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Exploring the practical implementation of marine biodiversity offsetting in Australia.

Holly J. Niner[a*, b, c], Peter J.S. Jones[d], Ben Milligan[e], Craig A. Styan[f]

[a] School of Biological and Marine Sciences, Marine Building, University of Plymouth, Drake Circus, Plymouth, PL4 8AA, UK
[b] Centre for Blue Governance, Aalborg University, Department of Planning, Rendsburggade 14, 9000, Aalborg, Denmark
[c] Department of Engineering, University College London, Gower Street, London, WC1E 6BT, UK
[d] Department of Geography, University College London, Gower Street, London WC1E 6BT, UK
[e] Faculty of Law, University of New South Wales, Sydney, Australia
[f] UniSA STEM, University of South Australia, GPO Box 2471, Adelaide, SA, 5001, Australia

* Corresponding author: holly.niner@plymouth.ac.uk

Abstract

Biodiversity offsetting with associated aims of no net loss of biodiversity (NNL) is an approach used to align economic development with conservation. Biodiversity offsetting may be more challenging in marine environments, with recent evidence suggesting that the current application of the approach in Australian marine environments rarely follows 'best practice' and is unlikely to be meeting stated policy aims. To understand how and why this deviation from best practice is taking place in marine systems, we analysed current practice in Australia through in-depth semi-structured interviews with 31 participants with professional experience in the development and implementation of associated policy. Thematic analysis of results indicated that, despite commitment to best practice in principle, practitioners recognised that operationalisation of marine biodiversity offsetting was inconsistent and unlikely to be meeting stated goals such as NNL. Participants described the central barrier to the adoption of best practice as the technical complexity of assessing and quantifying biodiversity losses and gains, and uncertainty in restoration in marine contexts. With offsetting described as an integral part of development consent for marine economic development, both these barriers and their navigation presents threats to users setting off a chain of accepted activity leading away from best practice. These threats were perceived to arise from low governmental capacity or prioritisation for environmental management, institutional needs for a social licence to operate, and overarching demands for economic growth. We conclude that marine biodiversity offsetting has come to be ambiguous in its practical definition, with a range of conflicting factors influencing its use and preventing the standardisation required to meet rigorous interpretations of best practice necessary to ensure biodiversity protection and NNL.

Keywords: Marine offsets; No net loss, Mitigation hierarchy; Environmental impact assessment; Social licence to operate

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Highlights:

- Marine biodiversity offsetting is unlikely meeting stated aims.
- Marine biodiversity offsetting is accepted as a component of development consent.
- *Ad hoc* process creates risks for users of marine biodiversity offsetting.
- Explicit acknowledgement of failure and risks is necessary in policy formulation.
- It remains unclear whether marine biodiversity offsets are an appropriate tool.

1. Introduction

Biodiversity offsets and associated aims of no net loss (NNL) and net gain have been subject to increasing interest as a way to manage the competing societal aims of environmental protection and economic growth (Bull et al., 2013). In theory, biodiversity offsetting requires "*demonstrably quantifiable equivalence*" (Bull et al., 2016) between the biodiversity lost through development and gained through related conservation actions. Despite the growth in its use, evidence of the approach preventing biodiversity loss and performing successfully is not available (e.g. Harper and Quigley, 2005; Lindenmayer et al., 2017). Several factors appear to prevent success, including the misuse of scientific information in offset design (Maron et al., 2015a), a lack of adaptive management and compliance monitoring (Brown and Veneman, 2001; Lindenmayer et al., 2017), and goal ambiguity (Clare and Krogman, 2013).

Best practice for biodiversity offsetting, centres around criteria identified as essential for its success as described by BBOP (2012) in their Standard on Biodiversity Offsets. These criteria are widely accepted as applicable to all environments. The Standard on Biodiversity Offsets (BBOP, 2012) sets out that the approach should only be used as a measure of last resort, as defined by the mitigation hierarchy. The mitigation hierarchy requires that identified impacts are first avoided and then minimised before considering all potential remediation options, prior to compensating residual impacts using offsets (BBOP, 2012; McKenney and Kiesecker, 2010). Building on this grounding principle, best practice can be distilled to further requirements of transparency, equivalence and additionality of offsets (Bull et al., 2016), where biodiversity losses and gains can be measured against a specified frame of reference to demonstrate how these criteria have been met, and therefore policy success.

