessary to access common resources (Bice and Moffat, 2014). Practitioners describe how aims of NNL where seen as one way to improve *"the licence to operate by providing an environmental differentiator from other companies"* (CON7) and lead to a societal preference for those with a good SLO. Further, good environmental performance is raised a one of the *"key pillars"* for corporations required to *"get a project over the line financially, particularly in low … [resource] … prices"* and biodiversity offsets are described as *"a way to make it happen" and "a way of returning to a community"* (IND1).

> **IND4:** *…it's an opportunity to demonstrate industry's social licence to operate, it demonstrates to the government and community that we are following the right measures and that it also assists in the reputational rights to operate…*

The need for an SLO is also influencing how the mitigation hierarchy is being applied and the offsetting preferences of industry. For example, practitioners described how losses to iconic biodiversity components which are perceived as unlikely to be acceptable to society will lead to a more rigorous application of the mitigation hierarchy.

> **CON4:** *…they're [turtles and whales] well known and people have very, very strong views about them … if your dredge is going to take out 20ha of coral you'll get that permitted but if they're going to kill 10 turtles you would not be going to get that permitted … in general the approach has been 'well, we just won't do it we'll lose our social licence'…*

Further influence of an SLO on marine biodiversity offsetting practice relates to the definition of offset projects. The need to track environmental performance to demonstrate this is described as likely leading to the selection of *"highly visible offsets … something that may benefit particular groups and it makes them look good"* (NGO1). This also incentivises hedging against the risk of offset failure and to "*get the right messaging out there"* (IND5) which may also diminish uptake of strategic conservation funds such as The Reef Trust where outcomes are less easily attributed to a specific contribution.

> **IND3:** *…that it's actually going to target the right things, have the right environmental outcomes, because if it fails that affects our social licence to operate … so there's a lot riding on it other than just, you know, we're looking at it more than just ticking a box. We actually want to see that it's actually, you know, delivering the outcomes that it should be…*

Participants acknowledged that the contribution of industry to conservation in locations such as the Great Barrier Reef *"just because it's a good thing to do"* (CON1) is significant. They describe how an SLO is determined not only by adhering to the assurance processes delineated by regulation (such as biodiversity offsets and the mitigation hierarchy) but also through voluntary efforts of *"goodwill"* (CON4). A concern voiced across several participants is how to manage the growing expectation of demonstration of the biodiversity benefits arising from this activity that is stemming from the aims of NNL. This expectation is perceived by practitioners to fall disproportionally on industry, particularly those operating in the extractive sectors. Practitioners describe how this increased liability and associated financial commitment may pose the risk of jeopardising current SLO activity and contributions to conservation outside of consenting frameworks.

The strict enforcement of NNL of any definition requires consistent regulatory support, such as using metrics to define equivalence and points of success. Consistency and transparency are essential to *"level the playing field"* (CON7) and for user (e.g. project proponent/industry) buy-in. Perceptions and experiences are described by participants that an SLO may not be strictly tied to a robust interpretation of NNL and that doing so in the absence of standardisation may become an unnecessary burden.

> **CON7:** *…we were never able to then track that [attempts to achieve NNL] back to shareholder value, and certainly within some of the government jurisdictions we were working in … they didn't give a damn about it … it didn't matter what your performance was like around environment or social. So, you know in that respect it actually became a bit of a, a bit of a barrier to the organisation…*

## 6.4. **Discussion**

*The varying definitions of marine biodiversity offsetting*

Marine biodiversity offsets are described by participants to be an established part of development consenting frameworks in Australia. This is in accordance with the trends described in terrestrial environments (Madsen et al., 2011) where there is also an absence of evidence of success in meeting aims of NNL (Gibbons et al., 2017; Lindenmayer et al., 2017). In marine environments, the use of biodiversity offsets was described as being ad-hoc and there appears to have been little intent to apply the principles required to successfully meet aims of NNL (BBOP, 2012; Bos et al., 2014; Bull et al., 2013). Participants in practitioner roles describe how the use of the approach is inconsistent and largely dependent on the relationships between the regulator assessing proposals and industry representatives. However, despite an absence of standard process for the definition of marine biodiversity offsetting requirements they describe how biodiversity offsetting frames negotiations in relation to environmental compensation, adding structure that wasn't previously evident. This supports assertions in the literature that biodiversity offsetting has led to the implementation of compensation with a stronger sustainability ethic as compared to historic practice (Vaissière et al., 2016).

Participants in practitioner and regulatory roles, both describe that the use of marine biodiversity offsetting with development consent frameworks is influencing the application of the mitigation hierarchy and the avoidance and minimisation of impacts. Regulators describe avoidance as being incentivised by biodiversity offsets and imply that the mitigation hierarchy is explored in sequence (avoid, minimise, remediate, offset). Practitioners' experience is reported as different, where project design and budget are fitted retrospectively to meet the required demonstration of the mitigation hierarchy within development consent proposals. The difference in participants' perceptions hints at the varying definitions or roles being attributed to biodiversity offsetting in marine development consenting processes at the 'boundary' where project approval presents risks for both government and industry. Regulators cite the main benefit of biodiversity offsetting as being the demonstration of environmental protection at the point of project approval. In contrast, practitioners describe how biodiversity offsets provide a map to guide a project proposal through development consenting processes. This map allows for a reduction in the risk of project refusal and for unforeseen costs through arbitrarily defined compensation liabilities. One avenue through which risk can be averted is through project design to reduce biodiversity impacts through avoidance and minimisation efforts. However, participants describe how this financial incentivisation is contingent on metrics to establish offset liabilities at the point of project design. Metrics that have been developed to specifically address marine biodiversity are currently unavailable or under development in most jurisdictions in Australia.

*Standardisation of marine biodiversity offsets*

The development of metrics for marine application has been challenged by the complexity and connectedness of marine ecological systems, in addition to administrative challenges of implementing physical marine offsetting projects (Figure 6.2., Freestone et al., 2014; Van Dover et al., 2017). Further, the marine environment presents difficulties in applying NNL in 'like for like' settings, where biodiversity losses and gains are considered equivalent in type, location and quantity. In addition to current limitations in the field of marine restoration science, these difficulties relate to current inabilities to identify, quantify and control impacts that are often remote, diffuse and acting in combination to exert pressure on marine systems. One participant also suggested that these difficulties have led to a lag in uptake of offsets in marine contexts, with it being historically being viewed as unfeasible. Despite this lag, the approach is being applied to meet aims of marine NNL in Australia, but in most jurisdictions is undertaken using financial offsets. Financial offsets are applied because physical offsets are described as too uncertain and inefficient with participants describing how pooling offset finance is the best option to address these challenges at a strategic level. When pooling funds to apply to strategic conservation projects, meeting NNL through 'like for like' measures is very unlikely to be possible and so metrics are required to meet equivalence using another method. Most commonly this means that biodiversity impacts are reduced to a financial equivalent. The process of placing a financial value on biodiversity is widely contested for a range of reasons, not least the difficulty in encompassing the wide range of values attributed to biodiversity (Ives and Bekessy, 2015; Soulé, 1985). A further challenge in the development of metrics for conservation funds is how to establish the equivalence of biodiversity gains funded by many biodiversity losses from different projects affecting different biodiversity components.

To date, financial offsets have been based on arbitrarily defined contributions and simple metrics that are described by participants as likely under-valuing marine biodiversity. Under current scenarios marine biodiversity offsetting is described as the *"least cost option"* (REG4) and the economically favourable option when compared to avoidance and mitigation opportunities. As such, it is unlikely to be providing the financial signal required to stimulate extensive exploration of avoidance and minimisation measures. Moreover, there is an absence in consideration by participants or within planning documentation of what indicators for success for marine NNL using these strategic mechanisms might look like (Chapter 5). There is little evidence that beyond measuring the receipt of finance that an ecological definition of marine biodiversity offset success or NNL is being considered in practice. The aims of marine biodiversity offsetting in Australia are not clear and participants indicate that this allows for perversion and politicisation of its interpretation. The absence of standardisation of the approach is creating conflict as to how biodiversity impacts are managed within development consent. However, despite tacit support for the development of standardised policy infrastructure and the transparent use of the approach the standardisation of marine biodiversity offsetting is being resisted (Cash et al., 2003; Van Enst, 2017; White et al., 2010).

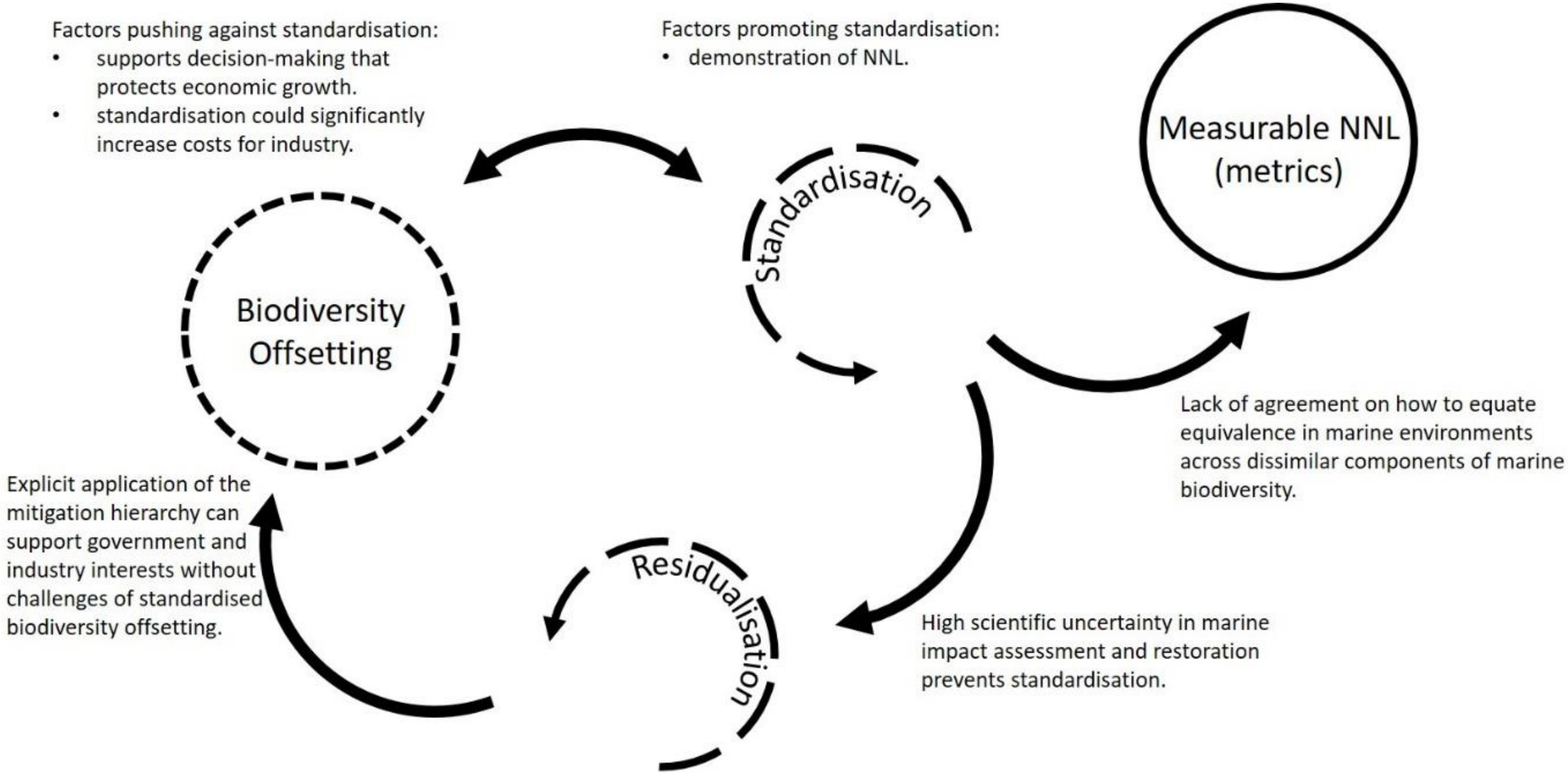


**Figure 6.2.** The life cycle of marine biodiversity offsetting as a boundary object adapted from (Star, 2010; Steger et al., 2018) including the scientific and political drivers and influences maintaining biodiversity offsetting as a boundary object to support negotiations and navigation of development consent decision-making.

*Resistance to standardisation*

Participants describe several reasons for the standardisation of marine biodiversity offsetting required to meet aims of NNL (Figure 6.2.). These relate to the varying definitions being applied to the approach which perpetuate its existence as a boundary object. For example, for government, biodiversity offsetting offers a way to demonstrate their commitment to environmental protection whilst permitting development projects to support the economy. The standardisation of marine biodiversity offsets could potentially incur high costs for industry, to account for the challenges posed by creating biodiversity gains, and the rejection of project proposals. This is inferred by participants, in addition to a low level of political prioritisation of environmental protection, to lead to a lack of political will to undertake this standardisation in the development of governance frameworks such as metrics. The ambiguity also supports pathways for political pressure to influence decisions and to favour the interests of economic development (Clare and Krogman, 2013). Current use of marine biodiversity offsets, where their use is not tied to an associated impact, is also described to present an avenue for governments to accrue funds to support their environmental protection remit. This arbitrary use is also described as resulting in the approach becoming a standard expectation of development consent which is warping the definitions of biodiversity offsets held by society. Despite the perverse use of biodiversity offsets described by participants, they are also reported to provide avenues to leverage biodiversity benefit under current political climates that do not favour environmental protection. Regulators describe how despite not realising NNL these benefits, such as the development of improved baseline understanding, may lead to improved application of the mitigation hierarchy in the future or the refusal of damaging projects.

For participants working in practitioner roles, marine biodiversity offsetting practice is described with ambiguity. Concerns were expressed that the lack of consistency threatens both the financial viability of projects and a corporation's SLO. However, biodiversity offsets under current ambiguous modes of use were reported as presenting an opportunity to demonstrate commitment to an SLO. It is not immediately clear that a rigorous interpretation of NNL was supported by practitioners. Participants described how approaches being developed from an ecological perspective including metrics do not fit the purposes of industry. It was intimated that the costs arising from the development of these metrics are unworkable under current economic climates. Current modes of biodiversity offsetting in marine environments appear to be driven by perceptions of risk and the need to meet multiple agendas that are not easily aligned. The influence of these risk management strategies arising and the need to foster a corporation's SLO is not limited to the use of biodiversity offsets, they are also influencing how impacts are being addressed within project design. For example, the avoidance of impacts is explored more thoroughly where an ecological receptor to be impacted is thought to be highly emotive, such as marine mammal species. Following this, the importance of being able to track biodiversity outcomes to support an SLO is reported. There are concerns that whilst strategic biodiversity offset funds present a simple way to discharge liability, these mechanisms do not provide sufficient control to allow for SLO benefit. Further, these methods require that control of offsetting activity is relinquished and passed to government. Participants describe a lack of trust and concern over governments' ability to manage these funds and to deliver the biodiversity offsetting requirements.

Environmental protection and the adherence to governance frameworks is described as an important facet of an SLO. However, there is little evidence to suggest that the value of this activity to an SLO could be enhanced by an ecologically defensible demonstration of NNL (Bull et al., 2016). The concept of NNL and environmentally benign or sustainable development is one that is easily understood on a basic level and provides a simple message to communicate. However, as highlighted in a survey designed to understand the role of marine biodiversity offsets in relation to an SLO, the scientific basis for NNL is perhaps a more challenging concept and one that is *"difficult to judge for more lay people"* (Richert et al., 2015). Results here indicate that the value of going above and beyond that which is required by regulators is difficult to justify. Because of this, seeking a scientifically supported NNL under current scenarios where this is not required by regulation can become a burden to a corporation. Furthermore, there are concerns that increasing the burden of what is mandated through regulation could crowd out voluntary contributions and conservation activity undertaken by industry. This is understood to be a significant source of revenue in some areas such as the Great Barrier Reef (Commonwealth of Australia, 2015, 2016; Great Barrier Reef Foundation, 2018) and as such the significance of such a disadvantage should be considered in the context of developing policy and guidance. How this in turn would affect biodiversity protection or social licences of both industry and government is unclear.

## 6.5. **Conclusion – towards a meaningful NNL**

Despite the approach being used for different purposes across stakeholders and the resistance to standardisation, the ambiguity inherent to the current use of marine biodiversity offsetting practice presents risks for users. These risks include the lack of a consistent approach, which can lead to personality or politically driven use of marine biodiversity offsets. Participants describe how offsets can be used as part of a "*punishment*" (CON1) of industry by regulators for political purposes. This presents financial and reputational risks for industry, who in seeking to maintain an SLO are dependent on being seen to be responsible and not in need of castigation. For governments to maintain legitimacy, transparency is essential, and this can only be afforded by the standardisation of marine biodiversity offsetting processes. However, as demonstrated by stakeholder perceptions analysed here, efforts of standardisation of practice to date have been unable to meet the various requirements of stakeholders under current scenarios of business as usual (Apostolopoulou and Adams, 2015; Clare and Krogman, 2013). This has been a result of the absence of political priority for environmental protection evidenced by the perversion of decision-making and the absence of investment in marine capacity to match the scientific and governance demands of meeting aims of NNL. The standardisation of marine biodiversity offsetting to meet a scientifically justifiable NNL, is likely to implicate a fundamental shift in how biodiversity impacts are managed. The cumulative approach identified as necessary to achieve biodiversity gains in marine environments (Dutson et al., 2015; UNEP-WCMC, 2016) necessitates a level playing field, where all pressures exerted on marine environments are able to be either captured by offsetting policy or controlled to some degree. Meeting these demands in addition to requirements of additionality is a complex task not well supported under current policy frameworks. However, aims of NNL are only likely to be realised under standardised policy infrastructure that supports industry to invest in the innovation required to maximise their application of the mitigation hierarchy, such as has occurred in Europe in response to strictly enforced environmental standards (Dähne et al., 2017). Without robust policy support, a robust interpretation of marine NNL and biodiversity offsets is likely to represent a risk and burden to government and industry alike.

# 7. The influence of marine no net loss and reputational risk on development consent decision-making

## 7.1. Introduction

*Demonstrating credibility through no net loss (NNL)*

The use of marine biodiversity offsetting could be described as both facilitating damaging development and providing leverage for additional environmental benefit. There were several perceived roles of the approach described by industry representatives. This includes a perception that biodiversity offsets are a "*punishment*" enacted by government and a hurdle required to be crossed to obtain development consent. Another perception commonly described was that they are an opportunity to demonstrate an organisation's commitment to a community and environmental protection. Accordingly, the value of biodiversity offsetting and associated aims of NNL to an organisation's SLO is described as one of the reasons for its proliferation (Rainey et al., 2014; ten Kate et al., 2004). An SLO is increasingly recognised as an essential requirement for organisations including business (Prno and Scott Slocombe, 2012), government, non-governmental organisations (Boutilier, 2017; Dare et al., 2014; Jijelava and Vanclay, 2014) and research (Raman and Mohr, 2014). The concept has been particularly embraced by large multi-national corporations engaged in the extraction of natural resources to become a core area of strategic focus (Rio Tinto, 2018), having been described as a "*make or break*" for the future of such industries (Rio Tinto, 2015).

The concept describes the legitimacy provided through an effective relationship between an organisation and stakeholders or community (Bice, 2014; Boutilier, 2014). Such a 'licence', although issued through informal processes, is contingent on the credibility of an organisation and the trust afforded by the transparent demonstration of this (Bice and Moffat, 2014; Parsons and Moffat, 2014a). Industry have led in the concept's development and are increasingly adopting private standards outlining how their activities align or contribute to the varying aims of sustainability (Parsons and Moffat, 2014a). Whilst environmental performance is only one component of an SLO, for many companies maintaining the natural capital and associated ecosystem services within their areas of operation and beyond is accepted as an important target and at the core of sustainability. This is evidenced by the increasing number of private standards held by industry for operations to meet aims of NNL or net benefit (Chapter 4; Rainey et al. 2014; Calvet et al. 2015). The importance of this is also echoed in standards upheld by financial institutions, including development banks such as the International Finance Corporation (IFC, 2012).

NNL is described as a *"specific and quantified"* goal to demonstrate an organisation's commitment to environmental sustainability (Rainey et al., 2014). This is echoed in the results presented in Chapter 6, where participants across all sectors described how biodiversity offsetting and aims of NNL provide *"an opportunity to demonstrate industry's social licence to operate"* (IND4). Furthermore, the perceived requirement of an SLO appears to influence how biodiversity offsetting is being used: such as through a preference for *"highly visible"* (NGO1) and successful offsetting activities that *"target the right things"* (IND3) and *"get the right messaging out there"* (IND5). A preference was described by participants, particularly in practitioner roles (industry and consultancy representatives), to be able to clearly link their activity or investment to a positive biodiversity outcome.

*The challenges of meeting marine no net loss (NNL)*

The analysis of stakeholder perceptions described in Chapter 6 suggested that the absence of a clearly defined expectation of NNL and biodiversity offsetting in marine environments caused challenges in implementation. A key issue relates to the difficulties in delivering measurable and equivalent biodiversity benefits in 'like for like' settings. Establishing equivalence is challenged by the relative lack of knowledge and experience in marine ecological restoration techniques and the associated high costs of operation and meaningful data collection in remote marine environments (Bayraktarov et al., 2016; Jacob et al., 2016a). There are also further administrative factors complicating the delivery of marine biodiversity offsets in practice, such as the inability to restrict user access or limit diffuse impact sources (Bos et al., 2014; Jacob et al., 2016a). These challenges combined have led to the preference for the pooling of biodiversity offsetting finance for strategic application as a delivery mechanism in marine environments (Chapter 4). This has thus far been undertaken without full determination of how such finance will be applied to meet the key criteria required of biodiversity offsets (equivalence, continuity, additionality). In addition, there has been a lack of agreement as to how to define the value of financial offsets - current approaches were described by participants as having been arbitrarily assigned and likely under-valuing biodiversity losses incurred. Participants also described concerns and, in some cases, evidence that there was insufficient capacity both in terms of finance and expertise in relation to government being able to manage the demands of marine biodiversity offsetting. Addressing these issues through the development of a robust policy basis is required to meet aims of NNL and use of biodiversity offsetting under scientifically justifiable definitions (Bull et al., 2016). This standardisation will likely implicate complex accounting procedures across varying biodiversity components to establish equivalency and additionality, something that is not currently supported by existing rudimentary methods.