Biodiversity offsetting policy and guidance has been developed predominantly for terrestrial applications but the approach is now also being applied in the consenting of development projects in marine environments (Bos et al., 2014; Brodie, 2014; Niner et al., 2017a, 2017b; Vaissière et al., 2014). Specific differences posed by marine environments complicate the application of biodiversity offsetting in marine contexts compared to their use in terrestrial environments. These differences include the complex, diffuse and poorly understood ecological relationships often linked across large scales, the high costs of operation at sea, and the convoluted administrative arrangements often inherent to coastal and marine areas (Bas et al., 2016; Bos et al., 2014; Niner et al., 2017a). Combined, such challenges increase uncertainty in current abilities to create (or adequately monitor) marine biodiversity gains through offsetting activities to match losses and meet aims of NNL or otherwise.

Reviews of literature and documents describing the application of biodiversity offsetting in marine and coastal settings by Niner et al., (2017b) and Vaissière et al. (2014) show that the operationalisation of the approach has followed an *ad hoc* interpretation of terrestrially developed policies and guidance. Documentation indicates that there is a preference for financial offsets and their payment into strategic projects to address larger scale conservation projects (Bell, 2016; Niner et al., 2017b). Strategies to quantify financial offsetting liabilities in adherence to the best practice principle of equivalence include the development of agreed metrics or calculators (Maron et al., 2015b; Vaissière et al., 2016), however, these remained outstanding at the point of analysis. Accordingly, the terms under which marine offsetting liabilities are being agreed are unknown. 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 or pushed this to occur (Clare et al., 2013; Clare and Krogman, 2013).

Here, we address this gap and explore how the decisions and strategies employed by the users of offsets define (or implement) marine biodiversity offsetting policy in practice (Lipsky, 2010). We do this through an in-depth analysis of the perceptions of a range of actors involved in the development and implementation of marine biodiversity offsetting policy in Australia. Using this case study, we explore how the policy is operationalised in practice and the technical and administrative influences on this. Building on previous document-based reviews of the application of marine biodiversity offsets (Niner et al., 2017a, 2017b; Vaissière et al., 2014), we reveal a nuanced picture of the factors driving the apparent deviation from offsetting best practice. To support this analysis, we consider what marine biodiversity offsetting practice looks like for each participant, the different purposes for which it is used, and the risks and opportunities presented by current practice.

2. Methods

2.1. Case study selection - Australia

Global information on where biodiversity offsetting is being undertaken in a marine context, and the ways in which it is being implemented is limited. Australia has a comprehensive policy framework for biodiversity offsetting, acting at a range of jurisdictional scales and applicable to a range of marine environmental receptors (see Table 1) (Bell et al., 2014; Bos et al., 2014; Brodie, 2014; Niner et al., 2017b). Whilst these policies vary across jurisdiction in their frames of reference (e.g. how biodiversity is defined) and the specific target for biodiversity offsets, they are all similar in their aims to neutralise impacts to biodiversity. Further, all frameworks are similar in that they outline requirements to adhere to the central tenets of biodiversity offsetting best practice (BBOP, 2012), where the application of mitigation hierarchy and the demonstration of ecological equivalence (at some level) are required. At the time of data collection, these policies did not incorporate a sophisticated metric to measure the losses and gains of marine biodiversity. Accordingly, this study focusses on the overarching experience of marine biodiversity offsetting in Australia and more generally how the best practice concepts of the mitigation hierarchy and equivalence are enacted *in practice* by users of the approach in marine contexts. Through this case study of Australian experiences, we explore the factors influencing the practical application of biodiversity offsetting in marine environments, specifically how essential criteria associated with biodiversity offsetting are engaged with in practice, and the factors that lead to deviation from these criteria and best practice.

Whilst some revisions have been made to the various biodiversity offsetting policies discussed in the interviews since they were undertaken in 2016-2017, their targets and associated guidance remain largely unaltered and so we consider it unlikely that the operational landscape has significantly changed.

Table 1. Key elements of policy framework for marine biodiversity offsetting in Australia. Further detail provided in Appendix A.