*Issues posed by an ambiguous use of no net loss (NNL) and biodiversity offsetting*

Chapter 6 describes how there was common agreement across all participants that the implicit purpose of aims of NNL and biodiversity offsetting is for environmental protection. However, there was little evidence that marine biodiversity offsetting was being applied in ways to support the realisation of these aims. In most marine jurisdictions in Australia, biodiversity offsetting is being applied through the ad-hoc translation of terrestrial offsetting policy. Where marine application has been explicitly considered the detail of how to meet the principles required to meet aims of NNL have commonly not been established. The lack of standardisation of marine biodiversity offsetting leaves the approach open to interpretation by stakeholders. Chapter 6 describes how this ambiguity in the definition of what is meant and required of marine biodiversity offsetting allows the approach to serve different purposes for different stakeholders involved in marine development consent. Chapter 6 concludes that biodiversity offsetting is acting as a boundary object, facilitating communication across scientific and political worlds (White et al., 2010) and supporting the navigation of complex decision-making required to manage the use and protection of marine natural resources (Star, 2010; Steger et al., 2018). The varying perspectives of stakeholders indicated that biodiversity offsetting in marine environments is being used by governments for a range of purposes, such as a source of revenue to support core capacity for environmental management and to manage the conflicting agendas of economic growth (through development projects) and biodiversity conservation.

*The risks of an ambiguous interpretation of marine no net loss (NNL)*

Chapter 6 reports how the ambiguous use of NNL and biodiversity offsetting in marine contexts is widely accepted by participants. One reason for this relates to the perceived key role ascribed to biodiversity offsetting in assisting the management of risks associated with achieving and issuing consent (or a legal licence) to a development project and the associated profitability of that project. In Australia, these decisions are contingent on the political licence of government afforded by the support of the electorate, required by elected governments to maintain their position of power. They are further supported by the SLO held by industry and provided through societal approval of an organisation and activity. These 'licences' are interrelated and together, in theory, ensure that decisions relating to the use of natural resources are made on behalf of society. Given the flexibility of policy interpretation imbued by the lack of formally defined procedures for the marine application of biodiversity offsets in Australia it is possible that these licences provide the impetus for meeting aims of NNL and achieving offset success. Yet, the results presented in Chapter 6 indicate that current practice is unlikely to be meeting the aims stated to underpin decision-making and this could threaten the legal, political and social licences required for development to progress. It is currently not known how this ambiguity and the associated risks manifest within consenting processes. Through a further analysis of the stakeholder perceptions also examined in Chapter 6, this Chapter explores how current marine biodiversity offsetting creates risk, how this influences an SLO and in turn what this means for marine biodiversity offsetting in practice.

## 7.2. Methodological overview

Data was collected following the methodology and ethics procedure outlined in Chapter 3 and applied in Chapter 6 and interview transcripts were subject to a complete analysis. This analysis followed both an inductive and deductive thematic analysis like that applied in Chapter 6. Building on the findings presented in the previous Chapter, initial coding of transcribed interviews focussed on the themes of risk, trust and sentiment perceived by actors implicated in the use of marine biodiversity offsetting. Based on initial analysis this was then expanded to focus and explore the relationships described between actors. Following the mapping of relationships, the Social, Actuarial and Political (SAP) model developed by Bice et al., (2017) was applied to refine analysis and to provide structure to understand the context and relational dynamics perpetuating current modes of marine biodiversity offsetting practice.

*Conceptual framing – The SAP model*

The SAP model has been amended for the purposes of this analysis so that the term 'actuarial' used by Bice et al., (2017) is instead referred to as a legal licence. Legal licences include those required under most governance regimes controlling development. The SAP model and the core relationships encompassed within, centre around the 'public interest' that lead to, or challenge, the development and maintenance of an SLO for a range of organisations including industry and government (Bice et al., 2017). For the purposes of this analysis we consider NNL to be representative of this. Environmental protection is widely acknowledged as a societal preference and the rapid adoption and use of aims of NNL through biodiversity offsetting has been identified as a way to demonstrate the legitimacy of an activity or decision (Maron et al., 2016a; ten Kate et al., 2004; von Hase and ten Kate, 2017). Following Bice et al., (2017) participant perceptions were interpreted using a framework based on the SAP model and the relative risks associated with managing marine biodiversity damage through development. The model seeks to highlight the relationships between stakeholder groups governed by the need to meet the requirements of Social, Legal and Political licences which Bice et al., describe as protectors of the public interest or in this case environmental protection (2017). To uphold public interest (and meet aims of environmental protection) stakeholder concerns relating to each type of risk would be addressed. However, public interest is not only changeable but "*notoriously difficult to define*" and the relative weight afforded to each licence is rarely equal (Bice et al., 2017; Newman and Clarke, 2009). The model highlights the multifarious interactions of stakeholders and stakeholder groups in governing these licences and allows for an analysis of the relationships and factors that influence the use of biodiversity offsetting.

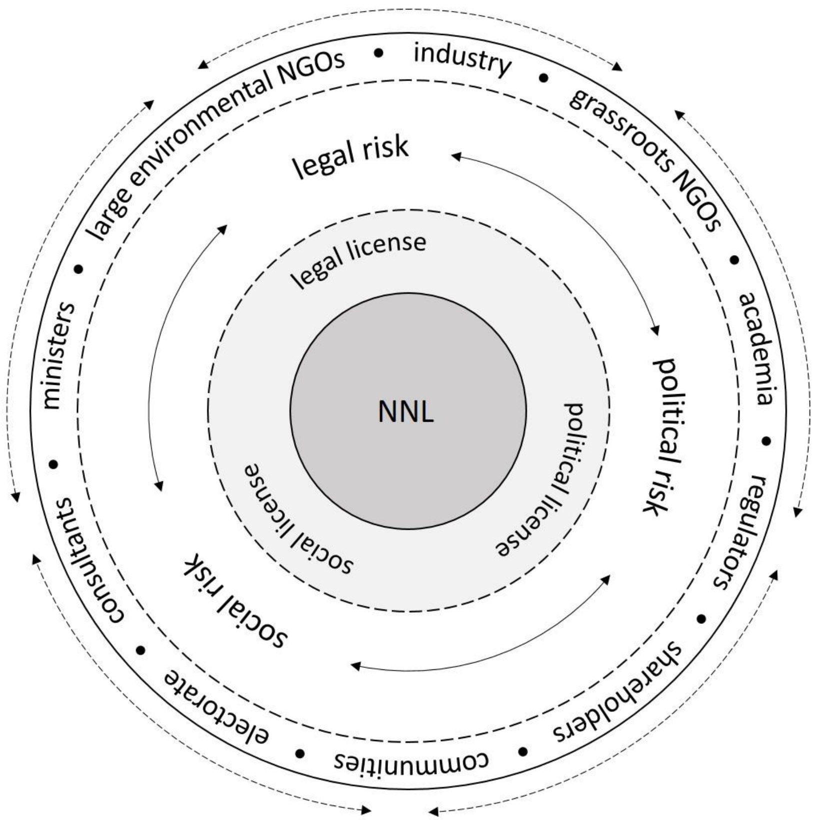


**Figure 7.1.** The Social, Actuarial (Legal) and Political (SAP) model as applied in the analysis presented, adapted from Bice et al., (2017). The diagram illustrates the complex network of relationships and interactions between varying societal actor groups and interests centre around the 'public interest' of no net loss of biodiversity delivered through the use of biodiversity offsetting

Legal licences contribute to the legitimacy of an activity through enforcing processes of assessment and regulatory sign off. In attaining a legal licence, societal assurance is provided that the required standards of environmental protection have been met. However, regulators are tasked with making decisions under often wicked circumstances, where aims of environmental and protection and economic growth are competing, subject to high degrees of uncertainty in assessment and highly controversial (Maron et al., 2016a; Rittel and Webber, 1973). Such situations necessitate trade-offs between these aims and can threaten the political licence of an activity and the regulators in question. Democratic governments are afforded a political licence to operate and are tasked with managing natural and economic resources on behalf of the public. Legitimacy of these decisions is imparted through the support of the electorate, required by elected governments to maintain their position of power. In addition, a government's perceived ability to manage their resources appropriately also relates to their risk profile for investment on an international stage, which in turn can have economic and political consequences (Haines, 2011). Social risk is posed by stakeholder's perceptions of an organisation's ability and commitment to meet the demands of a legal licence (e.g. through EIA and environmental consenting processes) and can be affected by the political licence held by government and industry/sector. Developing relationships based on trust between stakeholders has been identified as central to fostering an SLO and to managing the risks associated with not having one (Moffat and Zhang, 2014; Parsons and Moffat, 2014b). Activity to support this is often cited as requiring activity or focus beyond that which is regulated as part of legal licensing processes (Gunningham et al., 2004). Analysing the relationships between actors (stakeholders) and the concept of biodiversity offsetting will provide insight into how the approach is being applied to meet the requirements of the SAP model and associated licences. These relationships, as evidenced by the perceptions provided within participant interviews, have been analysed in order to shed light on the factors currently driving the ways that marine biodiversity offsetting is currently being applied.

## 7.3. **Results**

*Perceptions of risk to social licence to operate*

Marine biodiversity offsets were described by participants in industry as providing a way through which the risks posed by the perceived environmental impact of economic development can be managed.

> **IND1:** *…to provide more transparency and accountability for what's happening with a project and tying in cumulative impacts as a formal calculator. I think it is, it's sort of moving with the times I guess, so to speak. We'll see more and more elements that need to be considered in project planning and approvals and that will have to be, there will have to be more accountability with it*

This accountability was highlighted as an important demonstration of an industry, organisation or project's commitment to a community.

> **IND1:** *…it's a way to make it happen and it's a way of returning to a community as well what projects take out. And I think that's a, that's probably one of the key take home messages is that industry needs to return to the community, not just the government...*

However, biodiversity offsets, aims of NNL and associated requirements of demonstrable equivalence were also felt to pose threats to fostering an SLO. These were primarily perceived to be in response to the commonly held societal view of large corporations particularly involved in extractive industries and large-scale urban development as being *"baddies"* that need to be *"punished for what they do"* (CON1). This view was described as influenced by the agendas of large corporate environmental non-governmental organisations (NGOs).

> **CON1: …***a lot of the environmental groups have done a really good job of leveraging off some of that emotion that people have around 'oh my god, you know the reef it's like the icon you can't you know, what do you mean there is going to be a shipping super highway'. Where the level of shipping is actually globally very low through the Great Barrier Reef. So, I think, you know, there's been a lot of emotion put into that particular sort of public debate that various people feed off for their own intents and purposes…*

A variety of responses to manage the risk of this perception to an organisation's SLO were reported by participants using biodiversity offsets. This variation related to the degree to which control or ownership of an offset and its outcome is desired by an organisation. Industry representatives and consultants described how this variation was defined by an organisation's culture and whether they may be considered a *"good operator"* (IND2).

> **IND1:** *…other oil and gas companies might have had very different opinions to what we have. Some V.P.s [Vice Presidents] don't want any involvement, they don't want to be in the spotlight, they want to be completely removed, they'll meet their conditions and they'll have the pay and run policy. Whereas, I've been promoting and pushing it back that we want, we're in this space for the long term. We're going to have some lumps and bumps and hiccups and some projects that work and some that don't work but we want as much control as we can to deliver these projects. So I guess some companies don't have the technical people on board that can work out whether or not they're getting value for money for what they've invested. So there are lots of different contributing factors to, um, which defines where a, the direction that a company wants to move in...*

Those organisations that were considered risk averse were discussed as being less engaged in both the development and implementation of marine biodiversity offsetting policy. At the point of decision and where biodiversity offsets requirements are defined, such organisations were less likely to engage in scientific assessments or justification of the need for offsets.

> **CON3:** *…the regulator can come along here, they can come along here, and they can impose conditions on this and while the enviros don't agree with it, and it makes no environmental sense the risk people will say 'yes'…*

In contrast, other organisations approach the management of environmental responsibility as a core value and seek to meet the aims biodiversity offsets outside of legislated requirements.

> **IND2**: …*you know, you may have a good operator who is willing to offset but they're not going to offer it up because they don't want to oversell, they'll wait and see what comes back and if they need to they'll go down this path, but then you've got other operators who won't offer up anything…*

However, the value of an SLO to an organisation through the adoption of stringent environmental standards that go beyond the requirements of legislation was not easily demonstrable and can be perceived as an unnecessary or unjustifiable burden.

> **CON7:** *…one of his big pieces was making sure that the company was not disadvantaged from taking on that voluntary commitment by providing a set of barriers to entries into projects, but also ramping up the operational cost compared to competitors because the company had made a voluntary commitment … one of the things in terms of structuring the business case was improving the licence to operate by providing an environmental differentiator from other companies. That worked to a degree, but we were never able to then track that back to shareholder value…*

The overt demonstration and communication of environmental impacts required by biodiversity offsets was described to open several other avenues of risk for industry. These included the perception of corruption or bribery attributed to the transactional quality of offsets and the increased public perception that industry, through biodiversity offsets, will fix current trends of environmental degradation.

**CON8:** *…the independent scientific committee put it at less than five percent, so the impacts from industrialisation on the GBR less than five percent of impacts. They'll tell you off the record it's like two percent, but they went 'ok let's put some buffer in there and says its less than five'. So, ninety-five percent of the impacts are coming in from other things, other industries, where's our debate, media, public debate…*

Further, the relative proportion of impacts captured by marine biodiversity offsets are likely to be small when compared to the efforts required to make significant large-scale positive benefits. Industry and consultants suggested that there was a fear that current use of marine biodiversity offsets is setting unrealistic expectations of industry, which if not met, could in turn affect their SLO.

**IND1:** *…it's a very big problem out there, that is both naturally occurring and influenced by human interaction … money isn't going to fix everything. There's a lot of contributing factors, so there is a risk that the public might think that … industry will fix the problem and that's not going, that's not the case. We'll contribute to, we'll be involved in mapping out projects in priority areas but there is accountability to that process and that, there's a, a delivery framework tied into each of those projects…*

An industry strategy described to manage some of the risks of marine biodiversity offsets was the partnership or cooperation with environmental NGOs. Large international NGOs were described as performing advisory and consultancy roles and influencing through "*quiet coffees*" (NGO4) with industry representatives or through delivering the biodiversity offsetting activity itself.

**NGO3:** *…that's the other opportunity we have is because we're not for profit we can actually talk to corporate entities and say well, you know, 'we'll be the honest broker you put some money up as offset type material money we'll manage the property and restore it'…*

This contrasts with relationships with smaller community-based NGOs that felt that they are removed from biodiversity offsetting processes and commonly viewed as being *"obstructionists"* that *"want to stop everything and block things up"* (NGO2).

> **IND3:** *…a lot of those things tend to be focussed on you know the international NGOs and the people that turn up to the AGMs [Annual General Meeting] and those sorts of things, and it's, it's often I suppose, easy to lose focus around the local. You know the corporate beast focuses on you know the big the big things and you know the emerging issues at an international level…*

> **NGO4:** *… they {large environmental NGOs] were good, but then they don't have many members up in [the North] so they tend to put their money where most of their members are, and if their focus was in the North, it's mainly in the Kimberley or the Northern Yorke, … or its on things like Kakadu and uranium mining...*

*Perceptions of risks to a legal licence*

A source of perceived risk of industry and consultant representatives related to the finances associated with marine biodiversity offsets. Concerns were described that formalised mechanisms such as metrics and accounting could present a barrier to the viability of future projects.

> **CON8:** *…it's left to the company to negotiate or try and find a way through that mess, rather than the government. … We need industry, we need investment, we need infrastructure - we need to be cognicent of, you know, what the overall cost for business is. And think that through - so I mean some of the numbers that are starting to push out of, some of the sort of metrics that people are thinking about for marine offsets are absolutely frightening for industry...*

These risks relate to being able to meet the financial expectations of shareholders and management of this risk was described as conducted through negotiations at a project level and through lobbying at a ministerial level.

> **CON1:** *…at some point you sort of think, well, why are you quibbling over a hundred thousand dollars to plant a bit of seagrass? Just do it and move on. But then if they had to do that for every single project then it would get off the ground um, and, and yeh, they wouldn't be able to pay their shareholders so it's a whole different consideration…*

> **IND1:** *…it's through ongoing discussions and sitting at the table in different sort of memberships, meetings, frameworks and keeping the dialogue open. And if things start to, if things don't look all that rosy well then, and I'm not having success on, or my managers aren't having success at getting the outcomes, well then I guess you have to take it to the minister and voice your concerns that way…*

Other ways in which the risks of not being granted a legal licence were reported as being managed included through the ready agreement to conditions or offsetting activity without clear justification linked to an impact.

> **CON3:** *…it was almost if you like a, a given that you would go to [regulator name] with a particular impact that probably wouldn't have much of an impact or you'd certainly mitigated for the impact, but they would also ask on top of that, 'could you do some stuff on [marine mammal species]?' And you would agree to that because you would get your project approved, um, and so you would add to the state of knowledge of things that noone else was going to pay for…*

*Perceptions of risk to political licence*

Policy was described as a reflection of community expectation which then sets the framework as to how natural resources, such as biodiversity, are managed on behalf of society, alongside competing societal needs, such as economic development.

> **REG4:** *…so our policy can't say anything else, the expectation has been set by the community by what they want to see in that space … your policy states what the community want because you know, talking as a public servant, I work for the community and that's, I take the lead from them. If they don't want their marine resources, they're happy to go with this industry over here, then we will explain 'well if you do that this is what you won't have and this is what you will have'. Community needs to make a choice about what they want...*

However, the challenges of balancing the economic and environmental interests of society was described as influencing the implementation of biodiversity offsets. Being perceived as obstructionist to economic development was considered a threat to the political licence of a government.

> **REG1:** *…it's so frustrating ... we're getting letters, like we got a letter from the Tourism Minister the other week saying 'why are you stopping this development, this development sounds like it's going to be fantastic'. And you get letters from the Planning Minister as well, [Government department] … getting to us saying 'this is totally unreasonable, why can't they just do some work on the adjoining park and isn't that a fantastic offset'…*

In addition to this, the threat of being seen incapable of effectively managing natural resources and weighting economic growth as a priority over environmental protection was reported as a concern. This was described as influencing the rigour with which the approach is being applied within development consent decision-making.

**CON8:** …*the biggest barrier and it's, there's two there's a legal, a legal fear and a... human fear of failure, we're too scared of failure, we aren't prepared to fail. So we spend all our time trying to make sure that it's fool proof and holds water and then we don't go and measure it because we don't actually want to know that it's failed. So, we're too scared of the nasty answer, Minister doesn't want to stand up in parliament and go well my department has issued four hundred approvals requiring this many offsets and none of them have worked, it doesn't work, he's not going to do it...*

However, in the absence of rigorous transparency in the use of biodiversity offsetting there were concerns that use of the approach can be seen as corrupting decision-making both from the perspective of society and also industry who are concerned they may "*end up doing, doing the government's job for them if you like rather than rather than offsetting a residual impact*" (IND3).

**REG7:** *…a lot of people were 'mate this is verging on corrupt', well not, corrupt is the wrong word, it's just not, it's just, you know, a huge cloud. We can't see that, there's no connect, and it was just seen to be ambit claims, just ways of getting money out of industry, you know. Some of those are, you know, some of those criticisms are probably correct. And so that's when government said 'we'll, now we'll bring that, offsets, into the front end'…*

**NGO4:** *… from their government point of view, a good sovereign risk deal because they see the Australian government as non-corrupt, pro-business, makes things happen…*

Strategies applied to manage this risk have been to increase the transparency in terms of embedding biodiversity offsetting processes within consenting decisions and through the development of metrics to assist in the definition of offsetting requirements. Participants describe how academia has and continues to assist in the development of metrics, both in the capacity of advisors and consultants.

> **CON1:** *… the consultancies have been given to people who have very strong academic backgrounds and networks, and so a lot of the development of the … [metrics] … has been reliant on the perspective of academics…*

This approach was described as *"overblown"* (CON7) by one practitioner and removed from a *"real-world perspective"* (CON1) by several others in similar practitioner roles. However, an NGO representative welcomed such efforts that seek to *"keep[ing] the regulators honest"* (NGO6).

## 7.4. **Discussion**

*Reputational risk*

The demonstration of environmental responsibility is perceived by research participants as being essential to maintain the legitimacy of their activity. NNL and biodiversity offsetting was considered one way through which this is done and was described as increasingly being expected within development-consent processes, with indications that in some cases biodiversity offsetting is even being applied in the absence of accompanying biodiversity loss, as evidence of government and industry commitment to environmental protection. Societal pressure to adopt and meet these aims was reported as being coordinated by environmental NGOs, acting on national and international scales. In response to these perceived risks, governments appear to be using biodiversity offsetting to avert the political risk of rejecting development approvals on environmental grounds and to maintain the national reputation as a good place to invest and locate business. However, the challenges of the application of marine biodiversity offsetting mean that meeting these aims is highly uncertain and likely to entail high economic costs to industry over prolonged time periods (Bayraktarov et al., 2016; de Groot et al., 2010; Paling et al., 2009; Van Dover et al., 2014). Further, there is little evidence from experience in marine restoration (Bas et al., 2016; Jacob et al., 2017; Vaissière et al., 2014; Van Dover et al., 2014) and the use of biodiversity offsetting in terrestrial environments that investment in offset projects can deliver a financial or reputational return given their low levels of success. The risk of failure and the potential damaging consequences this might have for social and political licences was described as a major concern of participants.

In general, participants' views agreed with views expressed across peer-reviewed literature that the best chance of achieving efficient marine biodiversity benefits is through pooling funds for strategic application (Bos et al., 2014; Jacob et al., 2016b; Maron et al., 2016a). In Australia, these approaches have been coordinated by government as an extension of their remit for environmental protection and management of development activity. However, those organisations who identify as *'responsible'* (IND5) or are described as *'good corporate citizens'* (NGO4) or as having a good SLO indicated that retaining some control or influence over biodiversity offsetting activity is important to ensure that activity is appropriate and selected to reduce the risks of offset failure and maximise contribution towards an organisation's SLO. Of further importance was the need to manage how this activity is communicated to control risks and benefits towards an SLO. Little confidence was held that governments possess the capacity to deliver the pathways that would allow engagement with industry to manage these requirements. Strategic offsetting funds also necessitate a handover of control for the activity from industry to government. Given the high uncertainty of meeting aims of NNL in marine contexts, even through these strategic funds, this lack of control and reliance on government to undertake this to meet the needs of their SLO is a perceived source of risk for industry. Another concern relates to the high expectations raised that offsets, particularly those through strategic funds, are the silver bullet for the conservation finance deficit for marine environments (Bos et al., 2015). Many of the pressures exerted on marine environments are not captured by biodiversity offsetting policy and as such these impacts are not creating corresponding and equivalent finance to match the financial costs of delivering equivalent biodiversity benefit. In particular, the Great Barrier Reef was described as an example where those responsible for less than 5% of the impacts causing a degradation of biodiversity were liable for biodiversity offsets and 95% of impacts do not currently require compensation. This highlights the issue that the financial sums typically raised by biodiversity offsetting may be insufficient to address conservation issues on the large scales thought to be necessary for marine environments. Participants described concerns that if societal expectations are not managed so as to appropriately communicate the limitations and uncertainty of marine biodiversity offsetting (Fischhoff and Davis, 2014) there may be repercussions to an organisation's SLO.

For some organisations liable for marine biodiversity offsets, active engagement with how government activities use offsetting funds was seen as unnecessary, accepting the risks described by other participants to arise from simply accepting the 'punishment' and handing over offset funds. These organisations were generally viewed less favourably by the interviewees, as evidenced by a description provided by one participant as *"bottom feeders"* (NGO4). For these organisations, biodiversity offsets were perceived to represent boxes to tick to progress through consenting processes and achieve development consent or a legal licence. Their main concern was considered to relate to obtaining this legal licence and, as such, would agree to any conditions put forward by government to smooth this process and to reduce the risk of refusal or non-compliance. Thus, although biodiversity offsets were leveraging biodiversity benefit from less-environmentally driven organisations, this practice was seen to reduce biodiversity offsetting to a transactional exercise. In turn, this may undermine opportunities for companies who invest in related capacity and who are required to demonstrate the value of such investment to their shareholders. This experience supports fears that biodiversity offsetting may form a 'licence to trash' and facilitate development and disregard environmental protection (Ferreira, 2017; ten Kate et al., 2004). However, the situation described is more nuanced than simply paving the way for development, with governments using biodiversity offsets as a revenue stream to fund conservation activity and to demonstrate commitment to environmental protection. Yet, current practice, in addition to under-valuing biodiversity losses (and under-budgeting for biodiversity restoration) falls short of demonstrating the additionality of offsets (Chapter 5). Additionality requires that biodiversity offsets create a biodiversity benefit beyond that which would occur in the absence of the offsetting activity (Bull et al., 2013; Ferraro and Pattanayak, 2006). Additionality ensures that biodiversity offsets represent a true gain and guards against the misuse of offsets through the displacement of other conservation funding or activity (Maron et al., 2015b; Pilgrim and Bennun, 2014). Examples of marine offsets in Australia are described where offset finance is being used to meet government targets for environmental protection through increasing capacity, such as through employment, physical projects or research to bolster future decision-making. It would be extremely difficult to justify the additionality of these activities and accordingly participants also identified the risk of a perception of corruption, where biodiversity losses are permitted in exchange for an arbitrary financial sum, particularly one that is broadly acknowledged to undervalue biodiversity losses.

Despite the numerous concerns expressed by industry, third party representatives and regulators about the ways in which governments are applying offsetting policy, passing the additional responsibility of delivering biodiversity offsets and the associated liability to government was viewed as preferable. This was true for organisations who are concerned with, and those who disregard, the importance of maintaining an SLO. Another area of agreement was that the financial value of marine biodiversity offsetting needs to remain in the realms of perceived proportionality. However, current scenarios seem to best meet the needs of those organisations who are not engaged in environmental activity, do not invest in the capacity required to manage biodiversity offsetting and seek to alleviate their liability through simple measures. Whilst these measures provide avenues to leverage environmental benefit from all organisations, they do not support the needs of those organisations for whom an SLO is a corporate priority. For these organisations, along with governments who are required to fulfil electoral mandates of environmental protection, current marine biodiversity offsetting practice which is unlikely to meet aims of NNL is a source of reputational risk.

*Independence and legitimacy*

Governments seeking to address the risks posed by an ad-hoc and ambiguous interpretation of marine biodiversity offsets to social and political licences, do so through the creation of overt standardised processes, such as metrics or through formalised strategies. Such strategies may include partnership with respected and independent third-party organisations or individuals. Participants describe how the risks posed to government through current modes of offsetting are alleviated through the legitimacy provided from close relationships with university academics and other researchers (hereafter, academics). The perceived independence and expertise of academics was reported as being respected by a range of participants across all types. This legitimacy was reported to be sought through informal advisory roles on policy and metric development, and through engagement of academics in the capacity of consultants to assist with standardisation. In addition to forging relationships with academics, environmental NGOs were identified as potential delivery partners for marine biodiversity offsetting. The use of independent third parties to deliver offsetting projects is often cited as a vehicle to ensure compliance (Bos et al., 2014), but it is also a way to share the burden should a project fail.

As independent third parties, large environmental NGOs could help deliver biodiversity offsetting projects, though they were also described as one of the main conduits of risk to social and political licences. This is attributed to their large membership and their ability to leverage widespread influence. This influence appears to accrue only to large environmental NGOs such as those working at national and international levels, highlighted by the perception that in the absence of their spotlight, environmental issues are viewed as less of a political priority. Such organisations also have vested interests, NGO representatives having described how marine biodiversity offsetting creates an opportunity to finance their activity and a potential pathway to increase capacity at local levels. However, representatives of smaller, locally focussed NGOs described how current offsetting practice does not support their engagement as they do not possess political power. They detailed how their attempts to engage and develop the capacity to support their participation in decisions relating to the use of marine environments were largely unsuccessful and had led to their passive engagement with biodiversity offsetting practice. Accordingly, most discussions from industry, consultants and regulators failed to explicitly cover roles for smaller, local NGOs. In contrast, large environmental NGOs who are reported to have great political power and strong capacity, are afforded the opportunity to influence industry activity at a strategic level. Partnerships between industry and large NGOs were described where NGOs assist in the design and administration of sustainability programs, such as baseline data collection and acting as 'honest brokers' to deliver biodiversity offsets. These opportunities, where environmental NGOs acting in the capacity of a consultant to industry, can provide expertise that may support the maximisation of environmental impact avoidance and minimisation measures. For industry, these close relationships allow for an informed negotiation of the risk posed by an activity to their SLO, but they do not appear to consider the risks or opportunities that may arise at a local community level.

The concept of an SLO is commonly described within the literature as being governed at a local scale, based on relationships of trust garnered through communication and transparency between industry and an affected community (Moffat and Zhang, 2014; Owen and Kemp, 2013; Prno and Scott Slocombe, 2012). In line with this, extractive companies place emphasis on developing their social strategies at a local level (Moffat and Zhang, 2014). The importance of this is echoed by the perceptions of a regulator participating in this study who described how biodiversity offsetting policy needs to represent community expectations. However, in practice it seems that the risks posed to SLOs arising from biodiversity offsetting are perceived to operate on a larger national or international scale, driven by large NGOs. Smaller, locally focussed NGOs including aboriginal organisations, described how they are removed from the point of decision in relation to biodiversity loss and report that efforts to engage with offsets have been unsuccessful. International best practice for biodiversity offsetting calls for both instrumental (e.g. extractive use such as fishing or economic development) and non-instrumental (e.g. spiritual, cultural, religious) values of biodiversity to meet aims of NNL (Griffiths et al., 2018). Therefore, it would seem logical that risks to an SLO would be perceived at the same local level at which these values are expressed.

The affected community of marine biodiversity loss in most cases is often more difficult to define than in terrestrial areas (Filer and Gabriel, 2016), which could weaken the legitimacy and therefore political clout of local NGOs as custodians of the marine biodiversity to be lost. The remote nature of many marine environmental developments could also be seen to decrease wider societal oversight or interest in marine biodiversity loss, where "*people tend to pay the most attention to what we know best, not necessarily what needs the most attention*" (Crowder and Norse, 2008). Given that obtaining an SLO is viewed as a priority by industry (Prno and Scott Slocombe, 2012; Rio Tinto, 2018) and biodiversity offsetting is viewed as contributing to this, the inability to easily define the community expected to demonstrate that this has been granted is challenging (Filer and Gabriel, 2016). It is perhaps for this reason that the tried and tested relationships with large international NGOs are the preferred avenue through which to demonstrate legitimacy and alleviate risk. Current marine offsetting practice in Australia does not adhere to best practice where NNL requires the demonstration of how biodiversity loss or an offsetting action may affect the distribution of biodiversity values (Griffiths et al., 2018). If the intent of biodiversity offsetting shifted to demonstrably meet marine NNL then engagement at a local level with NGOs and groups that can provide a more legitimate or informed representation of an affected community's preferences (Nuesiri, 2018) may become more important to the SLO of industry.

## 7.5. Conclusion

The risk management strategies deployed to protect social and political licences from the ambiguous use of NNL and biodiversity offsetting in marine environments include seeking legitimacy from influential, independent and respected partners. These include academics and large environmental NGOs through informal advisory relationships, formal partnerships and consultancy services. Despite a seemingly critical stance to biodiversity offsetting described by academic representatives in this study, and evident in the growing body of literature (Apostolopoulou and Adams, 2017; Dempsey and Collard, 2016; Maron et al., 2015a, 2015b), it seems that engagement is being viewed as providing legitimacy to current practice and supporting the social and political licences of industry and government. Large environmental NGOs appear to be less critical and perceive biodiversity offsetting as an opportunity to increase their influence. This contrasts the perceived engagement of locally-based NGOs who describe an absence of engagement in decisions or influence relating to natural resource use and marine environmental degradation. Further, NGO support for biodiversity offsetting within planning frameworks is provided through the production and dissemination of guidance for its application in marine contexts by large organisations (Fauna & Flora International, 2017). This acceptance of biodiversity offsetting and marine NNL as the norm, despite its ambiguity in application and lack of evidence of success, may be being perpetuated by the perceived legitimisation by respected independent parties. This perceived support of NNL in marine environments may be stifling inquiry as to whether it is an appropriate aim for such contexts and whether biodiversity offsetting should be used at all.

# 8. General discussion

## 8.1. Research overview

This thesis addresses current gaps in knowledge on how biodiversity offsetting policy, which has been predominantly developed for terrestrial environments, is being translated for marine application. There are various factors that could complicate this process, including the challenges posed by assessing impacts (Crowder and Norse, 2008), the lack of experience in marine restoration and administrative issues in addition to the high costs of operation in marine environments (Freestone et al., 2014; Pardo, 1967). In combination, these factors may impede assessments of equivalence between biodiversity losses and gains and the feasibility of offsets in 'like for like' settings, particularly given the cumulative pressures on marine environments that are poorly understood and widely associated with trends of biodiversity degradation (Halpern et al., 2015; Johnson et al., 2017; Worm et al., 2006). Prior to the research contained in this thesis it was not currently understood how current marine biodiversity offsetting practice accounts for these challenges and whether and how aims of NNL are being met in marine environments.

*Setting the scene*

In addressing research question 1, which asks what policy support exists for marine biodiversity offsetting on a global scale I find that biodiversity offsetting is being used in marine contexts (Chapter 4). However, marine use of the approach does not holistically or uniformly comply with the key principles and best practice developed through terrestrial experiences and accepted as necessary to meet aims of NNL (BBOP, 2012; Bull et al., 2013). I conclude in Chapter 4 that there is a limited policy basis specifically considering the marine application of biodiversity offsets. This review indicated that Australia provides useful insights into the application of biodiversity offsetting policy in marine contexts as a case study (Yin, 2013). Australia not only has a relatively developed biodiversity offsetting policy basis operating at numerous levels from federal to state, it also has a well-structured EIA framework that captures much marine development (Elliot and Thomas, 2009; Harvey and Clarke, 2012). Recent history has seen economic development in the offshore and coastal marine environments, particularly in relation to industry associated with natural resource extraction (e.g. ports and export facilities) and the associated use of biodiversity offsets within consenting processes (Bos et al., 2014; Brodie, 2014). Further, Australia has been cited as a leader in marine management, with management of the Great Barrier Reef often referred to as an example of best practice (McCook et al., 2010). Australian biodiversity offsetting policy is looked to by those seeking to develop similar frameworks elsewhere, including in low-income countries (Belize Coastal Zone Management Authority & Institute and Australia-Caribbean Coral Reef Collaboration, 2014; Bull et al., 2016). As such, the findings of this study using Australia as a case study could foreseeably translate to other jurisdictions exploring the use of biodiversity offsets in marine contexts and may, in part, also apply to terrestrial applications.

Chapter 5 presents a systematic review and analysis of Australian development control documentation for projects with associated marine biodiversity offsetting requirements. This review was undertaken to provide insight to how and whether the marine application of biodiversity offsetting follows the principles identified as necessary for NNL and how practice aligns with existing policy (research questions 2 and 3). The results of this review indicate that these principles, whilst identified as necessary for terrestrial applications are recognised as being challenged by marine application at a policy level. Following this, the use of marine biodiversity offsetting in practice does not appear to meet these principles and Chapter 5 concludes that current use is unlikely to realise an aim of NNL. This review shows that several strategies have been employed regularly in the translation of terrestrial offsetting policy and practice to marine environments. These strategies include the use of offset packages comprising management activity and research initiatives to improve the scientific basis for impact assessment (Chapter 5). Another offsetting strategy identified in Chapter 4 as being increasingly adopted as the preferred mechanism to manage biodiversity offsetting in marine environments, is to pool offset finance with the intention to apply consolidated funds to larger strategic projects. These strategic projects seek to affect a greater conservation benefit by addressing priority issues at scale, such as water quality which has been identified as a key management issue for the Great Barrier Reef (Commonwealth of Australia, 2018). These strategies frequently use ‘out of kind’ offsets and can obscure how the principles required to meet aims of NNL such as that of equivalence and additionality are met in practice.

*Exploring the drivers and role of marine biodiversity offsetting practice*

Building on the findings of Chapter 5 to better understand how current policy arrangements support decision-making in relation to marine biodiversity offsets and EIA, interviews were conducted with a range of stakeholders with experience in applying or developing marine biodiversity offsetting policy. Analysis of these interviews explored participant perceptions on how biodiversity offsetting is being applied in marine environments, the drivers behind current practice and the role of the approach within Australian marine development consent frameworks (research questions 4, 5 and 6).

Results from these analyses, presented in Chapters 6 and 7, confirm that NNL is unlikely to be realised from current marine biodiversity offsetting efforts and that there is a lack of strategy or clarity surrounding how and why offsets are being used. This has led to the *ad hoc* and ambiguous interpretation of biodiversity offsetting in marine settings and the use of arbitrarily defined offsetting requirements. A recurring theme was that biodiversity offsetting and aims of NNL set expectations of sustainable development that do not align with current capabilities in marine restoration and the costs budgeted for compensation. Despite this, biodiversity offsetting was widely accepted and there were suggestions that it is even becoming an expected component of development consent decision-making. The ambiguous definition of NNL and marine biodiversity offsetting presents risk for governments and industry, and this in turn influences its interpretation in practice which is driven by risk management strategies to protect political and social licences.

This Chapter draws together the body of research presented within Chapters 4-7 and explores why ambiguous definitions for marine NNL and biodiversity offsetting may have arisen and how this influences the implementation of biodiversity offsetting policy in marine environments. I discuss the relationships perpetuating the ambiguous use of NNL and biodiversity offsetting in marine environments and the divergence from the tightly controlled definitions commonly described in academic literature. Following this, I consider how these relationships influence the implementation of marine biodiversity offsetting and explore the potential factors perpetuating the use of marine biodiversity offsetting and NNL despite a recognition that it is unlikely to be meeting stated aims. Reflecting on this, marine biodiversity offsetting is analysed through the lens of the principles for 'good' governance. This Chapter concludes by considering recommendations for the future of marine NNL and biodiversity offsetting and appraising potential avenues for further research.

## 8.2. Meeting best practice in marine environments

Further to the scientific and technical issues posed by operating in marine environments, the compliance frameworks surrounding marine biodiversity offsetting do not promote a rigorous interpretation of NNL, with little detail evident as to the indicators of success used to monitor offsets (Chapter 5). A similar situation occurs for terrestrial environments in Australia, with little available evidence to suggest that biodiversity offsetting can be used successfully in any habitat (Gibbons et al., 2017; Lindenmayer et al., 2017). However, it is not clear if the ambiguity identified as inherent to marine biodiversity offsetting (Chapters 5, 6 & 7) is common to the use of biodiversity offsets in terrestrial environments. In many terrestrial examples in Australia, metrics have been developed to guide and inform assessments of equivalence (Gonçalves et al., 2015; Maron et al., 2013). However, where such metrics are applied against marine impacts they are commonly used to determine a financial equivalent (Fairfull, 2013). This exercise requires calculation and agreement of the monetary value of biodiversity, which can be a highly controversial exercise (Robertson, 2007; Spash, 2015), and was described by participants as one of the difficulties in designing metrics to establish the equivalency of marine offsets (Chapter 6).

The standardisation of biodiversity offsetting is often considered necessary to provide evidence that the aims of NNL are being met in a consistent and demonstrable way (Bull et al., 2013). In marine environments, standardisation has been resisted for several reasons. The uncertainty associated with marine science and marine restoration mean that it is likely that expert elicitation methods will form the basis of such assessments. Expert elicitation is increasingly accepted as necessary within natural resource management where decisions are made with insufficient data (Hemming et al., 2018). In the process of standardisation of marine biodiversity offsets, expert advice has been sought in the development of metrics to support assessments of equivalence in marine biodiversity offsetting (Chapters 6 and 7). Practitioners described a perceived inability of government to manage these processes to avoid the biased and subjective results that can arise from poorly structured use of experts (Hemming et al., 2018). This lack of trust leads to a resistance by stakeholders to accept attempts to standardise processes that also commonly implicate higher costs than historically required for compensation prior to the use of biodiversity offsets (Chapter 7).

Despite this resistance, in some jurisdictions in Australia steps are being made towards the standardisation of a scientifically justifiable definition of NNL. These efforts were shown to include the development of metrics to establish equivalence (Maron et al., 2016b) and the building of scientific basis to enforce the mitigation hierarchy and future project refusal (Chapters 5 & 6). However, the majority of the examples provided by participants when describing their experience of marine biodiversity offsetting do not fit the academic definitions of biodiversity offsets that are commonly accepted as best practice and required to meet NNL (Bull et al., 2016; Maron et al., 2018). One of the essential criteria essential to meet aims of NNL is that of additionality, where biodiversity offsets present a benefit beyond that which would have occurred in the absence of the offset activity or impact (Bull et al., 2016). Without this NNL is rendered meaningless as the counterfactual scenario against which it is established remains unknown (Bull et al., 2016; Maron et al., 2015a). The concept of additionality was rarely described in accounts of participants' experiences with the implementation of marine biodiversity offsetting and there was little evidence of its consideration in offset definition (Chapter 5).

Additionality is particularly challenged by the absence of property rights in marine environments and the consequent application of pooled offset finance. For example, Australia has a commitment to improving the state of the GBR by 2050 (Commonwealth of Australia, 2018) to maintain its UNESCO designation (Morrison, 2017). However, given that many strategic targets and priorities have previously been committed to by the government, it is questionable whether funds provided through strategic 'out of kind' offsetting mechanisms can be considered additional. Similarly, using biodiversity offsetting finance to undertake targeted research to build future capacity to support impact assessment cannot be considered additional as they are effectively financed by biodiversity loss (Maron et al., 2015b). Where metrics exist, they are facilitating the calculation of equivalent financial contributions, but a strategy is yet to be developed governing how this finance should then be applied to maintain equivalence and additionality. It is evident, that in the majority if not all marine jurisdictions in Australia, demonstrable NNL is not being sought and that biodiversity offsetting is being used for alternative purposes.

## 8.3. Ambiguity and biodiversity protection through development consent

Despite an ambiguous use of terms, decision-making processes and limited indications of biodiversity offsetting success, the approach has been rapidly adopted on a global scale (Madsen et al., 2011). In accordance, biodiversity offsets are described by participants as becoming an increasingly expected component of environmental licensing processes (Chapter 7). In marine environments their use does not appear to be contingent on an identified impact to biodiversity and there is little evidence of how or if the first steps of the mitigation hierarchy (avoid, minimise) are being applied. For example, in negotiations relating to the regulation of areas beyond national jurisdiction and the mining of deep-sea resources, the lack of firm understanding over what is being lost does not seem to influence decisions about whether exploitation of a resource should go ahead. Instead, discussions appear to jump ahead to what might form appropriate and acceptable compensation for damage, circumventing the mitigation hierarchy. Thus, despite there being little evidence as to whether there is a societal acceptance or need for deep-sea mining (Kim, 2017) discussions are already focussing on how impacts should be offset as a way to navigate the precautionary principle (Niner et al., 2018; Van Dover et al., 2017). Thus, whilst there are some indications that biodiversity offsets may be leading to environmental protection in some situations, there are others suggesting it may be facilitating biodiversity loss.

Superficially, biodiversity offsetting addresses the difficult remit of government to manage environmental protection whilst supporting economic growth. Results presented in this thesis suggest that these competing demands are significant factors for those involved in offsetting, perpetuating the ambiguous use of marine biodiversity offsetting. By using biodiversity offsets, governments can maintain and protect their political licence and be seen to act in the interest of both agendas. However, in many cases, a robust interpretation of biodiversity offsetting would likely signal an increase in environmental expenditure for projects and could adversely affect the profit margins expected by shareholders. Concerns were raised by interview participants as to the effect this might have on project viability, with some initial predictions of the costs prompting industry representatives to suggest that some essential infrastructure projects would be unable to proceed. This narrative casts government as acting obstructively and raises doubt over their political license to manage the economy and was described to set in motion risk management activity, leading to the ambiguous use of offsets. Another perceived threat relates to the limited success of biodiversity offsets, recognition of this lack is becoming increasingly documented (Gibbons et al., 2017; Lindenmayer et al., 2017; Quigley and Harper, 2006a). There are indications that a political fear of failure is preventing the evaluation and consequent adaptation and learning from offsetting experience and thus perpetuating the status quo.