Jurisdiction	Relevant policy and guidelines	Policy aim	Relevant marine receptors
Federal	EPBC Act Environmental Offsets Policy (2012)	Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	Wetlands of international importance (listed under the Ramsar Convention) Listed threatened species and ecological communities (e.g. certain areas of sea grass or kelp, turtles, dugongs, whales and dolphins). Migratory species protected under international agreements (e.g. sawfish, shark and ray species) Commonwealth marine areas Great Barrier Reef Marine Park
Great Barrier Reef (GBR) Marine Park	Reef 2050 Plan Net Benefit Policy	Net Benefit – a positive change in the condition and trend of GBR values, regardless of whether they occur within or outside the GBR, incl. internationally.	Biodiversity - GBR habitats Biodiversity – terrestrial habitats that support the GBR Biodiversity – species Geomorphological features Aboriginal and Torres Strait Islander heritage Historic heritage Community benefits of the environment
New South Wales	Policy and guidelines for fish habitat conservation and management (2013)	No net loss of key fish habitats in NSW	Key fish habitats
Queensland	Environmental Offsets Act (2014); Environmental Offsets Regulation (2014); Queensland Environmental Offsets Policy (v1.2 (2014)-v1.8 (2020))	Offsets must achieve an equivalent or better environmental outcome	Marine plants or works in a declared Fish Habitat Area

South Australia	Policy for Significant Environmental Benefit (2015, updated 2019)	Net environmental gain - to achieve an overall environmental gain over and above the scale of the impact. This must involve measurable conservation outcomes resulting from specific actions.	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
Victoria	Planning and Environment Act (1987); Guidelines for the removal, destruction or lopping of native vegetation (2017)	Offsets are designed to compensate for the biodiversity value of native vegetation only, not its other values	Native vegetation (e.g. seagrass)
Tasmania	None applicable	None applicable	None applicable
Northern territory	None applicable	None applicable	None applicable
Western Australia	WA Environmental Offsets Policy (2011); WA Environmental Offsets Guidelines (2014)	Protect and conserve environmental and biodiversity values for present and future generations. This policy ensures that economic and social development may occur while supporting long term environmental and conservation values. Environmental offsets are actions that provide environmental benefits which counterbalance the significant residual environmental impacts or risks of a project or activity.	Significant impacts requiring an offset – any significant residual impact of this nature will require an offset. These generally relate to any impacts to species, ecosystems, or reserve areas protected by statute or where the cumulative impact is already determined to be at a critical level.

2.2. Sample selection

In-depth semi-structured interviews were held between October 2016 and May 2017. Participants were purposively selected for their experience with the development and implementation of marine biodiversity offsetting policy across a range of jurisdictions and policy frameworks. Participant selection aimed to provide a representative range of perspectives across all key actor groups: regulators, industry and consultancy practitioners, Non-Governmental Organisations (NGOs), and academics. Participants in regulatory roles were employed in a government capacity 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 identified as consultants were employed by consulting firms in a role related to biodiversity offsetting. For the purposes of this study, consultancy and industry representatives are collectively referred to as 'practitioners'. Academic representatives were working within universities with research interests related to biodiversity offsetting. Participants described as representing NGOs held positions within environmentally focussed NGOs that interacted with biodiversity offsetting. Some participants described overlapping experience-types (32% of sample) where experience was discussed with respect to both their current and previously held position, and many participants described experience that crossed jurisdiction (74% of sample).

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. The small number of people engaged in the use of marine biodiversity offsetting is evidenced by the two projects requiring marine biodiversity offsets across all Australian jurisdictions in 2014 (Niner et al., 2017b) as compared to a total of 86 projects requiring offsets under the EPBC Act alone in the same year (Bell, 2016) and 7410 mainly terrestrial projects referred to the EPBC for assessment (Australian Government, 2020). Offset agreement and design was described by many participants as a negotiation, a responsibility imparted to senior professional positions within both regulatory bodies and industry which possibly limited the number of people involved in decision-making around marine offsets that were therefore available to participate in this study. Once key participants were identified, however, a snowball sampling strategy based on the recommendations of key informants for further interviewees was successfully adopted (Reed et al., 2009). In total 31 participants were interviewed, covering all of profession types and most of the jurisdictions where marine biodiversity offsetting has occurred (Table 2). The aim of the interviews was to explore a range of different typical perspectives amongst different actors rather than achieve a representative sample of interviewees, accordingly sampling was assessed as complete when the same views within a category of interviewees were being reported, i.e. when thematic saturation reached.

Table 2. The distribution of participants across profession type *Industry and consultancy representatives are collectively referred to as practitioners.