> **CON8:** …*the biggest barrier and it's, there's two there's a legal, a legal fear and a... human fear of failure, we're too scared of failure, we aren't prepared to fail. So we spend all our time trying to make sure that it's fool proof and holds water and then we don't go and measure it because we don't actually want to know that it's failed. So, we're too scared of the nasty answer, Minister doesn't want to stand up in parliament and go well my department has issued four hundred approvals requiring this many offsets and none of them have worked, it doesn't work, he's not going to do it...*

This fear of failure is not unique to government, industry are also acutely aware of the importance of an SLO to maintain their legitimacy and position within society (Boutilier and Thomson, 2011; Moffat and Zhang, 2014). This requires communication strategies to ensure that community expectations are met, and stakeholder relationships are based on a mutual degree of trust. In the case of biodiversity offsetting it is often assumed that NNL is representative of community or societal preference about the way that biodiversity is managed. However, ambiguity in the ways in which biodiversity offsetting was understood by participants, none of which seem likely to meet aims of NNL, suggests that the overt demonstration of NNL is not necessary to meet such expectations. Industry describe how their offsetting activity, in addition to other conservation and community focussed activity beyond that mandated by licenses and regulation, fits a narrative of environmental responsibility and the building of community relations. There are indications that strategies are employed to address the potential risk to their SLO of offset failure by opting for mechanisms where the measure of success is more diffuse (Addison et al., 2018), unless they are able to take ownership and control of the offset to ensure delivery and its associated 'story'.

Setting aspirational private targets adopted by business such as NNL can be seen as an opportunity for industry to safeguard against the risks of the repercussions of biodiversity loss, which can include damaging their SLO and consequent limitations in access to finance (Addison et al., 2018; Equator Principles Association, 2013). Such targets can also serve as an environmental differentiator whereby an organisation's SLO is improved by demonstrating their commitment to sustainable modes of operation and environmental protection. However, voluntarily adopting private standards to go above and beyond mandated practice when implementing NNL policy and biodiversity offsets can also disadvantage an organisation. These disadvantages include the open acknowledgment of impact when other similar organisations or activities are not doing so and the consequent impact on an SLO as a result. Another disadvantage is the increased cost associated with demonstrably meeting a NNL target, which is likely to involve significant investment in areas that are not in the core interests or expertise of the organisation. Practitioner experience examined in Chapters 6 and 7 indicates that tracking the benefits of this activity to evidence its value to shareholders is difficult and can be viewed as an unnecessary burden. Moreover, it poses a risk of SLO damage if such targets are not met or are unable to be demonstrated. Accordingly, a step back from specific aims such as NNL has been observed in organisations that explicitly embedded biodiversity accountability within their corporate strategy. One such example is the mining multinational company Rio Tinto who have backed away from their 2004 commitment to a "*net positive impact*" on biodiversity across all operations, intimating that such an ambitious target may have been unfeasible in practice (Rio Tinto, 2017).

In contrast to the shift away from NNL observed within private standards, current governmental uptake of NNL or equivalent targets appears to be increasing (Chapter 4; Madsen et al. 2011) and often without a clear definition of success and defined strategies to measure and appraise the outcomes of such policy aims. As indicated by the results in Chapter 6, aspirations to meet such aims in marine contexts appear to be limited and so offsetting requirements issued by Government are often unlikely to realise stipulated aims of NNL. This inconsistency presents risks for industry who are required to adhere to government standards and processes to meet the conditions of development consent. These risks include the normalisation of the arbitrary use of biodiversity offsets even in the absence of an impact, so that offsets become an expected part of development consent and a cost to be borne by industry. Further, there are concerns that the strategic approach increasingly preferred for the marine application of biodiversity offsetting - the pooling of offset finance into conservation funds - sets expectations that the cumulative pressures influencing trends of marine biodiversity degradation will be met through biodiversity offsets. Participants described how this presents a risk for industry, where they are almost certainly likely to fall short of community expectations.

For licencing purposes, industry are required to adhere to conditions required by government and are to some degree tied to the processes and outcomes contained within licensing frameworks. In seeking to manage the potential disadvantages and risks presented by processes unlikely to meet the expectations set by a NNL target there are several courses of action that industry may take. These may include attempts to undermine a government's political license and force a change in approach through lobbying, the cessation of additional 'voluntary' conservation activity (Addison and Bull, 2018), or the use of alternative options that offer more control and certainty over an organisation's environmental performance. The dis-engagement with strategic government operated marine conservation funds may promote industry to reduce their offset liability through avoidance and minimisation as per the mitigation hierarchy (Bull et al., 2013; Rainey et al., 2014). However, as intimated by Rio Tinto (Rio Tinto, 2017) and described by others, for many activities, particularly those involving resource extraction such as mining, is it is likely to be impossible to avoid all associated biodiversity loss (Niner et al., 2018; Van Dover et al., 2017). Accordingly, it is likely that the need for some sort of engagement with biodiversity offsetting will be required if the use of aims such as NNL persist. Given that the success of strategic funds for marine conservation is premised on their ability to deliver benefits at scale, the engagement of industry will be required to ensure all potential offset finance is captured. To enable this, a relationship based on trust between industry and government is required to ensure that these funds meet the needs of all parties will be essential (Chapter 7).

There is little evidence from past and current practice as presented in Chapter 5 that the *ad hoc* implementation of biodiversity offsetting is conducive to better meeting aims of marine NNL or that government has sufficient capacity or expertise to manage *ad hoc* biodiversity offsetting to meet such aims. Strategic conservation funds, in theory, offer the opportunity to deliver cost effective conservation outcomes for large diffuse issues such as those common to marine environments. With a well-designed strategy it is likely that they could require less capacity to govern as opposed to the management of many varying ad-hoc marine offsets. Industry concerns (Chapter 6) related to the potential poor management of funds and a lack of accountability to track the use of their specific funds. These fears were based on previously held perceptions of government and the absence of trust in government's ability to understand business needs. To maximise engagement and uptake of these strategic opportunities these needs should be built in to policy and frameworks to allow for the flexibility and accounting required by industry. Further, the risks posed by setting unachievable targets also need to be addressed through an honest acknowledgement of the trade-offs required for certain activities. This should be accompanied by a shared responsibility by all parties implicated in decision-making for the biodiversity loss arising from such decisions.

## 8.4. **What is preventing a shift away from NNL?**

Without the support of decision-making tools that match stated aims, participants described several strategies that are employed to manage the perceived threats arising from current practice to a government or industry's social and political licence. One of these is the use of independent brokers such as academia and environmental NGOs to provide legitimacy to activity and policy positions. These independent brokers influence marine biodiversity offsetting practice in both different and overlapping ways. One of the main avenues of risks perceived to emerge through current offsetting practice was through the societal leverage that large international NGOs possess as the "*global watchdogs of sustainability*" (Larsen and Brockington, 2018). In response to this risk, some members of industry are working with large NGOs to develop strategies in collaboration, to ensure that their SLO is supported through processes fitting normative expectations of environmental protection (Figure 8.1). These partnerships may be through the delivery of offsetting activity as an 'honest broker' or in an advisory capacity to develop strategies to meet required standards of performance in relation to environmental protection and biodiversity offsetting. Similar relationships were described by government and academic representatives among other participants and outlined in Chapter 7. Government were reported to use the expertise and perceived independence of academics to provide legitimacy to policy and consequent decision-making activity. These relationships exist through the contracting of academics on a consultancy basis (Figure 8.1) to develop guidance or technical tools such as metrics, or in a less-formal advisory capacity where views are sought on a strategy such as through sense-checking.

Boundary spanning between business, academics and NGOs does seem to be influencing how marine biodiversity offsetting is being used in practice (Bednarek et al., 2018). However, these relationships appear to be limited to those that have established legitimacy or power (Figure 8.1). For example, academics have qualifications and professional positions to demonstrate their expertise and large international NGOs can use their large membership to leverage political support (MacDonald, 2010, 2018; Morrison, 2017; Nuesiri, 2018). In areas outside of the interest of large NGOs (either in terms of subject matter or location), the perceived risks to an organisations' social or political licence may be reduced. Interview participants representing smaller community-based NGOs described how they feel excluded from biodiversity offsetting processes at the point of acceptance and definition, citing their lack of power and an inability to influence industry in the way larger NGOs can. This lack of consideration and engagement at a local level suggests that these organisations are not perceived to present the risk to marine industry and government perceived to arise from larger organisations influential at national and international scales. This contrasts with a widespread understanding that an SLO is provided from a directly affected community (Boutilier and Thomson, 2011), such as might be represented by smaller, locally-based NGOs. One explanation for this contrast could be the difficulties posed with determining who constitutes the community affected by marine biodiversity loss. This creates ambiguity as to who is providing an SLO and in turn creates difficulties for industry or government to demonstrate approval for their activity (Filer and Gabriel, 2016).

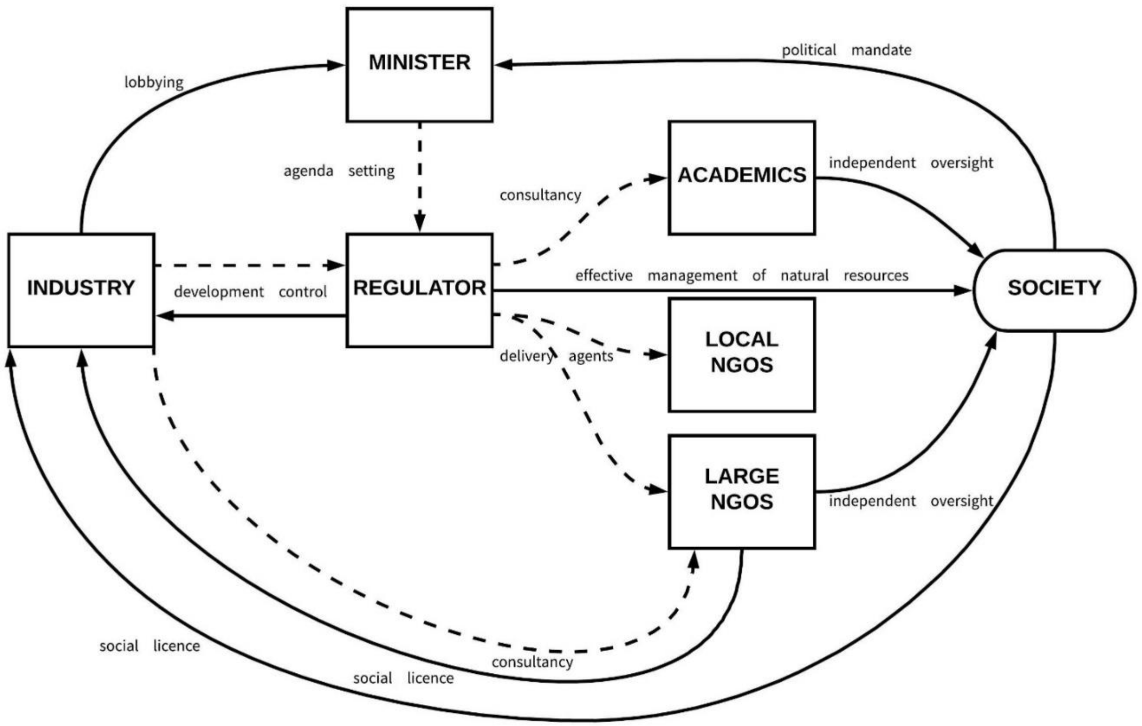


**Figure 8.1.** A conceptual model of the relationships through which social and political licences are perceived to arise (solid lines) and are actively managed or sought (dashed lines) under aims of marine NNL through biodiversity offsetting. The SLO presents risk to the social licence of industry from society and is also coordinated by large NGOs. Smaller NGOs benefit only as a passive delivery partner for biodiversity offsets and are not sources of risk for government and industry. Ministers operating at higher levels of government are subject to lobbying by industry to support their interpretation of biodiversity offsetting or NNL, the political risk presented by this is alleviated through setting agendas that match industry expectations, that are implemented by regulators issuing development consent. Academics in acting as advisors to regulators (and policy makers) provide legitimacy to development consent decision making.

Close cooperation between NGOs and academics with the development and implementation of biodiversity offsetting might be leading to biodiversity benefits beyond those that are currently measured in relation marine biodiversity offsetting. For example, engagement with NGO and academic representatives at a strategic level or at stages of project planning may increase the scientific rigour of policy development and implementation. However, if aims of NNL are not the true target of marine biodiversity offsetting, these relationships could be serving to undermine the intentions of environmental protection that have led to these relationships (Morrison, 2017). Through engaging and providing legitimacy to the use of biodiversity offsets without explicitly challenging the modes of use in external and public-facing fora they could be unintentionally contributing to the 'greenwash' effect (MacDonald, 2010) and reducing societal assessment of current practice. This is depicted in the conceptual diagram (Figure 8.1.) where academics' key role of independence is leveraged by regulators through the procurement of consultancy-type services. Whilst academics involved in offsets are increasingly sceptical of current biodiversity offsetting practice in academic literature, there is little outward criticism of the political will required to meet stated aims of NNL and a tendency to focus on the technicalities of the approach (Calvet et al., 2015). Large NGOs are developing 'best practice guidance' for marine biodiversity offsetting and the use of the mitigation hierarchy which perpetuate the narrative that NNL is an achievable and politically supported target, even though the limitations of the approach are acknowledged (Fauna & Flora International, 2017). What appears to be absent is the trust between regulation and implementation to allow for a discussion over whether aims such as NNL are appropriate for marine application and what this might mean for governance and operation in marine environments.

## 8.5. Marine biodiversity offsetting as 'good' governance

Management of natural resources, particularly marine natural resources that necessitate strategic, large scale and long-term approaches, is complicated by a lack of clarity over who should be responsible (Lockwood et al., 2010). Marine biodiversity offsetting seeks to pass this responsibility to industry, in step with current trends in the decentralisation of environmental governance. This is premised on the theory that by setting aims of NNL and through the application of the mitigation hierarchy, economic activity will be steered towards environmental sustainability. However, the challenges of meeting NNL in marine contexts are such that the current use of biodiversity offsetting in marine environments does not meet the principles of good governance (Lemos and Agrawal, 2006; Lockwood et al., 2010; Rhodes, 1997). The key tenet of good governance i.e. legitimacy, is widely recognised by stakeholders involved in the development and implementation of marine biodiversity offsetting policy as essential to their respective activities. Yet how this is achieved does not align with the principles of transparency, accountability, inclusivity and fairness (Lockwood et al., 2010; Rhodes, 1997). Current relationships between civil society groups (e.g. industry, NGOs, regulators, ministers) involved in the use of marine biodiversity offsetting are not pushing for a robust adherence to these principles. Instead, through risk management strategies set in place to manage the expectations of aims of NNL, legitimacy is conferred through various relationships such as the perceived approval of large environmental NGOs. The research presented in this thesis indicates that these relationships are carefully cultivated to manage the preservation of social and political licences and as a result does not include all stakeholders implicated in trade-offs and resulting risks of biodiversity loss.

The risks posed by openly acknowledging that marine biodiversity loss is inevitably associated with many economic development projects appear to be perceived as greater than those posed by setting impossible targets such as NNL. Current governance arrangements surrounding biodiversity offsetting appear to be focussed more on societal responsiveness as opposed to accountability. Governments are required to set policy that is responsive to the preferences of society (Esaiasson et al., 2017); NNL and biodiversity offsetting meet this requirement in that they in theory support both aims of economic growth and environmental protection. Accountability - the acceptance of responsibility for decisions and the demonstration of this responsibility - is not sought through current marine biodiversity offsetting practice in Australia. Accountability in natural resource management in Australia is criticised in being most often limited to one direction – upward to government (Lockwood et al., 2010; Moore and Rockloff, 2006). This trend can explain how aims of NNL, set by government, are continuing to meet societal aims and are not being subject to high degrees of societal scrutiny or demands for increased transparency. With such targets increasingly becoming widely expected and adopted into development consent frameworks, the risk of contributing to biodiversity decline is likely becoming more pronounced. As highlighted by Cashore (2002) in an exploration of the dynamics of legitimacy in market-driven governance systems and indicated in results presented here, a reversal away from an accepted 'norm' such as NNL may pose a greater threat to an organisation than if they had never committed at all. Accordingly, despite the challenges posed by aims of NNL, such aims are unlikely to be revoked in the near future despite their impossibility and their non-compliance with the principles of 'good' governance necessitated by their use.

## 8.6. Wider applicability and future work

The results presented in this thesis provide insight into the role of biodiversity offsetting under the scientifically uncertain (Crowder and Norse, 2008; McCook et al., 2010) and administratively complex circumstances presented by marine management. Given the relatively developed policy basis for biodiversity offsetting in Australia, it can be concluded that the findings presented in this thesis are likely to apply to other jurisdictions in which biodiversity offsetting is being applied to marine environments. Indeed there are indications of this occurring, as described in the exploration of the potential of biodiversity offsets to manage the impacts of deep-sea mining (Niner et al., 2018; Van Dover et al., 2017). Many of the challenges described by participants adhere to the terrestrial application of biodiversity offsetting. These include the ambiguous definition of policies (Clare and Krogman, 2013) and also the policy implementation gap, where impacts to biodiversity are not captured comprehensively as a means of trying to avert overall trends of degradation (Maron et al., 2018). However, it is not clear whether the 'unknown' or 'unseen' attributes of the marine environment serve to increase the ambiguity with which biodiversity is applied in such environments. This 'remoteness' or 'out of sight-ness' could be influencing how reputational risks influencing social and political licences manifest. Perceptions of both industry and government align in that they feel that maintaining a narrative around aims of NNL despite the lack of feasibility around meeting it is the best way to manage this risk. There is little explicit evidence of perceived risk relating to the misuse of NNL through biodiversity offsetting, perhaps a result of historical societal acceptance of these terms. Risks to social and political licences are perceived to arise from the relationships between stakeholders, where activity associated with aims of NNL and biodiversity offsetting demonstrates their commitment to sustainability and support negotiation between interested parties.

A social licence is most commonly understood to be 'issued' from local communities who are immediately affected by a project and its associated environmental impact (Filer and Gabriel, 2016; Owen and Kemp, 2013; Prno and Scott Slocombe, 2012). Results here indicate that for marine environments at least this may not be the case. A risk of not meeting the requirements of social and political licences is perceived to arise from a broad audience, coordinated by large NGOs and influencing political landscapes. This is contrary to commonly described SLO strategies that describe how it is through relationships of trust with local communities that demonstrates an organisations' (e.g. government or industry) credibility and legitimacy to undertake activity (Moffat et al., 2016; Owen and Kemp, 2013; Prno and Scott Slocombe, 2012). The challenges posed by defining this local community for a given biodiversity loss in marine environment is more difficult than in terrestrial environments owing to the diffuse and remote ways in which such environments are valued. It is possible, that the idea of local, which is entrenched in the processes surrounding 'community consultation' within development-consent frameworks, does not ascribe to marine biodiversity in the same way that it does in terrestrial environments. Without this easy delineation of a 'local' and effected community and in the absence of any local pressure established 'tried and tested' relationships with large international NGOs are leveraged to demonstrate social and political licences. These relationships, perhaps unintentionally, are not leading to a realisation of NNL under scientifically justifiable means and are not applying pressure to explore whether such aims are appropriate for marine environment. There has been little reported as to how the perceived scales of societal pressure are influencing environmental resource management and decisions relating to biodiversity loss. An area of future research interest to explore would be to understand this phenomenon (in both marine and terrestrial settings) and how these relationships should be reflected within policy and governance frameworks to support biodiversity protection. This research is particularly important for marine management, where decisions relating to the use of natural resources do not appear to be subject to the same oversight afforded to most terrestrial ecosystems.

Another avenue of research interest arising from the findings presented in this thesis relates to the influence of current narratives around development consent and environmental impact. Whether a true definition of NNL, where the risks and difficulties in meeting such an aim are fully understood, is a societal preference has not been tested. Further research relating to how societal preference for management decisions should also be examined under scenarios of declining biodiversity and the altered ecological landscapes predicted to occur as thresholds of loss are reached and climate change advances (Hobbs et al., 2011).

# 9. Conclusions

Marine biodiversity offsetting in Australia is not being applied in line with the principles established as necessary to meet aims of NNL. Transparency is essential to avoid the misuse of biodiversity offsetting and NNL in marine contexts and to enable societal oversight of the transactions implicated by offsets. However, the standardisation required for this to occur results in a range of risks relating to the social and political licences of industry and government. These include, those related to the open acknowledgement (and acceptance) of impact, the uncertainty of gains and the likely high financial costs of offsets. Aims of NNL for marine environments are difficult to meet in practice and setting such aims constrains the narrative around impacts and development, such that any organisation seeking to be transparent about the challenges with biodiversity offsets are potentially disadvantaged. One of the founding aims of biodiversity offsetting was to improve the transparency of decision-making surrounding natural resource use (BBOP, 2012), it seems that in marine environments it has had the opposite effect and acts to stifle enquiry into the detail of decisions and the trade-offs implicated by development proposals. Thus, it is not clear that NNL and biodiversity offsetting as practised are appropriate tools to protect marine environments. Despite this, biodiversity offsetting appears to be firmly established within development consenting processes.

This thesis provides insights into the current system of marine biodiversity offsetting in Australia, which is driving the use of offsets in ways unlikely to prevent biodiversity loss and thus meet aims of NNL. In doing so, it forms the first step towards resolving the misuse of an approach which is becoming prevalent. Biodiversity offsetting is currently viewed as a legitimate way to meet aims of sustainable marine development, initiating a chain of risk management activities focussed on maintaining reputation and legitimacy as opposed to upholding stated aims of environmental protection. Instead, rather than minimising the risk that the not achieving goals of NNL might be uncovered and then seen as irresponsible or as a failure, more consideration is needed of whether aims of NNL are appropriate for marine contexts at all. In other words, the honest communication of the difficulties of offsetting in the marine environment and the limited possibilities to do so effectively. If a goal of NNL is deemed to be appropriate, then compensation calculations should only be undertaken rigorously, along with a shift in narrative so that biodiversity offsetting (or compensation) is understood as undesirable and that in most marine contexts will still probably involve biodiversity loss. Such a shift, although unlikely to counter all damaging activity, may provide the incentive required for those industries and governments concerned with maintaining social and political licences to invest in innovation and activities to maximise avoidance and minimisation strategies.

A change in the approach used to manage biodiversity losses through development is needed and will become increasingly important if and when the public (and government and possibly other parts of industry not already involved) become more aware of the difficulties and shortcomings of biodiversity offsetting in the marine environments. There will be some marine economic activities perceived to be essential to the economy or to be required for the 'public good' for which biodiversity damage is unavoidable, such as maintenance dredging at a port or clearing of a public boat ramp. This thesis describes that while biodiversity offsetting is sometimes applied in these situations, those involved in the process do not currently perceive it possible to properly offset for impacts and so more transparent consideration of what might be appropriate in the way of compensation is required. Such discussions, where decisions to accept the impact have been taken by government, should reflect the shared responsibility for the biodiversity loss predicted to take place. These societal discussions could be facilitated by honest brokers such as NGOs, to support a shift in the perceptions that environmental responsibility is defined by aims such as NNL, as proposed by Dempsey et al (2016) who call on NGOs to challenge their current collegial modes of operation with business and adopt a more disciplinary role to force political change to support environmental protection. In facilitating exchange, a key focus should be to change the narrative surrounding marine biodiversity offsetting to highlight the biodiversity loss implicated by development consent.