Participant type		**ID**	**Total participants**
Practitioner*	Industry	IND#	6
	Consultancy	CON#	7
Regulator		REG#	7
Non-Governmental Organisation		NGO#	6
Academia		ACA#	5
Total			**31**

2.3. Data collection

Interviews followed a topic guide developed to inform the research question identified through literature review highlighting the knowledge gaps surrounding marine biodiversity offsetting in practice (Appendix B). Questions prompted participants to describe their experience with marine biodiversity offsetting and the challenges, opportunities and barriers presented by the approach in practice. The topic guide provided an outline for the interviewer (HN) to steer 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 (Gaskell, 2000). This 'loose' structure also provides freedom that allows for a sensitive account to be revealed through a flexible and naturally flowing dialogue between interviewer and participant (Brinkmann and Kvale, 2014). The questions explored the nature of participants' experience with marine biodiversity offsetting, the context within which the experience occurred, how they perceive current practice, the challenges of application in marine contexts and how policy success might be achieved (Appendix B). Ethical approval was obtained from University College London (UCL) and all participants provided voluntary verbal and/or written consent prior to interviews. All interviews were digitally recorded, transcribed and anonymised by the lead author (HN). No incentives were offered for participation.

2.4. Analysis

Analysis of interview data followed an iterative, step-wise process (adapted from Braun and Clarke, 2006): (1) 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. Transcription of recorded interviews was undertaken using the NVivo 10 (QSR International Pty Ltd, 2018) transcription function. Familiarisation entailed the reading of the transcripts and double-checking their accuracy against the audio recordings. During this process, notes were made to complement those taken during the interview, which included specific observations or ideas arising from the interaction with the participant, and the analytical memos from the initial transcription process. This familiarisation was a pre-cursor to developing a coding framework and was supported by the personal transcription of the interviews by the lead researcher, which enabled a close familiarisation with the data.

Coding of the transcripts was initiated using deductive (etic) themes derived from the literature and familiarisation with relevant policies, summarised in the topic guide (Appendix B) used to steer the semi-

structured interviews. This was complemented by open coding of new inductive (emic) themes emerging during the interviews and their analysis. This combined approach is commonly used to address exploratory research questions so as to include emerging areas of interest (Fugard and Potts, 2016). On initial analysis 35 codes were identified, many of which were identified as overlapping. Transcripts were revisited to reduce overlap and to identify overarching themes and sub-themes within the data (Braun and Clarke, 2006). Sub-themes were limited to the theme of 'Applied definition' (Table 3) where six common threads were identified that described different purposes ascribed to marine biodiversity offsetting by participants. Through iterative refinement of the coding framework (Green and Thorogood, 2018) a narrative exposing the divergence in the practical definition of marine biodiversity offsets from best practice principles (BBOP, 2012) and factors influencing this variation became apparent. All coded data was then revisited to explore this narrative including the purpose and factors governing the use of marine biodiversity offsets through a refined framework of eight themes presented in Table 3.

Table 3. Coding framework applied for analysis

Theme	**Sub-theme**	**Code definition**
Policy development or historical application		Descriptions and experiences of how the policy and its use has evolved and changed development consent processes over time.
Applied definition	• Community engagement • Social licence to operate • Economic/financial • Global environmental commitments • Improved environmental performance • Risk management	Driver or role of biodiversity offsetting within development consent decision-making and/or project design.
Process of offset definition		References to the method by which marine biodiversity offset requirements are decided/agreed e.g. negotiation vs standard scientific process using a metric.
Capacity		Reference to available data, knowledge, expertise and experience to develop and implement policy.
Mitigation hierarchy		Experience or perceptions of how and whether the mitigation hierarchy is applied in practice.
Definitions of success		Experience or perceptions of operational marine biodiversity offset success and how it is measured.
Barriers to success		Experience or perceptions of challenges in achieving successful marine biodiversity offsetting.
Opportunities		Perceptions of the types of opportunities presented by and for marine biodiversity offsetting.

3. Results

Thematic analysis of interview data, specifically exploration of the 'definitions of success' (Table 3) of offsets, indicated that the practical definition of marine biodiversity offsetting rarely followed best practice, in that demonstration of equivalence and/or adherence to the mitigation hierarchy were not a clear requirement as policy was enacted. Through examination of the 'Process of definition' it became clear that approaches were wide ranging and the majority of participants explicitly described how marine biodiversity offsetting practice, in their experience was not principally science-based. In analysing the opportunities presented by biodiversity offsetting and the barriers to the implementation of best practice, three key factors emerged as strong influences on the form of marine biodiversity offsetting practice. These factors related to low levels of regulatory capacity to manage the high scientific uncertainties of impact quantification and marine restoration, overarching low levels of political prioritisation for environmental protection, and the importance of a social licence to operate (SLO). Using the thematic framework developed for this analysis (Table 3) we explore the influences driving current modes of marine biodiversity offsetting practice. Stepwise, we firstly consider marine biodiversity offsetting in practice, this leans on the themes of Policy development and historical application, Applied definitions and the Process of offset definition. Secondly, focussing on themes relating to the Process of definition and Barriers to success, we consider the effects of technical challenges to the ways that marine biodiversity offsetting is used. Finally, we explore the socio-political challenges of marine biodiversity offsetting, focussing on themes of Capacity, Opportunities and Applied definitions.

3.1. Marine biodiversity offsetting in practice

In looking at the evolution of marine biodiversity offsetting, participants across all types and jurisdictions were in agreement that offsets were a *"cornerstone … [or a] … key regulatory tool … [for] … compensation"* (REG3) and an established part of development consenting frameworks in Australia. Whilst the majority of participants were familiar with the theoretical basis and standard approach or best practice for biodiversity offsetting (BBOP, 2012; Bull et al., 2016), examples of marine offsets provided by participants across all professional types rarely demonstrated alignment with these. For example, the offsetting actions described included a range of actions, such as the use of financial contributions from industry towards an improved scientific basis for Environmental Impact Assessment (EIA), the salary of environmental regulators or insurance against future risk of environmental damage. The majority of academics promoted the need to instil scientific principles to meet the stated aims of offset policies and biodiversity protection, yet acknowledged, along with the majority of participants across all types, that offsets were often used as a negotiating tool to navigate the consenting processes *"around those developments"* (NGO1). Outside of academia, participants were more explicit in their description of the ambiguity of marine offsets and indicated an acceptance of the non-specific use of the term.

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

The best practice principle of the mitigation hierarchy, common to all offset policies in Australia, was reported by participants across all profession types, as poorly monitored or controlled. When queried directly as to its

use, none were able to confirm that it is being applied in line with its theoretical application (BBOP, 2012). However, the same participants also outlined a common personal experience that led to confidence that offset liabilities were driving a detailed application of the mitigation hierarchy.

REG3: *…incentivising of avoidance measures as a result of our offset policy is something that is real and that definitely happens…*

In agreement with this, participants in practitioner roles suggested that the development of offsetting policy has led to an increase in scientific rigour of what were previously considered to be tokenistic or *"fluffy fluffy"* (CON1) negotiations over compensatory requirements.

3.2. Technical challenges of marine biodiversity offsetting

Participants across all types reported that the application of marine biodiversity offsets was made difficult by the complexity and connectedness of marine ecosystems, in addition to the administrative challenges of implementing offsets in practice. As a result of these challenges, participants indicated that marine offsetting has *"…always been one of those things that people have stayed away from"* (ACA1) and that, where it has been applied, physical offsets (replacing like for like) are widely considered 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…*

The difficulties of marine restoration were widely acknowledged by participants, and were described to have channelled financial offsets towards bigger, 'strategic' offsets, on the principle that they will offer *"better bang for buck"* (IND5). Despite the unanimous support across participants for large-scale strategically coordinated conservation projects to act as pooled offsets, participants described situations where procedures to meet the principle of equivalence through these projects remained outstanding. The lack of established procedures raised 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.

IND3: *…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'…*

One of the major issues presented by the use of financial equivalency for marine biodiversity offsetting is a lack of consistent agreement on how to value biodiversity to meet the aims of biodiversity offsetting policy. In the absence of formally agreed metrics to quantify the amount and type of biodiversity required to be

offset, participants across all types reported that the financial basis for offsetting is currently determined using *ad hoc* and rudimentary methods. Use of financial equivalence was described by participants in both regulatory, academic and practitioner roles as being unable to represent the broad range of values of biodiversity such as *"ecosystem services, intrinsic value all those sort of things [that are] incredibly difficult to get a handle on"* (REG5). Further, a lack of a common agreement on how to place a consistent financial value on marine biodiversity was described as leading to the current situation where *"the perception is that this [marine biodiversity offsetting] is the least cost option because no one knows how to calculate it, no one knows how to achieve the outcome…"* (REG4).

3.3. Socio-political challenges of marine biodiversity offsetting

3.3.1. Siloed regulation and knowledge exchange

In addition to the absence of a formalised process or standard for agreeing how to define marine biodiversity offsets, there were indications that current practice is not sufficiently meeting the needs of actors using the approach. This was observed in the frustration of a practitioner at the perceived "*outrageous"* (CON8) insufficiency of government transparency in their application of offsets and a situation where the "*federal government can't even tell you where all of its offsets are"* (CON8).