Whilst the overarching conclusion of this thesis is that the use of marine biodiversity offsetting and NNL should be reconsidered within development consent, current governmental trajectories indicate that an increased uptake of such aims can be foreseen. If aims of NNL and biodiversity offsetting are deemed appropriate for marine environments then standardisation of the approach is essential, and the legitimacy lent by academic expertise and NGO support may be essential to bridge the gap between industry and government. This support could take the form of the coproduction of a standard approach to marine biodiversity offsetting in line with academic definitions (Bull et al., 2016) or through the staging of societal pressure for a more transparent interpretation of marine NNL.

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# **Appendix A:** Mode of uptake of biodiversity offsetting principles in the marine environment by country[8]

Table A. Mode of uptake of biodiversity offsetting principles in the marine environment by country

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| US | National offsetting policy | Clean Water Act (CWA) | *"no overall net loss"* (DoD and EPA, 1990) | No | Applies to special aquatic sites including sanctuaries and refuges, wetlands, mud flats, vegetated shallows and coral reefs | Bank, ILF, PRM | (BenDor and Riggsbee, 2011a, 2011b; Broad, 2009; DoD and EPA, 1990, 2008; Environmental Protection Agency, 2008; US EPA, 2015a; Wilkinson, 2008) |
| US | National offsetting policy | Endangered Species Act 1973 (ESA) | Application of species recovery goal. | No | List of endangered species includes 125 marine species. | Bank, ILF, PRM | (Bauer et al., 2004; Kormos et al., 2015; Madsen et al., 2010; NOAA Fisheries, 2015; US EPA, 2015b) |
| US | National offsetting policy | Magnuson-Stevens Fishery Conservation and Management Act | *"conservation and enhancement of essential fish habitat"* (NOAA, 2007) | Yes | | | (NOAA, 2007; Office of Sustainable Fisheries) |

[8] Assessment criteria are defined as outlined in the accompanying manuscript, the absence of evidence to support criteria is noted by a blank in the table.

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| US | Sub-national policy | National Marine Fisheries Service's (NMFS) California Eelgrass Mitigation Policy | *"no net loss of eelgrass habitat function in California"* (NOAA Fisheries - West coast region, 2014) | Yes | | Bank, ILF, PRM | (NOAA Fisheries - West coast region, 2014) |
| Canada | National offsetting policy | Fisheries Act<br>- Policy for the Management of Fish Habitat 1986 | *''no net loss of the productive capacity of fish habitats''* (DFO, 1986) | No | Includes marine fish habitats. | Bank, PRM | (DFO, 1986, 2002, 2013, Harper and Quigley, 2000, 2005b, 2005a; Minister of Justice, 1985; Quigley and Harper, 2006b, 2006a) |
| Canada | National offsetting policy **–application restricted to federal property** | Federal Policy on Wetland Conservation (FPWC) | *"no net loss of wetland functions on all federal lands and waters"* (Government of Canada, 1991) | No | Marine and coastal area | | (Austen and Hanson, 2007; Government of Canada, 1991; Lynch-Stewart et al., 1996; Rubec and Hanson, 2008) |
| Australia | National offsetting policy | Environment Protection and Biodiversity Conservation Act 1999 (The EPBC Act)<br>- EPBC Act Environmental Offsets Policy 2012 | *"improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action"* (Australian Government, 2012) | No | Applies to marine and coastal habitats and species including Ramsar wetlands, listed threatened species and ecological communities, migratory species, commonwealth | Bank, ILF, PRM | (Australian Government, 2012; BBOP, 2012; Bull et al., 2013; Department of the Environment and Energy, |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | marine areas and, specifically, the Great Barrier Reef marine park. | | 1999; Miller et al., 2015) |
| Australia | Sub-national offsetting policy | Queensland: Environmental Offsets Act 2014<br>- Queensland Environmental Offsets Policy | *"provide a conservation outcome that is equivalent to the value being lost"* (Queensland Government, 2016) | No | Applies to Marine Fish Habitat, Marine parks. | Bank, ILF, PRM | (Queensland Government, 2014a, 2014b, 2016) |
| Australia | Investment strategy **(relating to national and sub-national policy)** | Reef Trust | To channel offset finance (required through EPBC offsetting requirements) to strategically address high priority threats to the Great Barrier Reef | Yes | | Bank, ILF | (Dutson et al., 2015; Maron et al., 2016b) |
| Australia | Sub-national offsetting policy | New South Wales: Fisheries NSW policy and guidelines for fish habitat conservation and management | *"no net loss of key fish habitat"* (Fairfull, 2013) | No | Applies to marine and coastal habitat including but not limited to seagrass, mangroves, saltmarsh, estuarine and marine rocky reefs | ILF, PRM | (BBOP, 2012; Fairfull, 2013; NSW Government, 1994) |
| Australia | Sub-national offsetting policy | Victoria | *"No net loss in the contribution made by native vegetation to Victoria's biodiversity"* (Victoria State Government, 2016) | No | *"plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses"* (Victoria State Government, 2016) | Bank, PRM | (Department of Environment and Primary Industries and State Government Victoria, 2013; Victoria State |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | | | Governement, 2015; Victoria State Government, 2016) |
| Australia | Sub-national offsetting policy | Western Australia: Environment Protection Act 1986<br>- Western Australia's Environmental Offsets Policy<br>- Western Australia's Environmental Offsets Guidelines<br>- Environmental Assessment Guidelines, No.5 Environmental Assessment Guideline for protecting marine turtles from light impacts<br>- Environmental Assessment Guidelines, No.3 Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment<br>- Environmental Assessment Guidelines, No.7 Environmental Assessment Guideline for Marine Dredging | *“counterbalance the significant residual environmental impacts or risks of a project or activity"* (Government of Western Australia, 2014) | No | Applies to all WA lands, inland waters and marine coastal waters within three nautical miles. Native vegetation includes marine and aquatic species. | Bank, ILF, PRM | (Environmental Protection Authority, 2009, 2010, 2011, 2015, Government of Western Australia, 1986, 2011, 2014) |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | Proposals<br>- Environmental Assessment Guidelines, No.15 Environmental Assessment Guideline for Protecting the Quality of Western Australia's Marine Environment | | | | | |
| Australia | Sub-national offsetting policy | South Australia: Native Vegetation Act 1991; Native Vegetation Regulation 2003<br>- Policy for Significant Environmental Benefit | *"significant environmental benefit (SEB), which is over and above the impact of the clearance"* (Department of Environment Water and Natural Resources, 2015) | *No* | *"native vegetation means a plant or plants of a species indigenous to South Australia including a plant or plants growing in or under waters of the sea…"* (Government of South Australia, 1991) | Bank, ILF, PRM | (Department of Environment Water and Natural Resources, 2015; Government of South Australia, 1991, 2003) |
| European Union | Emergent (supra-) national offsetting policy **[on hold]**[9] | Biodiversity strategy to "halt biodiversity and ecosystem service loss by 2020" | To address biodiversity losses outside of protected areas. | No | Includes marine environments | | (Conway et al., 2013; European Commission, 2011; Tucker et al., 2014) |
| European Union | Supra-national offsetting policy **- application restricted to designated sites** | European Union (EU) Habitats and Birds Directives | *"overall coherence [of network]"* (European Commission, 2012b) | No | Includes marine birds and habitats | ILF, PRM | (European Commission, 1992, 2000, 2010, 2012b; |

[9]Development of the strategy has been put on an indefinite hold.

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | | | Natural England, 2010) |
| France | National offsetting policy | Doctrine (2012) and guidelines (2013) outlining implementation of mitigation hierarchy | no net loss as outlined in other public policies. | No | Includes marine habitats and species | Bank, PRM | (MEDDE, 2012a, 2012b, 2013; Quétier et al., 2014; Regnery et al., 2013b; Tucker et al., 2014) |
| Germany | National offsetting policy | Federal Nature Conservation Act (FNCA) and Federal Building Code | *"Intervening parties shall primarily avoid any significant adverse effects on nature and landscape. Unavoidable significant adverse effects are to be offset via compensation measures (Ausgleichsmaßnahmen) or substitution measures (Ersatzmaßnahmen) or where such offset is not possible, via money substitution"* (Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2010) | No | Applicable to *"impacts on soil, water, air and climate functions and associated biodiversity and landscape values"* (Tucker et al., 2014) | Bank, ILF, PRM | (Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2010; Madsen et al., 2010; Tucker et al., 2014) |
| The Netherlands | National policy requiring partial application of offsetting principles | Dutch National Nature Network established under the Infrastructure and spatial planning policy. | long term sustainable development | No | Applies to protected areas that include those in marine environments. | | (Conway et al., 2013; de Bie and van Dessel, 2011; Tucker et al., 2014) |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| United Kingdom | Emergent national offsetting policy (on hold) | Offsetting pilot studies - not progressed | To explore use of offsets | No | Included coastal study sites. Subtidal areas were excluded from scope. | | (Cook and Clay, 2013; DEFRA, 2013; Dickie et al., 2013) |
| United Kingdom | Biodiversity markets | Private investment in marine offset feasibility (The Crown Estate) | Alignment of stewardship and revenue raising streams of organisation | Yes | | | (Cook and Clay, 2013) |
| United Kingdom | Biodiversity offset research and development (R&D) | Regulator led research and development project into "The location, condition and features of significant sites" | To improve knowledge around potential sites for easy habitat creation/restoration to assist in the marine development applications with compensatory requirements. | Yes | | | (MMO, 2016) |
| South Africa | Emergent national offsetting policy | South African centralised biodiversity offsetting policy | | No | Supported by requirements of NEMA. | | (Chadwick et al., 2014; Department of Environmental Affairs and Development Planning, 2007; Ezemvelo KZN Wildlife, 2013; Jenner and Balmforth, 2015; Macfarlane et al., 2014) |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| South Africa | National policy supporting development of offsetting-specific policy | National Environment Management Act (NEMA) (Act 107 or 1998) | *"disturbance of ecosystems and loss of biological diversity should be avoided or, where it cannot be altogether avoided, minimised and remedied"* and *"environment is held in public trust… protected as the people's common heritage"* (Republic of South Africa) | No | Extends to land below the high-water mark and further provisions for the protection of marine receptors are provided through the National Environmental Management: Integrated Coastal Management Act | | (Driver et al., 2012; Harris et al., 2012; Jenner and Balmforth, 2015; Republic of South Africa, 1998b, 1998a, 2014) |
| South Africa | Sub-national offsetting policy | Western Cape - provincial guideline on biodiversity offsets | Adherence to NEMA's principles | No | *"… deals primarily with terrestrial ecosystems and wetlands (a type of freshwater ecosystem)."* (Department of Environmental Affairs and Development Planning, 2007) | PRM, ILF | (Brownlie and Botha, 2009; Department of Environmental Affairs and Development Planning, 2007) |
| South Africa | Sub-national offsetting policy | KwaZulu-Natal - offsetting scheme and guideline | Adherence to NEMA's principles | No | Supported by KZN biodiversity plans to identify areas of importance - includes estuarine environments and links to offshore counterparts highlighted in | Bank, ILF, PRM | (Ezemvelo KZN Wildlife, 2013; Harris et al., 2012) |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | Coastal and Marine Biodiversity Plan. | | |
| Liberia | Sectoral offsetting policy | Draft mining act | References IFC performance standard 6 aim of no net loss | No | Contribution to protected area commitments which extend into the marine and coastal environment. | | (IFC, 2012; Johnson, 2015; Ministry of Foreign Affairs, 2002) |
| Liberia | Sectoral offsetting policy | Mineral Development Agreements | Integrating IFC performance standard 6 aim of no net loss | No | Contribution to protected area commitments which extend into the marine and coastal environment. | | (IFC, 2012; Johnson, 2015; Ministry of Foreign Affairs, 2002) |
| Liberia | Private standards* (requirements of the IFC and other development banks only) | Offsets framework for mining sector | Led by World Bank Group to contribute to protected area commitments. | No | Contribution to protected area commitments which extend into the marine and coastal environment. | | (IFC, 2012; Johnson, 2015; Ministry of Foreign Affairs, 2002) |
| Mozambique | Sectoral policy | Article 23 of the Petroleum Laws | *"ensuring there is no ecologic damage or destruction caused by the petroleum operations and that when inevitable, the measures for the protection of the environment are in accordance with internationally accepted standards"* (Republic of Mozambique, 2014) | No | Relates to oil and gas operators with offshore assets. | | (IFC, 2012; Moye and Nazerali, 2010; Republic of Mozambique, 2010, 2014) |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| Mozambique | Conservation fund | BIOFUND | To support fiscal instruments such as biodiversity offsets to fund conservation initiatives | No | Protection of Mozambique's marine environment is a well-recognised conservation priority. | ILF | (BIOFUND, 2016; Peace Parks Foundation, 2015; UNEP, 2015; WWF, 2015) |
| Gabon | Corporate standards | Private standards - Tullow | Partnership with Wildlife Conservation Society to improve EIA processes and the application of the mitigation hierarchy in offshore environments. | Yes | | | (Le Gabon, 2012; Tullow Oil, 2009, 2013) |
| China | Resource access fee | Marine Ecological Damage Compensation (MEDC) requirements. | to achieve sustainable development and *"to make developers of ocean space pay the full costs associated with their activities, including damages to the marine ecosystems"* (Rao et al., 2014) | Yes | | ILF | (Peng et al., 2010; Rao et al., 2014; SOA, 2009) |
| Korea | National policy requiring partial application of offsetting principles | Act on the Conservation and the Use of Biodiversity | Fixed charge relating to construction costs to be held as a bond against compensation. | No | Applicable to marine development, discussions have been held as to how a no net loss policy might be applied to manage marine impacts. | | (Kim, 2010; Lee, 2013; Ministry of Economic Affairs, 2014; Ministry of Environment of the Republic of Korea, 2014b, 2014a; Ministry of |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | | | Land Transport and Maritime Affairs - Marine Environmental Policy Division, 2009; OECD, 2006) |
| Yemen | Corporate standards | Yemen LNG Company Biodiversity Action Plan | *"Company goal to achieve internationally recognized environmental performance in biodiversity conservation during all phases of design, construction, operation and decommissioning of the plant."* (Yemen LNG, 2008) | | | PRM | (Yemen LNG, 2008) |
| Argentina | National policy requiring partial application of offsetting principles | National Environmental Law (Ley General del Ambiente) | *"sustainable and adequate management of the environment, the preservation and protection of biological diversity and the implementation of sustainable development"* [5] (Republic of Argentina, 2002) | No | *"Maintain the balance and dynamics of ecological systems"* [10] (Republic of Argentina, 2002)<br><br>*"Ensure the conservation of biological diversity"* [5] (Republic of Argentina, 2002) | ILF, PRM | (Republic of Argentina, 2002) |

[10] Our translation

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | Applies to biodiversity and ecological systems in a broad sense. | | |
| Belize | Emergent national offsetting policy | Voluntary marine and coastal offsets framework | To address growing threats to marine biodiversity in Belize. | Yes | Also includes coastal zone in recognition of influence on coastal waters. | | (Belize Coastal Zone Management Authority & Institute and Australia-Caribbean Coral Reef Collaboration, 2014) |
| Colombia | National offsetting policy | resolution 1517 of 2012 and associated offsetting manual | *"to ensure the effective conservation of an ecologically equivalent area where a permanent conservation strategy and / or ecological restoration can be generated, so that when comparing with the baseline, the net loss of biodiversity is guaranteed"* (Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012a)[5] | No | Covers all biodiversity but marine application of the policy is currently not considered in the manual for the implementation of offsets. | PRM | (Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012b, 2012a) |
| Chile | Biodiversity markets | Independent project - habitat bank | To provide innovative financing for marine protection using territorial | Yes | | | (Castilla et al., 1998; Gelcich et al., 2012; |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | user rights for fisheries (TURFs). | | | | Gelcich and Donlan, 2015) |
| US Virgin Islands | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| Peru | Emergent national offsetting policy | | *"to ensure NNL of biodiversity resulting from investment from large-scale infrastructure development projects in the country"* (Pilla, 2014) | No | Guidelines for marine habitats expected to be developed | | (Pilla, 2014) |
| Puerto Rico | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| American Samoa | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| Guam | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| New Zealand | National Policy | Resource Management Act 1991 (RMA) – not applicable to offshore marine areas unless outlined within a regional or district plan. (New Zealand Government, 2014) | | No | | | (New Zealand Government, 2014) |
| New Zealand | Sub-national policy | Bay of Plenty Regional Coastal Environment Plan | *"the sustainable management of the natural and physical resources of the Bay of Plenty coastal* | No | extends 12 nautical miles offshore. (Bay of Plenty Regional Council, 2015) | PRM, ILF | (Bay of Plenty Regional Council, 2015) |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | *environment"* (Bay of Plenty Regional Council, 2015) | | | | |
| New Zealand | Sub-national policy | Proposed Marlborough Environment Plan | *"(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment."* (Marlborough District Council, 2016) | No | *"The purpose of regional and district plans is to assist the Council in carrying out its functions in order to achieve the purpose of the RMA and specifically for a regional coastal plan, to achieve the purpose of the RMA in relation to the coastal marine area."* (Marlborough District Council, 2016) | | (Marlborough District Council, 2016) |
| New Zealand | Sub-national policy | Waikato Regional Policy Statement | *"to maintain the full range of ecosystem types and maintain or enhance their spatial extent as necessary to achieve healthy ecological functioning of ecosystems"* (Waikato Regional Council, 2016) | No | *"marine and estuarine ecosystems"* (Waikato Regional Council, 2016) | | (New Zealand Government, 2014; Waikato Regional Council, 2016) |
| Northern Mariana Islands | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| Papua New Guinea | Corporate standards | Project finance standards - Papua New Guinea | No net loss against IFC Performance standard 6. | No | An element of the biodiversity | | (D'Appolonia, 2015; IFC, |

| Country | Offset mechanism | | Aim | Marine specific | Marine relevance if not specific | Instrument used | References |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | Liquefied Natural Gas (PNG LNG) | | | offsetting proposal included a kikori dolphin project' to improve understanding and protection of the species. | | 2012; James Cook University, 2015) |

Table A continued.

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| US | National offsetting policy | Clean Water Act (CWA) | Yes | *"Compensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular DA permit."* (Environmental Protection Agency, 2008) | *"Credits for compensatory mitigation projects on public land must be based solely on aquatic resource functions provided by the compensatory mitigation project, over and above those provided by public programs already planned or in place."* (Environmental Protection Agency, 2008) | *"Temporal loss is the time lag between the loss of aquatic resource functions caused by the permitted impacts and the replacement of aquatic resource functions at the compensatory mitigation site. Higher compensation ratios may be required to compensate for temporal loss."* (Environmental Protection Agency, 2008)<br><br>*"The district engineer shall require sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with applicable performance standards."* (Environmental Protection Agency, 2008) | managed through planning conditions[11] |
| US | National offsetting policy | Endangered Species Act 1973 (ESA) | Yes | *"ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any listed species or result in the destruction or* | | | managed through planning conditions |

[11] Compliance success determined by the need for planning consent and the conditions appended to any permission granted and consequent implementation of associated compliance regime.

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | *adverse modification of habitat that has been designated as critical for the species"* (Kormos et al., 2015)<br><br>*"minimize and mitigate adverse effects"* [of incidental take of species] (Kormos et al., 2015) | | | |
| US | National offsetting policy | Magnuson-Stevens Fishery Conservation and Management Act | Yes | | | | managed through planning conditions |
| US | Sub-national policy | National Marine Fisheries Service's (NMFS) California Eelgrass Mitigation Policy | Yes | *"It is NMFS' policy to recommend no net loss of eelgrass habitat function in California."* (NOAA Fisheries - West coast region, 2014)<br><br>*"It is the intent of this policy to ensure that there is no loss associated with delays in establishing compensatory mitigation. This should be accomplished by creating a greater amount of eelgrass than is lost, if the mitigation is performed contemporaneously or after the impacts occur."* (NOAA Fisheries - West coast region, 2014) | *"only with the approval of NMFS and other appropriate resource agencies and subject to the caveats below, eelgrass habitat expansion resulting from project activities, and that otherwise would not have occurred, has the potential to be considered for future mitigation needs."* (NOAA Fisheries - West coast region, 2014) | *"Delays in eelgrass mitigation result in delays in ultimate reestablishment of eelgrass habitat functions, increasing the duration and magnitude of project impacts to eelgrass. To offset loss of eelgrass habitat function that accumulates through delay, an increase in successful eelgrass mitigation is needed to achieve the same compensatory habitat function. Because habitat function is accumulated over time once the mitigation habitat is in place, the longer the delay in initiation of mitigation, the greater the additional habitat area needed (i.e., mitigation ratio* | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | | | *increasingly greater than 1.2:1) to offset losses."* (NOAA Fisheries - West coast region, 2014) | |
| Canada | National offsetting policy | Fisheries Act - Policy for the Management of Fish Habitat 1986 | Yes | *"The no net loss principle is fundamental to the habitat conservation goal. Under this principle, the Department will strive to balance unavoidable habitat losses with habitat replacement on a project-by-project basis so that further reductions to Canada's fisheries resources due to habitat loss or damage may be prevented."* (Fisheries and Oceans Canada, 1986) | *"Only the difference in productive capacity between the before and after scenarios can be considered as compensatory gains"* (DFO, 2002) | *"Higher (weighted) ratios are justified on the basis of uncertainty of success, variance in the quality of the fish habitat being replace, and recognition of the lag time required for the new habitat to become functional. Lower ratios would be needed if the compensation works are completed and functional before the HADD occurs."* (DFO, 2002) | managed through planning conditions |
| Canada | National offsetting policy **–application restricted to federal property** | Federal Policy on Wetland Conservation (FPWC) | Yes | *"balance the unavoidable loss of wetland functions"* (Lynch-Stewart et al., 1996) | | | managed through planning conditions |
| Australia | National offsetting policy | Environment Protection and Biodiversity Conservation Act 1999 (The EPBC Act) - EPBC Act Environmental Offsets Policy 2012 | Yes | "*deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action"* (Australian Government, 2012) | *"be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs"* (Australian Government, 2012) | *"Offsets should compensate for an impact for the full duration of the impact. Offsets that deliver an outcome prior to the impact commencing are encouraged, as they minimise effects on the protected matter resulting from offset time delays"* (Australian Government, 2012) | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| Australia | Sub-national offsetting policy | Queensland: Environmental Offsets Act 2014 - Queensland Environmental Offsets Policy | Yes | “*Offsets must achieve a conservation outcome that achieves an equivalent environmental outcome.”* (Queensland Government, 2016) | *“Offsets will not replace or undermine existing environmental standards or regulatory requirements…”* (Queensland Government, 2016) | *“Offset provision must minimise the time-lag between the impact and delivery of the offset.”* (Queensland Government, 2016)<br><br>*“Where legal security is required, offsets must be legally secured for the duration of the impact on the prescribed environmental matter.”* (Queensland Government, 2016) | managed through planning conditions |
| Australia | Investment strategy **(relating to national and sub-national policy)** | Reef Trust | | (Yes)[12] | | | Yes |
| Australia | Sub-national offsetting policy | New South Wales: Fisheries NSW policy and guidelines for fish habitat conservation and management | Yes | *“Habitat replacement (as a compensation measure) will need to account for indirect as well as direct impacts of development to ensure that there is “no net loss” of key fish habitats”* (Fairfull, 2013) | | *“Pre-development habitat compensation (i.e. prior to disturbance) is recommended over post-development compensation (i.e. after the habitat is lost).”* (Fairfull, 2013)<br><br>*“Scientific research and monitoring programs should be established to quantify the impacts of development and the effectiveness of* | managed through planning conditions |

[12] Work is currently being undertaken addressing the issue of equivalence in the Great Barrier Reef in support of the development of the Reef Trust mechanism (Maron et al., 2016b).

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | | | | | *environmental mitigation and compensation measures. Management should be adaptive to incorporate the findings of these programs."* (Fairfull, 2013) | |
| Australia | Sub-national offsetting policy | Victoria | Yes | *"Where native vegetation is permitted to be removed, ensure that an offset is provided in a manner that makes a contribution to Victoria's biodiversity that is equivalent to the contribution made by the native vegetation to be removed."* (Victoria State Government, 2016) | *"For the native vegetation on an offset site to deliver gains in the contribution to biodiversity which can be used to offset removing native vegetation, management commitments must be undertaken that maintain and improve the condition of native vegetation. Gain can only be generated by management commitments that are in addition to existing obligations under legislation, existing agreements or contracts."* (Department of Environment and Primary Industries and State Government Victoria, 2013) | *"A compliant offset must be secured, to the satisfaction of the responsible or referral authority, before the native vegetation is removed."* (Department of Environment and Primary Industries and State Government Victoria, 2013) | managed through planning conditions |
| Australia | Sub-national offsetting policy | Western Australia: Environment Protection Act 1986<br>- Western Australia's Environmental Offsets Policy<br>- Western Australia's Environmental Offsets Guidelines | Yes | *"relevant and proportionate" and designed to counterbalance the impact"* (Government of Western Australia, 2014) | *"Actions undertaken offsite which are required by other legislation generally cannot be considered an offset."* (Government of Western Australia, 2014) | *"However, while rehabilitation is an important component of the mitigation hierarchy, not all environmental values can be effectively rehabilitated. Some values or ecosystem functions may be permanently lost, and it may be necessary to consider the time* | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | - Environmental Assessment Guidelines, No.5 Environmental Assessment Guideline for protecting marine turtles from light impacts - Environmental Assessment Guidelines, No.3 Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment - Environmental Assessment Guidelines, No.7 Environmental Assessment Guideline for Marine Dredging Proposals - Environmental Assessment Guidelines, No.15 Environmental Assessment Guideline for Protecting the Quality of Western Australia's Marine Environment | | | | *lag before values are re-established to the maximum extent possible."* (Government of Western Australia, 2014)<br><br>*"Where an impact creates a temporary loss of value, the length of the offset should be matched to counterbalance this temporary impact. If an impact is permanent, offsets must ensure a long lasting environmental benefit and be capable of being maintained into the future (including after the project has been completed)."* (Government of Western Australia, 2014) | |
| Australia | Sub-national offsetting policy | South Australia: Native Vegetation Act 1991; Native Vegetation Regulation 2003 - Policy for | Yes | *"In order to achieve a net gain, a method for calculating the loss at the development site and the potential gain at the proposed SEB area will be used. The offset design and* | *"…biodiversity offsets need to be new, or additional, to what is required by duty of care or any other environmental and planning legislation at any level of government… Offsets must* | "*Offsets need to secure outcomes for at least as long as the project's impact. The impacts of most projects are permanent and therefore offsets generally need to be* | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | Significant Environmental Benefit | | *implementation includes provisions for addressing sources of uncertainty and risk of failure in delivering the SEB."* (Department of Environment Water and Natural Resources, 2015) | *be additional to what has been paid for by other programs or schemes, such as stewardship programs, carbon sequestration projects or other environmental programs where funds are allocated to land owners to manage biodiversity on their properties…. Offsets must provide a gain that is additional to what would likely have occurred in the absence of the offset area being established (considering the likely trajectory of any change in vegetation condition)."* (Department of Environment Water and Natural Resources, 2015) | *secured in perpetuity."* (Department of Environment Water and Natural Resources, 2015)<br><br>*"The SEB area should be established and management initiated at the time of, or prior to, the approved clearance being undertaken."* (Department of Environment Water and Natural Resources, 2015) | |
| European Union | Emergent (supra-) national offsetting policy **[on hold]**[13] | Biodiversity strategy to "halt biodiversity and ecosystem service loss by 2020" | n/a | n/a | n/a | n/a | n/a |
| European Union | Supra-national offsetting policy - **application restricted to designated sites** | European Union (EU) Habitats and Birds Directives | Yes | *"aim to offset the negative impact of a project and to provide compensation corresponding precisely to the negative effects on the species or habitat concerned"* | *"Compensatory measures should be additional to the actions that are normal practice under the Habitats and Birds Directives or obligations laid down in EC law."* (European Commission, 2012b) | | managed through planning conditions |

[13]Development of the strategy has been put on an indefinite hold.

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | | | (European Commission, 2012b)<br><br>*"ecological coherence [of network]"* (European Commission, 2012b) | | | |
| France | National offsetting policy | Doctrine (2012) and guidelines (2013) outlining implementation of mitigation hierarchy | Yes | *"Offset measures must restore environmental quality of the impacted biodiversity to a level at least equivalent to its initial level and if possible a better state…"* (MEDDE, 2013; Quétier et al., 2014) | *"Offset measures must be additional to existing or planned public policy targets for biodiversity and ecosystems. They can complement these policies but not substitute them."* (MEDDE, 2013; Quétier et al., 2014) | *"Offset measures must be timely and no irreversible damage must be done before offset measures are in place. Exceptions can be made when it is demonstrated that they do not compromise the efficacy of the offset measures."* (MEDDE, 2013; Quétier et al., 2014)<br><br>*"The outcome of offsets measures must be of sufficient duration, and proportional to the duration of impacts."* (MEDDE, 2013; Quétier et al., 2014) | managed through planning conditions |
| Germany | National offsetting policy | Federal Nature Conservation Act (FNCA) and Federal Building Code | Yes | *"The intervening party is obligated to compensate for any unavoidable adverse effects by means of nature conservation and landscape management measures (compensation measures) or to substitute them in some other way (substitution measures). An adverse effect shall be considered to have* | *"Measures that already result from other legal requirements or which are public funded cannot be considered as compensation measures."* (Tucker et al., 2014) | *"Compensation and substitution measures shall be maintained throughout the relevant required period and shall be legally protected. The relevant maintenance period shall be set forth by the competent authority in the relevant official approval notice. The intervening party, or his legal successor, shall be* | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | *been compensated as soon as the impaired functions of the natural balance have been restored in an equivalent way and landscape appearance has been restored or re-designed in a manner consistent with the landscape. An adverse effect shall be considered to have been substituted as soon as the impaired functions of the natural balance, in the relevant natural area, have been restored to an equivalent value and landscape appearance has been re-designed in a manner consistent with the landscape.”* (Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2010) | | *responsible for carrying out, maintaining and securing compensation and substitution measures”* (Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2010) | |
| The Netherlands | National policy requiring partial application of offsetting principles | Dutch National Nature Network established under the Infrastructure and spatial planning policy. | Yes | *“Compensation for the loss of protected areas must be compensated for by establishing a new area of land to perform that function (like-for-like compensation).”* (Tucker et al., 2014) | | *“The National Nature Network requires that a correction factor be applied to the areas that are developed within the Network in order to compensate for the qualitative loss of nature values during the time that the new area needs for development to a mature stage”* (Conway et al., 2013; de | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | | | | | Bie and van Dessel, 2011; Tucker et al., 2014) | |
| United Kingdom | Emergent national offsetting policy (on hold) | Offsetting pilot studies - not progressed | | | | | |
| United Kingdom | Biodiversity markets | Private investment in marine offset feasibility (The Crown Estate) | | | | | |
| United Kingdom | Biodiversity offset research and development (R&D) | Regulator led research and development project into "The location, condition and features of significant sites" | | | | | |
| South Africa | Emergent national offsetting policy | South African centralised biodiversity offsetting policy | | | | | |
| South Africa | National policy supporting development of offsetting-specific policy | National Environment Management Act (NEMA) (Act 107 or 1998) | Yes | | | | managed through planning conditions |
| South Africa | Sub-national offsetting policy | Western Cape - provincial guideline on biodiversity offsets | Yes | *"Offsets must ensure sustainable development through compensating for biodiversity impact by contributing to biodiversity conservation, and should conserve biodiversity of at least as high significance as that impacted by the proposed development."* (Department of | *"Offsets should not comprise actions or activities already required by law."* (Department of Environmental Affairs and Development Planning, 2007) | *"Offsets in the most appropriate form must be secured before development commences, to give assurance of effectiveness."* (Department of Environmental Affairs and Development Planning, 2007)<br><br>*"Offsets must provide long term security for tenure."* (Department of Environmental | managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | | | Environmental Affairs and Development Planning, 2007) | | Affairs and Development Planning, 2007)<br><br>*"Offset must provide long term security for management"* (Department of Environmental Affairs and Development Planning, 2007) | |
| South Africa | Sub-national offsetting policy | KwaZulu-Natal - offsetting scheme and guideline | Yes | "*offsets must address all significant residual impacts on biodiversity; direct, indirect and cumulative"* (Ezemvelo KZN Wildlife, 2013)<br><br>*"offsets must explicitly target the pattern, process and/or ecosystem services residually impacted by the proposed development…"* (Ezemvelo KZN Wildlife, 2013)<br><br>*"offsets must consider and compensate for adverse impacts on biodiversity and ecosystem services with intrinsic, use and non-use values to affected communities in particular, and society as a whole, giving special attention to vulnerable or disadvantaged parties."* (Ezemvelo KZN Wildlife, 2013) | *"offsets must be 'new' conservation activities, over and above outcomes that would have occurred without the offset; e.g. existing or planned conservation areas cannot be used to offset a new activity. Also, offsets should not comprise actions or activities already required by law."* (Ezemvelo KZN Wildlife, 2013) | *"offsets must last for the duration of project impacts5 or in perpetuity.<br>They should be monitored and managed adaptively to sustain desired conservation outcomes."* (Ezemvelo KZN Wildlife, 2013)<br><br>*"offsets in the most appropriate form must preferably be secured before development commences."* (Ezemvelo KZN Wildlife, 2013) | Managed through planning conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| Liberia | Sectoral offsetting policy | Draft mining act | Yes | *"In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible"* (IFC, 2012; Johnson, 2015) | | | managed through planning conditions |
| Liberia | Sectoral offsetting policy | Mineral Development Agreements | Yes | *"In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible"* (IFC, 2012; Johnson, 2015) | | | managed through planning conditions |
| Liberia | Private standards* (requirements of the IFC and other development banks only) | Offsets framework for mining sector | Yes | *"In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible"* (IFC, 2012; Johnson, 2015) | | | managed through planning conditions |
| Mozambique | Sectoral policy | Article 23 of the Petroleum Laws | Yes | *Implies application of IFC Performance Standard 6 ""In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible"* (IFC, 2012) | | | |
| Mozambique | Conservation fund | BIOFUND | | | | Third party action to ensure delivery by proponent. | Third party action to ensure delivery by proponent. |
| Gabon | Corporate standards | Private standards - Tullow | Yes | | | | |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| China | Resource access fee | Marine Ecological Damage Compensation (MEDC) requirements. | | *"to make developers of ocean space pay the full costs associated with their activities, including damages to the marine ecosystems"* (Rao et al., 2014) | | | Managed through access fee |
| Korea | National policy requiring partial application of offsetting principles | Act on the Conservation and the Use of Biodiversity | | | | | Return of bond dependent on success. |
| Yemen | Corporate standards | Yemen LNG Company Biodiversity Action Plan | Yes | *"Providing compensation commensurate with loss, where negative impact cannot be fully redressed, and to do so in a legal, transparent and ethical manner."* (Yemen LNG, 2008)<br><br>In alignment with IFC performance standard 6 | | | |
| Argentina | National policy requiring partial application of offsetting principles | National Environmental Law (Ley General del Ambiente) | Yes | *"…those that cause the environmental damage will be objectively responsible for its restoration to the state prior to its production"*[5] (Republic of Argentina, 2002) | | | Managed through conditions |
| Belize | Emergent national offsetting policy | Voluntary marine and coastal offsets framework | Yes | *"Impacts on a particular biotope or habitat should generally be offset through 'like-for-like' or 'ecological equivalent''* (Belize Coastal Zone Management Authority | *"Ensure that gains are additional and can be linked directly to offset activity"* (Belize Coastal Zone Management Authority & Institute and Australia- | *"It is preferable that proponents deliver the required biodiversity offsets before the development or project commences to ensure that there is no time lag between* | Managed through conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | | | & Institute and Australia-Caribbean Coral Reef Collaboration, 2014) | Caribbean Coral Reef Collaboration, 2014) | *the loss of biodiversity due to the project and the gain in biodiversity delivered through offsets"* (Belize Coastal Zone Management Authority & Institute and Australia-Caribbean Coral Reef Collaboration, 2014)<br><br>*"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."* (Belize Coastal Zone Management Authority & Institute and Australia-Caribbean Coral Reef Collaboration, 2014) | |
| Colombia | National offsetting policy | resolution 1517 of 2012 and associated offsetting manual | Yes | *"Ecologically equivalent area selected for compensation must meet the following criteria:*<br>*a) be the same type of affected natural ecosystem.*<br>*b) be equivalent to the size or area to compensate the fragment ecosystem* | | *"They should be performed at least equivalent to the lifetime of the project period."* (Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012b) [5] | Managed through conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
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| | Type | Detail | | | | | |
| | | | | *shocked.* *c) Equal or greater and landscape context fragment ecosystem shocked.* *d) Equal to or greater species richness fragment impacted the ecosystem.* *e) that is located in the area of influence of the project."* [5] (Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012b) | | *"…operating and investment plan to develop the process of signing agreements conservation opportunity costs of land development for a period not less than the duration or life of the project, work or activity."* (Ministerio de Ambiente y Desarrollo Sostenible (MADS), 2012b) [5] | |
| Chile | Biodiversity markets | Independent project - habitat bank | | | | creation of biodiversity credits.[14] | Market managed through non-profit 'broker'.[15] |
| US Virgin Islands | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| Peru | Emergent national offsetting policy | | | | | | |
| Puerto Rico | | US Territory – subject to US compensatory mitigation requirements. | | | | | |

[14] Credits in theory could be 'earnt' through the delivery of biodiversity gain prior to exchange against offsetting requirements there minimising or removing any time lag between biodiversity loss through impact and gains.

[15] Effective third-party brokerage ensures delivery of biodiversity and receipt of finance in exchange.

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| American Samoa | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| Guam | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| New Zealand | National Policy | Resource Management Act 1991 (RMA) – not applicable to offshore marine areas unless outlined within a regional or district plan. (New Zealand Government, 2014) | | | | | |
| New Zealand | Sub-national policy | Bay of Plenty Regional Coastal Environment Plan | Yes (through RMA 1991) | *"Significance residual adverse effects…are offset to result in no net loss and preferably a net indigenous biological diversity gain"* (Bay of Plenty Regional Council, 2015) | A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place." (Bay of Plenty Regional Council, 2015) | *"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"* (Bay of Plenty Regional Council, 2015) | Managed through conditions |
| New Zealand | Sub-national policy | Proposed Marlborough Environment Plan | Yes | *"The goal of a biodiversity offset is to achieve no net loss and preferably a net gain of biodiversity with respect to species composition, habitat structure and ecosystem* | | *"There also needs to be certainty that the proposed offsets will occur."* (Marlborough District Council, 2016) | Managed through conditions |

| Country | Offset mechanism | | Mitigation hierarchy | Equivalence | Additionality | Continuity | Compliance success |
|---|---|---|---|---|---|---|---|
| | Type | Detail | | | | | |
| | | | | *functions. It is therefore important that offsets are appropriate compensation. There is a preference for the reestablishment or protection of the same type of ecosystem or habitat to avoid the difficulty of assessing relative values of different ecosystems or habitats of different species"* (Marlborough District Council, 2016) | | | |
| New Zealand | Sub-national policy | Waikato Regional Policy Statement | Yes (through RMA 1991) | *"…proposals should reasonably demonstrate that no net loss has been achieved using methodology that is appropriate and commensurate to the scale and intensity of the adverse effects."* (Waikato Regional Council, 2016) | " | | Managed through conditions |
| Northern Mariana Islands | | US Territory – subject to US compensatory mitigation requirements. | | | | | |
| Papua New Guinea | Corporate standards | Project finance standards - Papua New Guinea Liquefied Natural Gas (PNG LNG) | | Implies application of IFC Performance Standard 6 *"In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible"* (IFC, 2012) | | | |

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## Appendix B: Development projects in Australia associated with marine biodiversity offsets.

Table B. Development projects in Australia associated with marine biodiversity offsets. *This strategic assessment has not been taken forward for assessment. **Information relating to biodiversity offsetting requirements unavailable at the point of analysis for these projects and so have not been included in the detailed analysis relating to offsetting mechanism type (see Chapter 5).