Participants raised further concerns relating to the limited capacity, specifically with relation to marine expertise, within regulatory agencies. For one regulator this situation was made explicit where they described that in their state's environmental agency responsible for controlling marine offsetting they *"don't have anyone with any marine expertise whatsoever…"* (REG1). This lack of regulatory capacity was also described by practitioners 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 was the absence of *"real world perspective"* or *"experience"* (CON1) of both the academics in advisory roles and regulators leading these processes. Participants in practitioner roles expressed concern that the lack of required pragmatism and consideration of "*the overall cost for business"* (CON8) in the application of marine biodiversity offsetting could lead to unfeasibly high liabilities that are "*frightening for industry…"* (CON8).

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...*

Most participants explicitly acknowledged that, without a defined process, NNL or similar stated aims (Table 1) are unlikely being realised through marine biodiversity offsets. Despite this, the use of biodiversity offsetting was broadly communicated by all participants as a necessary or at least inevitable step towards improving biodiversity conservation and its governance. Participants indicated that there are several factors preventing the adherence of marine biodiversity offsetting to best practice and these can be distilled to two themes: that of political priority for environmental protection, and the demands of maintaining an SLO.

3.3.2. The political landscape for sustainability

Several participants in practitioner, regulator and NGO roles referenced the low level of public finance available for conservation or environment-focussed work. This was attributed to a perceived *"very strong downward trend"* (NGO6) in core environmental funding, but also funding available for industry *"to do good stuff"* (CON1). The absence of this was described as limiting the capacity *"to improve our understanding of these systems and how they operate"* (REG5), also leading to a prioritisation of financial considerations, where economic development or growth takes precedent over environmental concerns. A similar scenario was described by NGO2 where Traditional Owner management of marine environments was perceived as being a *"financial burden to taxpayers"* where the benefits or values of this work are not appreciated or understood.

Constrained central environmental funding, coupled with political agenda with a strong preference for economic development-focussed growth, were described as leading to the proliferation of biodiversity offsets and ambiguous modes of use in marine contexts. Different perceptions and experiences were provided as to the reasons driving their uptake. Participants in practitioner roles suggested that marine biodiversity offsetting had arisen as a direct response to 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). In direct support of this perception, further concern was expressed that an increased use of offsets may be being driven by the opportunity to *"get to the offset"* (CON8) and associated revenue to make up for decreasing core funding from government. In contrast, several participants within NGO, academic and regulator roles described how offsetting 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 …*

Situations described by participants across all profession types provided insight into the conflicted position of environmental regulators, where they were required to uphold environmental protection targets without being seen as obstructive to economic development. They were described as being subject to internal pressure from other (non-environmental) government sectors with alternative agendas such as "*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'"* (REG1). This experience highlights how the easily communicable solutions of NNL and biodiversity offsets are embraced with little regard to the ecological basis or technical criteria necessary for the associated exchange.

Other participants were more cynical and described the use of marine biodiversity offsets as *"part of a punishment"* (CON1) for big industrial development projects that are perceived as damaging by society. This was echoed by others working in practitioner roles who perceived that offsetting was 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 had a more openly critical stance and suggested that biodiversity offsets allow for a *"really good selling job"* (ACA3) for projects consented with associated environmental impacts and even went as far to describe their use as *"electoral bribery"* (NGO4). Several participants described the uneven distribution of power within the application of marine offsets, with industry's ability to leverage political favour through "*donat[ing] 20 million dollars to you know, our lobby group, the political party and peddle influence"* (NGO6) or "*tak[ing] it to the minister"* (IND1), thus highlighting the institutional constraints within which environmental regulators are working.

3.3.3. Social licence to operate (SLO)

Many participants discussed marine biodiversity offsetting with respect to its role in the maintenance of an SLO. While the concept of an SLO developed within the extractives industry to describe the community acceptance of their activities (Gunningham et al., 2004; Moffat et al., 2016), the term is now critically interpreted as a metaphor for industry-community engagement (Moffat et al., 2016). The concept was discussed by participants predominantly in relation to a company, sector or project and their need for a SLO, but it was also raised, albeit less frequently, in association with requirements for regulatory approval. Practitioners described how aims of NNL were seen as one way to improve *"the licence to operate by providing an environmental differentiator from other companies"* (CON7) that can lead to a societal preference for those companies with a good SLO. Further, good environmental performance was raised as one of the *"key pillars"* for corporations required to *"get a project over the line financially, particularly in [periods of] low … [resource] … prices"* and biodiversity offsets were 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 perceived necessity of an SLO was also described by participants as influencing the ways in which the mitigation hierarchy is applied and the offsetting preferences of industry. For example, practitioners described how losses to iconic biodiversity components, which are more likely to be perceived as unlikely to be acceptable to society, will often lead to a more rigorous application of the mitigation hierarchy. The need to track environmental performance to demonstrate this was described as likely leading to the selection of *"highly visible offsets … something that may benefit particular groups and it makes them look good"* (NGO1).

> **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 ten 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'…*

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 described 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 as demonstration of *"goodwill"* (CON4). A concern voiced by several participants, particularly in practitioner roles was how to manage the growing expectation for the demonstration of the creation of biodiversity to meet the aims of offsets. This expectation was perceived by practitioners to fall disproportionally on industry, predominantly those operating in the extractive sectors, when many other marine environmental impacts from various sectors are not captured by marine offsetting policies and so are not subject to these expectations. Practitioners also described how the increased liabilities and associated financial commitments associated with a more robust interpretation of offsets may pose the risk of jeopardising other (non-offsetting) activities that might also contribute to a SLO, such as contributions to conservation outside of consenting frameworks. Furthermore, the strict enforcement of offsetting best practice requires consistent regulatory support, such as using formally agreed metrics to define equivalence and points of success. Consistency and transparency were considered essential to *"level the playing field"* (CON7) and for user (e.g. project proponent/industry) buy-in. However, perceptions and experiences described by participants' outline that an SLO may not be strictly tied to a robust interpretation of equivalence and that deviation from best practice was not critical, as long as marine offsetting activity on the whole was perceived as legitimate.

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…*

4. Discussion

Offsetting, applicable to marine biodiversity, is incorporated into policy across most jurisdictions of Australia. Our interviews reinforced how, despite their acknowledged lack of success in Australian terrestrial contexts (Gibbons et al., 2017; Lindenmayer et al., 2017), offsets are an integral part of decision-making for economic development consent. Our results confirm the findings of document-based review (Niner et al., 2017b; Vaissière et al., 2014) that marine biodiversity offsetting is unlikely meeting stated aims and protecting against environmental damage. As hypothesised in previous academic analyses of marine biodiversity offsetting (e.g. Jacob et al., 2020; Niner et al., 2017b; Shumway et al., 2018) the uncertainties in quantifying losses and gains of marine biodiversity coupled with largely unproven and costly marine restoration techniques (Bayraktarov et al., 2016; Bell et al., 2014) have challenged the adherence to offsetting best practice (BBOP, 2012). Biodiversity offsetting through best practice requires measurement and agreement in the frames of reference against which biodiversity losses and gains are measured (Bull et al., 2016; Maron et al., 2015a) along with an assessment of what is feasible in terms of recreating biodiversity (Pilgrim et al., 2013; Pilgrim and Ekstrom, 2014). For many, if not all, marine environmental impacts occurring or predicted to occur as a result of economic development projects, measurement of specific losses and gains is not possible and restoration difficult. In such cases, this should theoretically lead to the conclusion that offsets are not possible and, in accordance with the mitigation hierarchy, they should be redesigned to minimise

damage and if total avoidance is not possible, then rejected (under a policy aim of NNL or similar). Experience of those involved in marine offsetting in Australia highlights that refusal of development consent is often not an option, and instead the use of financial offsets is mobilised to navigate the demands of offsetting policies and to feed into large strategic conservation projects (Bos et al., 2014). The uncertainty in knowledge of how to measure specific impact pathways and changes in specific components of marine biodiversity and then recreate these, manifests as ambiguity in policy implementation to navigate the risks of policy failure.

Our results suggest that offsetting has provided structure to the negotiations around how environmental impacts are financially or otherwise defined within marine development consent. This supports assertions that biodiversity offsetting has led to an improved sustainability ethic associated with marine development-consent (Vaissière et al., 2016) as compared to decision-making prior to the existence of offsetting-specific policy. However, current practice is still widely acknowledged by users as premised on an acceptance of undervalued biodiversity losses, with accepted financial values unlikely to sufficiently capture the full suite of benefits that fully functional healthy marine biodiversity provides (Böhnke-Henrichs et al., 2013; Costanza et al., 1997). Bringing financial valuations in line with the best practice principle of equivalence using formalised metrics or calculators, was under consideration at the time of interview for some jurisdictions such as the GBR (Maron et al., 2016). But, participants highlighted that this would likely result in vastly increased offset liabilities that were unlikely to be viewed as acceptable to investors. This was perhaps a predictable avenue of resistance to best practice, however our results provide a more nuanced understanding of the drivers for the resistance described.