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Short Term Continuation of Shell Sand Dredging, Success Bank, Owen Anchorage Strategy to Address Long-Term Environmental Issues of Shell Sand Dredging | WA | 1994 | Report and recommendations of the EPA | Aggregates | 67 ha dredge area. 50ha of which deemed acceptable owing to less than 25% coverage of seagrass. 17ha deemed unacceptable but could be impacted. | Yes | Dredging | Direct loss | Seagrass rehabilitation, study on ecological significance of seagrass.<br><br>- investigation by Murdoch University into means of restoring seagrass to dredged areas; - investigations into improved dredging techniques to minimise seagrass loss; - investigations into techniques for bulk transport of seagrasses; - investigations of beneficiation of lower grade sands to enable dredging in alternative areas; - investigations into enhancement of dredged areas for recreational use by establishing artificial reefs. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Geraldton Port Enhancement and Preparatory Works for Town Beach Foreshore Redevelopment | WA | 2002 | Report and recommendations of the EPA | Commercial port | Disposal of dredge material will effect 180ha bare sand and offshore limestone pavement habitat supporting a low density of red and brown algae and occasional shoots of seagrass. Approximately 6ha of reef habitat will be lost. | Yes | Dredge spoil disposal | Indirect loss | GPA proposed to create three stable ridges of spoil material with a view to achieving an artificial reef. It is likely that the proposed artificial reef habitat will increase lobster catch rates, as existing dredge disposal areas have proven to be productive lobster catching grounds.<br><br>Artificial Reef Management Plan (ARMP) - Prepare an ARMP which addresses the following key elements: 1. detailed design and location of reefs; 2. pre-construction baseline survey of habitat character and lobster catch productivity; 3. confirmation of impact predictions during construction stage; 4. post-construction monitoring of reef habitat development and lobster catch productivity, and; 6. reporting of survey results. |
| Pacific Highway Upgrade - Brunswick Heads to Yelgun | NSW | 2003 | Director-General's Environmental assessment | Terrestrial infrastructure | The location of the southern piers of the balanced cantilever bridge would directly impact small patch of seagrass that offers moderate quality habitat. | No | Dredging | Direct loss | The REF recommends translocation in consultation with NSW Fisheries. - commitment of offsets for residual impact |
| James Point Stage One Port, Kwinana | WA | 2004 | Report and recommendations of the EPA<br>Public Environmental Review<br>Proponent response to submissions | Commercial port | 17.2ha removal of potential seagrass habitat through reclamation and dredging. | No | Reclamation<br>Dredging | Direct loss | Contributions to Cockburn sound restoration initiative and offsets for impacts to near shore marine environment. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Port Botany Expansion | NSW | 2005 | Revised Primary Submission to the Commission of Inquiry<br>Department recommendation<br>Penrhyn Estuary Habitat Enhancement Plan<br>Development consent | Commercial port | 4ha seagrass<br>Unquantified impacts through disturbance to shore and seabirds. | Yes | Reclamation<br>Dredging | Direct loss<br>Disturbance | Transplantation and rehabilitation of seagrass habitat<br>Habitat enhancement at Penrhyn Estuary – creation of additional 11ha intertidal sand/mud flats, 5ha saltmarsh and 8ha seagrass habitat. |
| Port of Hay Point Capital Dredging Project | QLD | 2005 | Initial Advice Statement<br>Coordinator-general's report on the Environmental Impact Statement<br>Supplementary to the Draft Environmental Impact Statement<br>Draft Environmental Impact Statement | Commercial port | Unquantified impacts to marine plants - seagrass | Yes | Dredge spoil disposal | Indirect loss | A research and monitoring program to determine the impact and mitigation of impacts shall be undertaken in accordance with the program design – "Deepwater seagrass and algae dynamics in Hay Point: measuring variability and monitoring impacts of capital dredging". This research and monitoring program shall commence prior to the disturbance of any marine plants associated with the capital dredging of the apron areas and departure path for the Port of Hay Point. |
| Kurnell Desalination Plant | NSW | 2006 | Director-General's Environmental assessment<br>Independent panel report<br>Concept approval<br>Project approval | Desalination plant | Unavoidable loss of seagrass through pipeline development worst case 9000m2 | Yes | Installation of structure/removal | Direct loss | Seagrass management plan to rehabilitate/translocate seagrass habitat |
| Botany Bay Cable Crossing | NSW | 2007 | Director-General's Environmental assessment<br>Environmental Assessment<br>Submissions report<br>Project approval | Cable laying | Unavoidable seagrass loss | No | Trenching | Direct loss | To research into improving current methodologies on seagrass rehabilitation.<br>Rehabilitation/translocation of seagrass. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Pluto Liquefied Natural Gas Development Site B Option Burrup Peninsula, Shire of Roebourne | WA | 2007 | Report and recommendations of the EPA<br>Draft Public Environmental Review<br>Statement of Implementation | Commercial port | Direct loss of coral 12,100 m2 | Yes | Dredging | Direct loss | Research and monitoring consistent with the Indicative Management Plan for the Dampier Marine Park. |
| Wiggins Island Coal Terminal | QLD | 2008 | Environmental Impact Statement - executive summary<br>Supplementary Environmental Impact Statement<br>Coordinator-general's report on the Environmental Impact Statement<br>GPC Biodiversity Offset Strategy | Commercial port | loss of 300ha intertidal habitat of which 100ha incudes marine plants and loss of 140ha from within the boundaries of the GBRWHA. Loss of 7ha seagrass Unquantified indirect impacts to turtles, marine mammals, birds etc. | Yes | Dredging<br>Dredge spoil disposal | Direct physical loss<br>Indirect loss - turbidity | Protection of 5000 ha coastal land currently within the GPC's strategic port land at Port Alma AUD$5 million to support Fisheries Queensland initiatives – creation of additional fish habitats AUD$0.2m, rehabilitation works AUD$0.7m, marine plant management plans AUD$0.3m, declared fish habitat area investigations AUD$1.1m, applied fish habitat research AUD$0.5, fish habitat mapping $0.8m.Further contributions to research, management, enhancement or restoration programs. |
| Albany protected harbour development - Princess Royal Harbour | WA | 2008 | Report and recommendations of the EPA<br>Statement of Implementation<br>Environmental Protection Statement<br>Environmental Management Plan | Marina development | Not more than 1.6 hectares (approximately 0.111 hectares at 90% cover and 1.436 hectares at <20% cover). Total area of seagrass meadow loss, is equivalent to 0.3 hectares of 75% cover seagrass | Yes | Reclamation<br>Dredging | Direct physical loss | Shall replant 0.4 ha of seagrass in selected areas of Princess Royal harbour, at a planting density to achieve 75% average cover in those areas after a 10-year period. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Wallis Lakes Oyster Lease Dredging | NSW | 2009 | Director-General's Environmental assessment Environmental Assessment Project approval | Aquaculture | Loss of 1.14ha seagrasses (zostera and halophila) | Yes | Installation of structure/removal Dredging | Direct physical loss | rehabilitation bond of $34200 to be held by DPI until successful regrowth of seagrass is achieved within the project area. |
| Ceduna Keys Marina and Community Centre proposal | SA | 2009 | Assessment report prepared for the Minister for Urban Development and Planning Amended assessment report prepared for the Minister for Urban Development and Planning Associated gazettals | Marina development | Loss of seagrass and marine habitats/species as a result of development of the channel and increased recreational disturbance | Yes | Installation of stabilisation material Dredging | Direct physical loss Indirect loss - erosion Indirect loss - recreational pressure | Compensation for Vegetation Clearance including seagrass and terrestrial vegetation – prepare a management plan that results in a significant environmental benefit or make a financial payment to the NVF. Ratio of 10:1 for seagrass loss. Offshore signage for protection area within Murat Bay for protection area within marina. |
| Medium-term shell sand dredging, Success Bank, Owen Anchorage | WA | 2009 | Report and recommendations of the EPA Statement of implementation | Aggregates | Original impact from 1998 permission to which offset pertains and is reiterated in following permissions:<br><br>dredging of 99ha of Success Bank. Dredging of this area will result in the removal of 18ha of shallow unvegetated sediment with seagrass cover less than 25%, 39ha of low density seagrass (25-50% cover), and 42ha with high density seagrass (50-100% cover). | Yes | Dredging | Direct loss | Research trials seagrass transplantation |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Industrial Infrastructure and Harbour Development, Jervoise Bay | WA | 2009 | Report and recommendations of the EPA<br>Statement of Implementation<br>Seagrass research and rehabilitation plan | Commercial port | Direct loss 2.1ha seagrass | Yes | Reclamation<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | Revegetation of seagrass within an area of Cockburn Sound that has a reasonable chance of survival and is equivalent to the area of seagrass that will be lost as a direct consequence of the proposal |
| Long Term Shell sand Dredging Owen Anchorage | WA | 2009 | Report and recommendations of the EPA<br>Statement of implementation | Aggregates | 168.5ha seagrass<br>264.5+350ha shallow bare sand habitat with potential for seagrass colonisation. | Yes | Dredging | Direct loss | Seagrass research and rehabilitation plan<br>Commit a total of $3.5million over the next 10 years to support the collaborative Seagrass Rehabilitation and Management Programme<br>As part of the Seagrass Research and Rehabilitation Plan - rehabilitating areas in the vicinity that are shallow and unvegetated to mitigate the impacts of dredging. |
| Townsville Marine Precinct Project | QLD | 2010 | Initial Advice Statement<br>Environmental Impact Statement<br>Offset commitments<br>Supplementary information to the Environmental Impact Statement<br>Coordinator-general's report on the Environmental Impact Statement<br>North Queensland Conservation Council submission | Marina development | 110ha permanent loss of soft benthic habitat<br>220ha temporary loss of benthic habitat<br>Undefined indirect impacts | Yes | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | 10.55ha rock wall habitat creation<br>1.45ha creation of sub-tidal rock wall habitat<br>AUD$50k contribution to administrative cost of establishing expanded FHA<br>AUD$10k p.a. for 10 years contribution to management and enforcement of expanded FHA.<br>AUD$6.15m contribution for various research commitments to offset indirect impacts. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Fisherman's Landing Port Expansion | QLD | 2010 | Initial Advice Statement<br>Environmental Impact Statement - executive summary<br>Coordinator-general's report on the Environmental Impact Statement<br>GPC Biodiversity Offset Strategy | Commercial port | 174ha removal fish habitat<br>Indirect impacts to 461.52ha benthic habitat | Yes | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | Protection of 5000 ha coastal land currently within the GPC's strategic port land at Port Alma AUD$5 million to support Fisheries Queensland initiatives – creation of additional fish habitats AUD$0.2m, rehabilitation works AUD$0.7m, marine plant management plans AUD$0.3m, declared fish habitat area investigations AUD$1.1m, applied fish habitat research AUD$0.5, fish habitat mapping $0.8m.Further contributions to research, management, enhancement or restoration programs. |
| Gas Pipeline and Alternative Pipeline to Supply Natural Gas Liquefaction Plant (EPBC 2008/4096)** | QLD | 2010 | Environmental Impact Statement<br>Offsets strategy<br>EPBC approval | Pipeline installation | tbc | tbc | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | The Environmental Management Plan for the pipeline crossing of the Narrows (Gladstone Harbour to Curtis Island) must include proposed offset measures to compensate for unavoidable impacts on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef. |
| Queensland Curtis LNG Project** | QLD | 2010 | Initial Advice Statement<br>Environmental Impact Statement<br>Coordinator-general's report on the Environmental Impact Statement | Commercial port | Unquantified direct impacts to seagrass/benthic habitat through construction of pipeline/jetty.<br>Unquantified indirect impacts to marine mammals, turtles, fish etc | tbc | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | Offsets to be agreed - remain outstanding. The Environmental Management Plan for the pipeline crossing of the Narrows (Gladstone Harbour to Curtis Island) must include proposed offset measures to compensate for unavoidable impacts on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| Shipping Activity Associated with the Queensland Curtis LNG Project (EPBC 2008/4405)** | QLD | 2010 | Queensland Curtis LNG Project Environmental Impact Assessment<br>Queensland Curtis LNG Project - Coordinator-general's report on the Environmental Impact Statement<br>EPBC Approval | Shipping | Unquantified | Yes | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil<br>Increased shipping | Direct physical loss<br>Indirect loss - turbidity, disturbance | The Shipping Activity Management Plan must include provisions for the protection of the seagrass species Halodule uninervis, Halophila ovalis, Halophila decipens, Halophila minor, Halophila spinulosa, and Zostera capricorni and propose remedial action in the event of any impacts directly attributable to the proponent's shipping activities, including a feasible and beneficial offsets strategy. |

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| Port of Gladstone Western Basin Strategic Dredging and Disposal Project (EPBC 2009/4904) | QLD | 2010 | Initial Advice Statement<br>Environmental Impact Statement<br>Environmental Impact Statement Addendum<br>Coordinator-general's report on the Environmental Impact Statement<br>GPC Biodiversity Offset Strategy | Commercial port | Direct loss of 902ha benthic habitat including 258.8ha seagrass.<br><br>Indirect loss of 5416ha benthic habitat including 1406ha seagrass<br><br>Operating in sensitive area | No | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | a. measures funded to not less than $5 million including but not limited to:<br>i. funding for listed threatened and migratory species protection, habitat enhancement ad restoration actions in the region or the wider bioregion such as 'seagrass friendly' mooring systems, wetland rehabilitation projects and water quality improvement programs;<br>ii. actions to reduce fisheries netting pressure in Port Curtis and in adjacent waters; actions to reduce potential for coastal impacts such as commercial development in adjacent areas,.<br>b. Details of the management arrangement and a map of the 3000 ha of land at Port Alma proposed for protection in perpetuity as an EPA.<br>c. A Strategic Vessel Management Plan for Port Curtis that must include, but not be limited to...<br>d. Development of a seagrass conservation plan:<br>i. a map clearly illustrating the areas to be protected including the Wiggins/Mud island seagrass beds, seagrass beds east of Quion Island and seagrass beds in Pelican Banks;<br>ii. measures to ensure that the seagrass beds within the Port are protected from ongoing and future Port activity; and,<br>iii. commitments to ensure no further direct seagrass removal of the areas referred to above accounting for any increases in size of the mapped seagrass areas.<br>Protection of 5000 ha coastal land currently within the GPC's strategic port land at Port Alma<br>AUD$5 million to support Fisheries Queensland initiatives – creation of additional fish habitats AUD$0.2m, rehabilitation works AUD$0.7m, marine plant management plans AUD$0.3m, declared fish habitat area investigations AUD$1.1m, applied fish habitat research AUD$0.5, fish habitat mapping $0.8m.Further contributions to research, management, enhancement or restoration programs. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| Albany Port Expansion Project | WA | 2010 | Report and recommendations of the EPA<br>Statement of Implementation<br>Public Environmental Review<br>Response to Paul Lavery's Review of the Sampling and Analysis Plan and BPPH Report<br>Response to Public Submissions | Commercial port | Seagrass<br>King George Sound - (not to exceed 16.6 hectares); and 0.8ha in PRH | No | Reclamation<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | Prior to commencement of dredging and reclamation the proponent shall commence the rehabilitation of a minimum of 1 hectare of seagrass in Princess Royal Harbour using seagrass donor material from the zone of loss (identified). At a planting density that achieves 75% average cover in those areas within 10 years following planting. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| ICHTHYS Gas Field Development Project Blaydin Point | NT | 2011 | Joint Conservation Organisation Submission in response to the draft EIS for the Ichthys gas field development project<br>Offsets strategy<br>Environmental Impact Statement<br>NRETAS Environmental Assessment Report and Recommendations | Commercial port | An unquantified sustained increase in underwater noise could result in impacts to iconic species, particularly dolphins, in the Harbour. If blasting is required then greater the consequences will be significantly greater. Potential cumulative impacts on Darwin Harbour and regional marine ecosystems, as a result of development and habitat loss and ongoing disturbance/damage during operation. | No | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil<br>Marine noise<br>Increased shipping | Direct loss<br>Indirect loss | Darwin Harbour integrated marine monitoring and research program<br>Research on the conservation status, distribution and habitat use of coastal dolphins<br>Habitat mapping for Darwin Harbour regions.<br>Conservation management of marine megafauna in the wester Top End.<br>Publication of data collected for the Browse Basin and Kimberley coastline<br>Research on the conservation status, distribution and habitat use of coastal dolphins<br>Funding of Australian research council linkage project. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| East Arm Wharf Expansion | NT | 2011 | Biodiversity impact mitigation and offsets strategy<br>Coastal Offset Plan<br>NRETAS Environmental Assessment Report and Recommendations<br>Environmental Impact Assessment<br>Supplementary information to the Environmental Impact Assessment | Commercial port | • direct impacts on sensitive benthic habitat (44ha) due to dredging channels;<br>• direct impacts on loss of habitat (24 hectares) for migratory and shorebirds currently utilising Pond K;<br>• unknown direct impacts on marine megafauna due to noise and vessel collisions;<br>• unknown indirect impacts – moderate zone of impact, zone of influence and degradation of these sites over time as a result of Project operations. | Yes | Dredging<br>Disposal of dredge spoil<br>Marine noise<br>Increased shipping | Direct loss<br>Indirect loss | Protection of 50ha dolphin habitat<br>Protection of Pond habitat for migratory birds<br>Ranger program |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| APLNG Pipeline Project (EPBC 2009/4976)** | QLD | 2011 | Environmental Impact Assessment<br>Supplementary Environmental Impact Assessment<br>EIA Offsets strategy<br>Coordinator-general's report on the Environmental Impact Statement<br>EPBC Approval | Pipeline installation | Unquantified | tbc | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct loss<br>Indirect loss | The Environmental Management Plan for the pipeline crossing of the Narrows (Gladstone Harbour to Curtis Island) must include proposed offset measures to compensate for unavoidable impacts on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef.<br><br>If a bundled pipeline crossing of the Narrows is not pursued then to offset the unavoidable impacts on listed migratory birds within the ROW at the Kangaroo Island wetlands west of the Narrows, the proponent must contribute at least $250,000 to the GPC's migratory bird research study required by conditions for the Gladstone Western Basin Dredging and Disposal Project (EPBC 2009/4904) |
| Australia Pacific LNG Project – Development of a LNG Plant and Ancillary Onshore and Marine Facilities on Curtis Island (EPBC 2009/4977)** | QLD | 2011 | Environmental Impact Assessment<br>Supplementary Environmental Impact Assessment<br>EIA Offsets strategy<br>Coordinator-general's report on the Environmental Impact Statement<br>EPBC Approval | Commercial port | Terrestrial marine environments - 34ha; Intertidal and sub-tidal areas - 8ha; sea grasses - 21ha | Yes | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct loss<br>Indirect loss | Detail pertaining to Offsets strategy not available<br><br>The Shipping Activity Management Plan must include provisions for the protection of the seagrass species Halodule uninervis, Halophila ovalis, Halophila decipens, Halophila minor, Halophila spinulosa, and Zostera capricorni and propose remedial action in the event of any impacts directly attributable to the proponent's shipping activities, including a feasible and beneficial offsets strategy. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| Olympic Dam Expansion | SA | 2011 | Assessment report prepared for the Minister for Urban Development, Planning and the City of Adelaide and the Minister for Mineral Resources Development<br>Associated gazettals | Other | 1.5ha seagrass loss | No | Installation of structure/removal | Direct loss | Contribution to NVC fund |
| Wheatstone Development - Gas Processing, Export Facilities and Infrastructure | WA | 2011 | Report and recommendations of the EPA Environmental Impact Assessment/Response to submissions<br>Supporting assessment documentation<br>Biodiversity offsets strategy | Commercial port | Unquantified increased risk to dugongs, dolphins, migratory birds, marine turtle, sawfish and whale species.<br><br>Potential permanent/direct loss (ha)<br>Seagrass 10; Coral 37; Macroalgae 260; Filter feeders 2272<br><br>Potential temporary/indirect loss (ha)<br>Seagrass 2963; Coral 22.4; Macroalgae 4018; Filter feeders 904 | No | Reclamation<br>Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil<br>Marine noise<br>Increased shipping | Direct loss<br>Indirect loss | Regional Indigenous Sea Ranger Program.<br>Funding for research on seagrass in the project area or other areas in the Pilbara.<br>Funding for research into mechanism to remove barriers to sawfish migration and action as prescribed by this research.<br>Funding to develop and implement a 5 year threatened species information and protection program.<br>Regional Indigenous Sea Ranger Program.<br>Funding for research on seagrass in the project area or other areas in the Pilbara.<br>Funding for research into mechanism to remove barriers to sawfish migration and action as prescribed by this research.<br>Funding to develop and implement a 5 year threatened species information and protection program. |

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| Abbot Point Terminal 3 (EPBC 2008/4468) | QLD | 2007 | Initial advice statement<br>Environmental Impact Assessment - executive summary<br>EPBC Approval | Commercial port | 8.5ha coastal rocky habitat<br>0.1ha seagrass<br>0.5ha intertidal beach | No | Installation of structure/removal<br>Dredging<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | 41. As part of the Biodiversity Offsets Strategy, the person taking the action must include a Seagrass Offset Plan. The Seagrass Offset Plan:<br>a. Must ensure disturbance limits do not exceed that identified in Table 2 and confirmed during pre-clearance surveys undertaken as required in Condition 3 within the project area for the life of this approval;<br>b. identify mechanisms/opportunities for the ongoing protection and conservation of seagrass habitat that supports listed threatened species and migratory species, including inshore dolphins, marine turtles and dugongs within the Coral Sea Region, Great Barrier Reef World Heritage Area including Port of Abbot Point; and<br>c. identify mechanism in order to achieve the outcomes of this condition with the Queensland Government.<br>42. Offsets must be a minimum of 8:1 noting that the specific requirement will depend on:<br>a. the proposed improvement in quality of the offset site;<br>b. the averted loss achieved by securing the site; and<br>c. risks associated with the proposed offset activity.<br>44. The person taking the action is required to:<br>a. Contribute funding of $350,000 per annum (indexed at CPI), from construction until the expiry of this approval or cessation of operations, whichever comes sooner, to the Great Barrier Reef Field Management Program to fund the employment of Indigenous Rangers who will ensure that the threats to EPBC Act listed threatened and migratory species, coastline and tidal creeks as a result of construction and operation of the project are minimised.<br>b. provide an annual financial contribution of $50, 000 per annum (indexed at CPI) from construction until the expiry of this approval of cessation of operations, whichever comes sooner, to be provided to the GBRMPA as a contribution to the Australian |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| | | | | | | | | | and Queensland Government's joint program of field management for the GBRWHA. c. Provide an annual financial contribution of $200,000 per annum (indexed at CPI) from construction until the expiry of this approval or cessation of operations, whichever comes sooner to be provided to the GBRMPA to fund Net Conservation Benefits. |
| Outer Harbour Development – Port Hedland BHP Billiton Iron Ore (BHPBIO) | WA | 2012 | Report and recommendations of the EPADraft Environmental Impact Assessment/Public Environmental ReviewSupporting assessment documentation | Commercial port | Not specified - mangrove and marine benthic habitat and fauna. | No | DredgeDredge spoil disposalInstallation of structure/removalMarine noiseIncreased shipping | Direct lossIndirect loss | Project A - Understanding the ecology of sawfish and contribute to the regional studies being undertaken to understand sawfish migration. - $0.5 million over 2 years Project B - Support research on marine fauna (whales, dolphins, dugongs and sea turtles) in the Pilbara region. - $3 million over 4 years Project C - Improve the understanding and management of the impacts of dredging on tropical marine communities. - $3 million over 2 years Project D - Contribute to the regional data - regional mapping and surveys of Mangroves (intertidal BPPH) at the mouth of the De Grey River, Mandora Marsh and the Turner River delta. - $1 million over 4 years Project E - Improve the conservation of marine fauna consistent with the guidance provided by the indicative or final 80 Mile Beach Marine Park management plan. - $2.5 million over 6 years EPBC 31 - to complement research required under condition 16-4 of the Western Australian Government's approval, the person taking the action must commit to providing funding to the Western Australian Marine Science Institution for relevant research into, including but not limited to, the better understanding and management of the impacts of dredging on coral and filter feeding assemblages in the Commonwealth marine area. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| Browse Liquefied Natural Gas Precinct* | WA | 2012 | Cumulative environmental impacts of development in the Pilbara region<br>The Wilderness Society - A citizen's guide to the Kimberley 'gas hub strategic assessment': A politicised and compromised process<br>Report and recommendations of the EPA<br>Strategic Assessment Report: Response to submissions summary | Commercial port | Strategic assessment - unquantified BPPH, Coral, Marine mammals… noted that working under limited data availability and a very sensitive environment. | n/a | n/a | n/a | To study the impacts of significant marine noise sources on acoustic communication between Indo-Pacific humpback dolphins and their ability to maintain a cohesive group as a result of marine noise;<br>Mapping of cumulative noise levels from all significant marine noise sources...<br>Develop noise management procedures<br>Determination of specific marine fauna management zones<br>Indigenous ranger initiatives |
| Fraser Straits Marina, Tin Can Bay, QLD | EPBC | 2013 | EPBC Referral - Final preliminary documentation<br>Response to information requests<br>EPBC Approval | Marina development | The residual impacts required to be addressed in the environmental offsets plan are:<br>- The loss of the area identified in the seagrass assessment, or 0.83ha (whichever is larger), of seagrass habitat for threatened and migratory species including the Dugong and sea turtles; and<br>- The loss of 6.19 ha of intertidal foraging habitat for listed migratory shorebirds. | No | Installation of structure/removal<br>Increased recreational pressure | Direct physical loss<br>Indirect loss - turbidity, disturbance | Commit no less than $250,000 to implement offsets plan. And must include measures to rehabilitate and maintain seagrass and migratory shorebird foraging habitat; control weed species and pest animals; control access to the protected land; prohibit grazing or other damaging activities; monitor the status of seagrass and migratory shorebird foraging habitat report the results and frequency of monitoring and management activities to the minister; and, identify other EPBC Act listed threatened species and ecological communities that occur within the proposed offset area. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| Great Keppel Island Tourism and Marina Development (EPBC 2010/5521) | QLD | 2013 | Initial Advice Statement<br>Draft Environmental Impact Statement<br>Response to submissions<br>Coordinator-general's report on the Environmental Impact Statement<br>EPBC approval<br>EPBC approval variation | Marina development | a permanent loss of 10 ha of substrate supporting patchy seagrass with approximately 10 percent cover<br>alteration of 20 ha of non-vegetated soft sediment and associated macrobenthos (benthic invertebrates) enclosed within the marina basin<br>a permanent loss of approximately one ha of intertidal rocky shore.<br>Unquantified impact to turtle habitat and other marine species/habitat GBRMP/WHA through increased recreational disturbance.<br>Potential temporary impact of just over 1ha coral and 1ha seagrass during construction. | No | Reclamation<br>Installation of structure/removal<br>Increased recreational pressure<br>Dredge<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity, disturbance | 59. To compensate for significant residual impacts on the outstanding universal value of the GBRWHA and the marine environment of GBRMP the person taking the action must provide funding of $300,000 per annum (indexed at CPI) to implement a Marine Environment Offset Strategy to achieve net conservation benefits.<br>a. Identify research and management mechanisms/opportunities such as for the ongoing protection and conservation of marine habitat including seagrass, reefs and corals, listed marine species and listed migratory bird species in the Great Keppel Island region;<br>b. include provision for employment of indigenous rangers; and<br>c. provide timeframes for the implementation. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| Shute Harbour Marina | QLD | 2013 | Environmental Impact Statement<br>Supplementary Environmental Impact Statement<br>Coordinator-general's report on the Environmental Impact Statement<br>EPBC Approval | Marina development | 14 ha of macroalgae beds<br>12.7 ha of seagrass<br>1.84 ha of intertidal mangroves<br>0.44 ha of coral communities. | No | Installation of structure/removal<br>Dredge<br>Disposal of dredge spoil | Direct loss<br>Indirect loss | Restoration and rehabilitation of a large wetland to the west of the project site to improve water quality of storm water entering Shute Bay<br>Identify upstream management actions to improve water quality in other bays near Shute Bay, where turbidity affects seagrass growth<br>Investigate opportunities to remove private boat ramps in the Shute Harbour area and invest in mangrove rehabilitation<br>Fund management actions identified for the Repulse Bay Declared Fish Habitat Area<br>Contribute to Queensland Wetlands Program<br>Response Action Plans for managing the impacts associated with instream structures in the Bowling Green Bay Ramsar wetland and declared fish habitat area.<br>Restore seagrass in Mourilyan Harbour<br>provide funding to produce an annual update of the Queensland seagrass GIS atlas<br>Contribute to the research program to establish a sub-lethal toolkit to rapidly measure seagrass stress. |
| Gold Coast International Marine Precinct** | QLD | 2013 | Environmental Impact Statement<br>Coordinator-general's report on the Environmental Impact Statement<br>EPBC Approval<br>Addendum to Coordinator-general's report on the Environmental Impact Statement | Marina development | 1.37ha seagrass or amount identified in pre-construction surveys (whichever is larger)<br>Boat strike injury and mortality of EPBC listed species | Yes | Dredge<br>Dredge spoil disposal<br>Increased boat traffic | Indirect loss - turbidity | Offsets to address loss of 1.37ha of seagrass and potential seagrass habitat or the area identified under condition 16, whichever is larger; and boat strike injury and mortality of EPBC listed marine species |

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| South of the Embley | QLD | 2013 | Environmental Impact Statement<br>Supplementary Environmental Impact Statement<br>Final Environmental Impact Statement<br>Coordinator-general's report on the Environmental Impact Statement<br>EPBC Approval<br>EPBC Recommendation report | Commercial port | Unquantified impacts to turtle species, marine mammals and seagrass | No | Installation of structure/removal<br>Increased recreational pressure<br>Light disturbance<br>Dredge<br>Disposal of dredge spoil<br>Increase in shipping | Direct loss<br>Indirect loss | Development and implementation of an adaptive Feral Pig Management Offset Strategy to reduce the annual level of feral predation on listed turtle species nests for the period of this approval. The Feral Pig Management Offset Strategy must include collection of robust baseline data for listed turtle species nesting in the project area and include definition of outcomes including, benchmarks, performance indicators, corrective actions and contingency measures and specify where responsible for implementing actions. Information detailing Traditional Owner employment opportunities and mechanisms for reporting the number of local indigenous person/s actually employed in the implementation of this strategy should be provided. The findings from the Feral Pig management Offset Strategy must be used to inform the Marine and Shipping Management Plan on an ongoing basis.<br><br>Inshore Dolphin Offset Strategy Implement an Inshore Dolphin Offset Strategy to inform knowledge about the distribution and abundance of local and regional populations of listed dolphin species in the Western Cape York area, and identification of habitat utilised by listed dolphin species.<br>The approval holder must fund the strategy to a minimum of $800,000 and a maximum of $1,200,000. The findings from the strategy including corrective actions and contingency measures relating to operations, must be used to inform the Marine and Shipping Management plan on an ongoing basis.<br><br>Reference to removal of marine vegetation to be addressed. |
| Anketell Point Port Development, | WA | 2013 | Report and recommendations of the EPA | Commercial port | Direct loss of BPPH will occur within the Proposal footprint due | Yes | Installation of structure/removal<br>Dredging | Direct physical loss<br>Indirect loss - | Initiation of a cetacean monitoring programme to improve understanding of migration patterns and utilisation of Nickol Bay and surrounds; |

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| Antonymyre, Shire of Roebourne | | | Statement of Implementation<br>Response to draft EIA/PER<br>Supporting assessment documentation<br>Biodiversity offsets strategy<br>MNES Environmental review | | to dredging, spoil disposal and causeway construction. Direct losses to BPPH are: Subtidal<br>Hard Coral – 19.2 ha<br>Filter Feeder Habitat – 138.1 ha<br>Intertidal<br>Mangroves – 0.6 ha<br>Algal mat – 41.5 ha<br>Indirect BPPH losses may occur as a result of elevated turbidity or sedimentation due to suspension or migration of sediment during / following dredging.<br>Potential impacts to marine fauna include: Exposure to increased TSS during dredging and disposal.<br><br>Injury or modified behaviour due to underwater noise emissions during construction and operational activities.<br><br>Entrainment of turtles within the intake of the TSHDs during dredging.<br><br>Changes to turtle nesting beaches as a | | Disposal of dredge spoil<br>Increase in shipping marine noise | turbidity, disturbance | A plan to fund relevant scientific research to add to the understanding and management of the impacts ad risks to conservation significant marine fauna form marine and coastal development in the Pilbara region.<br><br>A plan to fund relevant scientific research to add to the understanding and management of the impact of marine noise o marine mammal behaviour<br><br>Management of Dixon Island to maximise conservation values, including the implementation of long term feral predator control, weed control and ecological monitoring - outcomes that further the conservation outcomes on Dixon Island sought by the Western Australia Government approval for the life of the project.<br><br>Long term turtle monitoring on beaches in proximity to the project area and management to maximise hatchling success;<br><br>Long term coral monitoring near Dixon Island and Delambre Island, to understand natural temporal variations; |

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| | | | | | result of altered coastal processes during construction and operation.<br><br>Surface strikes by vessels during construction or operation.<br><br>Impacts on turtle nesting success due to vibration during construction.<br>Disturbance of nesting adult turtles or misorientation of new hatchlings due to artificial light at nesting beaches on Dixon Island.<br><br>Temporary entrapment (hours) of marine fauna within Bouguer<br>Passage at low tide following construction of a temporary solid causeway across Bouguer Passage.<br><br>Entrainment of turtles within desalination plant intake. | | | | |
| Gorgon Gas Development – Barrow Island | WA | 2014 | Draft Environmental Impact Statement/Environmental Review and Management | Commercial port | 23.2ha loss coral<br>300ha clearing of 'critical' native | Yes | Installation of structure/removal<br>Light disturbance | Direct loss<br>Indirect loss | AUD$60m contribution for establishment of the Net Conservation Benefit Fund<br>Funding for management of Barrow Island for |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
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| | | | Programme<br>Report and recommendations of the EPA<br>EPBC decisions<br>Statement of Implementation<br>The Barrow Island Bill 2003<br>Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017 | | terrestrial vegetation<br>Increased risks relating to invasive species<br>Risk of impact to nesting flatback turtle habitat. | | Dredge<br>Disposal of dredge spoil<br>Increase in shipping | | duration of project<br>AUD$10m over 12 years threatened species translocation and reintroduction program<br>AUD$10m financial guarantee to cover the cost of any eradication programme required to any viable non-indigenous species introduced to the island.<br>AUD$62.5m towards the Northwest shelf flatback turtle conservation program to increase protection away from Barrow Island<br>AUD$5m contingency should measurable impacts to Northwest shelf flatback turtle occur. |
| Mangles Bay Marina Based Tourist Precinct | WA | 2014 | Memorandum: Justification for proposed approach to seagrass offsets for Mangles Bay marina precinct<br>Urban Bush Council Submission<br>Response to Matters Raised in Submissions on the Mangles Bay PER including technical notes<br>Report and recommendations of the Environmental Protection Authority<br>Mangles Bay Offsets Strategy | Marina development | 5.66ha with a commitment to reduce this to 5ha through project level mitigation/avoidance<br>Increase in chlorophyll-a concentrations | No | Installation of structure/removal<br>Dredge<br>Disposal of dredge spoil<br>Increase in shipping | Direct physical loss<br>Indirect loss - turbidity | Regional Park and Threatened Ecological Communities (TEC) rehabilitation plan – rehabilitation of adjacent areas.<br>Seagrass Project – replant 10.48 seagrass over a five-year period to meet 75% cover 10 years after initial transplanting. – net gain. If not successful a revised Seagrass restoration plan will be submitted.<br>Nutrient project - The offset to address the residual impacts is that proponent shall provide an initial $250,000 to the Cockburn Sound Management Council (CSMC) and an ongoing $25,000 per year for a period of five years. The purpose of the funding is for the coordination of nutrient reduction strategies within the catchment of Mangles Bay, consistent with the Environmental Management Plan for Cockburn Sound and its Catchment (2005), in order to improve the environmental quality of Mangles Bay. The aim of the offset is to improve seagrass health in Mangles Bay. |

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| Abbot Point Terminal 0, Terminal 2 and Terminal 3 Capital Dredging (EPBC 2011/6213 & Whitsunday Regional Council SDA-0115-017460) | QLD | 2015 | 2011 EPBC Approval<br>2011 Coordinator-general' report on the Environmental Impact Statement<br>2011 Environmental Impact Assessment<br>2015 Environmental Impact Assessment<br>2015 Supplement to Environmental Impact Assessment<br>2015 EPBC Approval<br>2015 EPBC Recommendation report<br>2015 EPBC Statement of reasons | Commercial port | EPBC<br>The exposure of 9,938t of fine sediment available for resuspension through the dredging activities.<br>Permanent loss of 10.5ha of potential seagrass habitat within the proposed berth pockets.<br><br>Whitsunday Regional Council<br>Disturbance of 1056m2 marine plant (seagrass) through trestle jetty and construction mooring installation. | Yes | Installation of structure/removal<br>Dredge<br>Disposal of dredge spoil | Direct physical loss<br>Indirect loss - turbidity | EPBC<br>150% net benefit requirement for water quality. The result will be a long-term net reduction of fine sediments entering the Marine Park from land-based sources, well beyond the life of the projects. Appropriate costs will be developed and provided to the Reef Trust for suitable offsets in relation to water quality/fine sediment load and seagrass.<br><br>Whitsunday Regional Council<br>Financial Settlement Offset for the amount of $15,840.00 to be paid prior to commencement. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Cairns Shipping Development Project** | QLD | current | Environmental Impact Statement - executive summary and technical synopsis | Commercial port | No impacts predicted | No | Installation of structure/removal<br>Light disturbance<br>Dredge<br>Disposal of dredge spoil<br>Increase in shipping<br>Marine noise | Direct loss<br>Indirect loss | Likely focus on:<br>• Impacts from the marine placement of dredge material in the GBR Marine Park<br>• Impacts on water quality and seagrass from dredging in the GBR World Heritage Area.<br>• Initiatives related to the GBRMP that are currently being explored include:<br>• Investment in programs related to reef health, management and tourism (COTS eradication program and other initiatives)<br>• Investment in reef-related research and education<br>• Disusing the current DMPA and use of the new DMPA for all future maintenance dredge placement.<br>• Initiatives related to the GBRWHA that are currently being explored include:<br>• Increased investment in programs that improve water quality coming out of the GBR catchments and in particular the Barron and Mulgrave Rivers in order to improve resilience of inshore habitats in Trinity Bay<br>• Investment in further rehabilitation of East Trinity site to improve outgoing water quality and quality of fish habitats in order to improve resilience of inshore habitats in Trinity Inlet<br>• Maintain and increase investment in monitoring of long-term ecosystem health in Trinity Bay and Trinity Inlet, including related to water quality, seagrass and corals.<br>• Where possible approach will be to invest and/ or leverage support for existing initiatives including, for example, programs under the joint Reef Water Quality Protection Plan. |

| Project name | State | Year of consent | Documentation available | Type of development | Impact identified (related to offset) | Other impacts identified and not assessed as significant | Source of impact | Class of impact | Offset |
|---|---|---|---|---|---|---|---|---|---|
| Sheep Hill deep water port facility (Stage 1) on Eyre Peninsula | SA | current | Public Environmental Report | Commercial port | Seagrass loss – 0.52ha - 5.36ha for offset | Yes | Installation of structure/removal | Direct physical loss | 25.73 ha Proposed terrestrial revegetation and rehabilitation along the south-east aspect of the site. |

**Table B continued.** Development projects in Australia associated with marine biodiversity offsets. *This strategic assessment has not been taken forward for assessment. **Information relating to biodiversity offsetting requirements unavailable at the point of analysis for these projects and so have not been included in the detailed analysis relating to offsetting mechanism type (see Chapter 5).

| **Project name** | **State** | **Receptor** | **Offset fully defined at point of decision** | **Offset package** | **Assessment of equivalence** | **ILF** | **Rehabilitation** | **Protection/Averted loss** | **Research** | **Management** | **Education** | **Insurance** | **Compliance** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Short Term Continuation of Shell Sand Dredging, Success Bank, Owen Anchorage Strategy to Address Long-Term Environmental Issues of Shell Sand Dredging | WA | Seagrass | Yes | No | No | Yes | No | No | Yes | Yes | No | No | No |
| Geraldton Port Enhancement and Preparatory Works for Town Beach Foreshore Redevelopment | WA | Reef<br>Seagrass<br>Algae | Yes | No | No | No | Yes - indirect | No | No | Yes | No | No | No |
| Pacific Highway Upgrade - Brunswick Heads to Yelgun | NSW | Seagrass | No | No | No | No | Yes | No | No | No | No | No | No |
| James Point Stage One Port, Kwinana | WA | Seagrass | Yes | No | No | Yes | Yes | No | Yes | Yes | No | No | No |
| Port Botany Expansion | NSW | Seagrass<br>Seabird | Yes | No | Yes | No | Yes | No | No | Yes | No | Yes | No |

| Project name | State | Receptor | Offset fully defined at point of decision | Offset package | Assessment of equivalence | ILF | Rehabilitation | Protection/Averted loss | Research | Management | Education | Insurance | Compliance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Port of Hay Point Capital Dredging Project | QLD | Seagrass | No | No | No | No | No | No | Yes | No | No | No | No |
| Kurnell Desalination Plant | NSW | Seagrass | No | No | No | No | Yes | No | No | Yes | No | No | No |
| Botany Bay Cable Crossing | NSW | Seagrass | No | No | No | No | Yes | No | Yes | No | No | No | No |
| Pluto Liquefied Natural Gas Development Site B Option Burrup Peninsula, Shire of Roebourne | WA | Coral | No | Yes | No | No | No | No | Yes | Yes | No | No | No |
| Wiggins Island Coal Terminal | QLD | Seagrass<br>Turtle<br>Marine Mammals<br>Birds<br>Fish | No | Yes | Partial | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Albany protected harbour development - Princess Royal Harbour | WA | Seagrass | Yes | No | Yes | No | Yes | No | No | No | No | No | Yes |
| Wallis Lakes Oyster Lease Dredging | NSW | Seagrass | Yes | No | Partial | No | Yes | No | No | No | No | Yes | No |
| Ceduna Keys Marina and Community Centre proposal | SA | Seagrass<br>Marine habitats | Yes | No | Partial | Yes | Yes - indirect | No | No | Yes | No | No | No |

| Project name | State | Receptor | Offset fully defined at point of decision | Offset package | Assessment of equivalence | ILF | Rehabilitation | Protection/Averted loss | Research | Management | Education | Insurance | Compliance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medium-term shell sand dredging, Success Bank, Owen Anchorage | WA | Seagrass | Yes | No | No | Yes | No | No | Yes | Yes | No | No | No |
| Industrial Infrastructure and Harbour Development, Jervoise Bay | WA | Seagrass | Yes | No | Yes | No | Yes | No | No | Yes | No | No | Yes |
| Long Term Shell sand Dredging Owen Anchorage | WA | Seagrass<br>Potential seagrass | Yes | No | No | Yes | No | No | Yes | Yes | No | No | No |
| Townsville Marine Precinct Project | QLD | Benthic (fish habitat) | No | Yes | Partial | Yes | No | Yes | Yes | Yes | No | No | No |
| Fisherman's Landing Port Expansion | QLD | Fish habitat<br>Benthic habitat | No | Yes | Partial | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Gas Pipeline and Alternative Pipeline to Supply Natural Gas Liquefaction Plant (EPBC 2008/4096)** | QLD | Undefined | No | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |
| Queensland Curtis LNG Project** | QLD | Seagrass<br>Benthic habitat<br>Marine mammals/turtles/fish<br>Sensitive area | No | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |

| Project name | State | Receptor | Offset fully defined at point of decision | Offset package | Assessment of equivalence | ILF | Rehabilitation | Protection/Averted loss | Research | Management | Education | Insurance | Compliance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shipping Activity Associated with the Queensland Curtis LNG Project (EPBC 2008/4405)** | QLD | Seagrass | No | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |
| Port of Gladstone Western Basin Strategic Dredging and Disposal Project (EPBC 2009/4904) | QLD | Benthic habitat<br>Seagrass<br>Sensitive area | No | Yes | Partial | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Albany Port Expansion Project | WA | Seagrass | Yes | No | Partial | No | Yes | No | Yes | No | No | No | Yes |
| ICHTHYS Gas Field Development Project Blaydin Point | NT | Marine mammals<br>Sensitive area | No | Yes | No | No | No | No | Yes | Yes | Yes | No | No |
| East Arm Wharf Expansion | NT | Benthic habitat<br>Bird habitat<br>Marine megafauna<br>Sensitive area | No | Yes | No | No | No | Yes | Yes | Yes | Yes | No | No |
| APLNG Pipeline Project (EPBC 2009/4976)** | QLD | Undefined | No | tbc | No | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |

| Project name | State | Receptor | Offset fully defined at point of decision | Offset package | Assessment of equivalence | ILF | Rehabilitation | Protection/Averted loss | Research | Management | Education | Insurance | Compliance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia Pacific LNG Project – Development of a LNG Plant and Ancillary Onshore and Marine Facilities on Curtis Island (EPBC 2009/4977)** | QLD | Seagrass | No | tbc | No | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |
| Olympic Dam Expansion | SA | Seagrass | No | No | No | Yes | Yes - indirect | No | No | No | No | No | No |
| Wheatstone Development - Gas Processing, Export Facilities and Infrastructure | WA | Seagrass<br>Coral<br>Macroalgae<br>Filter feeders<br><br>Dugongs<br>Dolphins<br>Migratory birds<br>Sawfish<br>Whales | No | Yes | No | Yes | No | No | Yes | Yes | Yes | Yes - Partial | No |
| Abbot Point Terminal 3 (EPBC 2008/4468) | QLD | Seagrass | No | Yes | Partial | Yes | No | Yes | Yes | Yes | Yes | No | No |
| Outer Harbour Development – Port Hedland BHP Billiton Iron Ore (BHPBIO) | WA | Marine benthic habitat and fauna | No | Yes | No | Yes | No | No | Yes | Yes | No | No | No |
| Browse Liquefied Natural Gas Precinct* | WA | n/a | n/a | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |

| Project name | State | Receptor | Offset fully defined at point of decision | Offset package | Assessment of equivalence | ILF | Rehabilitation | Protection/Averted loss | Research | Management | Education | Insurance | Compliance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraser Straits Marina, Tin Can Bay, QLD | EPBC | Seagrass<br>Habitat for dugong and turtles<br>Shorebirds | No | Yes | Partial | No | Yes | Yes | Yes | Yes | Yes | No | No |
| Great Keppel Island Tourism and Marina Development (EPBC 2010/5521) | QLD | Seagrass<br>Benthic<br>Turtle habitat<br>Sensitive area<br>Marine species<br>Coral | No | Yes | Partial | Yes | No | Yes | Yes | Yes | No | No | No |
| Shute Harbour Marina | QLD | Macroalgae<br>Seagrass<br>Coral | No | Yes | No | No | Yes | No | Yes | Yes | No | No | No |
| Gold Coast International Marine Precinct** | QLD | Seagrass<br>EPBC species | No | tbc | Partial | tbc | tbc | tbc | tbc | tbc | tbc | No | No |
| South of the Embley | QLD | Turtles<br>Marine mammals<br>Seagrass | No | Yes | No | No | No | No | Yes | Yes | No | No | No |
| Anketell Point Port Development, Antonymyre, Shire of Roebourne | WA | Coral<br>Filter feeder habitat<br>Algae<br>Megafauna<br>Turtles | No | Yes | Partial | Yes | No | No | Yes | Yes | No | No | No |
| Gorgon Gas Development – Barrow Island | WA | Coral<br>Turtles | No | Yes | No | Yes | No | No | Yes | Yes | Yes | No | No |
| Mangles Bay Marina Based Tourist Precinct | WA | Seagrass | Yes | No | Yes | Yes | Yes | No | Yes | Yes | No | Yes | Yes |

| Project name | State | Receptor | Offset fully defined at point of decision | Offset package | Assessment of equivalence | ILF | Rehabilitation | Protection/Averted loss | Research | Management | Education | Insurance | Compliance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abbot Point Terminal 0, Terminal 2 and Terminal 3 Capital Dredging (EPBC 2011/6213 & Whitsunday Regional Council SDA-0115-017460) | QLD | Seagrass | No | Yes | Yes | Yes | tbc | tbc | tbc | Yes | No | No | No |
| Cairns Shipping Development Project** | QLD | Sensitive area | No | tbc | No | tbc | tbc | tbc | tbc | tbc | tbc | tbc | tbc |
| Sheep Hill deep water port facility (Stage 1) on Eyre Peninsula | SA | Seagrass | n/a | No | Partial | No | Yes - indirect | No | No | No | No | No | No |