Several factors are resisting a shift towards biodiversity offsetting best practice in marine contexts (Figure 1). All of these are framed by what was described by many participants as an overarching climate of low political will for environmental protection and a prioritisation of economic development. Our results provide a distinct example of how the simple message of offsets is readily accessible and can be leveraged by those outside of environmental regulation to exert pressures that contribute towards ambiguous (mis)use (Clare and Krogman, 2013). The power of this simple message, where offsets can 'fix' any biodiversity losses associated with damage, was described by actors involved in their use as leading to their normalisation, whereby offsets have become an expected component or 'cost' of development consent regardless of the identification of impact (Niner et al., 2017b). The experience of actors described here reveals that whilst offsetting appears to have become a normalised expectation this perhaps, as indicated with the example provided by the planning and transport minister in our results, only operates at a superficial level. Societal oversight of marine offsetting exchanges is further challenged by the complex ecological basis of tests of equivalence in marine systems, as demonstrated in a study on societal preference for marine offsetting options (Richert et al., 2015). This is supported by actors perceptions that where biodiversity losses related to more 'known' (Crowder and Norse, 2008), visible, and emotive aspects of the marine environment (e.g. marine megafauna) they were subject to more scrutiny and rigour, than for other, less charismatic aspects.

Actors described how the ambiguity and unpredictability of marine biodiversity offsetting practice was perceived as both a source of risk and opportunity, particularly in relation to their need to foster and maintain an SLO. Our results suggest that a common, transactional perspective over what constitutes an SLO (Owen and Kemp, 2013) was held by many participants, framing offsets as an action that will lead to acceptance from the affected community or society (Richert et al., 2015). This contrasts with research on the drivers of an SLO which suggests relational factors between industry and society are more important than funding environmental remediation *per se* (Bartley et al., 2017). A transactional perspective of an SLO suggests that

the value of offsetting to industry equates to what it would take to maintain support from critical members of society rather than necessarily what is required to achieve NNL. Thus, different perspectives may lead to differences in the perceived costs necessary to gain this support. Accordingly, participants described how standardised processes using metrics developed by academics to support an ecological interpretation of NNL, do not fit the SLO generating purposes of industry, intimating that the potential costs arising from the development and application of such metrics were seen as too high by industry. On the other hand, practitioners described how the demonstration of offsetting outcomes that can be linked to a specific contribution (i.e. a return on investment) was important for building an SLO. Consequently, there were concerns from those in industry that while strategic (pooled) biodiversity offset funds might present a simple way to discharge liability for environmental impact, these mechanisms may not provide sufficient control to allow for SLO benefit or a necessarily efficient use of funds.

Lack of trust in the administration of marine biodiversity offsets emerged as another factor pushing away from the adoption of best practice (Figure 1.). Failure of an offset was described as politically unpalatable to both industry and regulators, and the lack of investment in developing regulatory capacity to address this risk was a common issue of concern. A specific point of attention was how to manage societal expectations that offsets (i.e. industry) will foot the bill for the strategic conservation aims to address ongoing wider trends of biodiversity decline such as through improvement of water quality (Commonwealth of Australia, 2018). In reality, the offset finance arising from comparatively small individual impacts of individual developments is likely to form a very small proportion of the total funds required. Financial offsets are, however, seen as a boon to others. Representatives of large environmental NGOs, well placed to navigate the corporate funding landscape, identified opportunities for their organisations to act as independent brokers to deliver offsets in line with their landscape scale ambitions. In contrast, there were indications that wider conservation activity, such as capacity building and community-based projects, may be reduced under a best practice scenario for marine offsets. There were also concerns that demanding a more robust evaluation of offsetting targets could reduce the overall need for voluntary contribution for conservation activity. However, industry representatives expressed concern that vastly increased offsetting liabilities may reduce the ways that they contribute to wider conservation efforts. Such voluntary funding is understood to be a significant source of revenue for conservation action in many areas such as the GBR (Commonwealth of Australia, 2016, 2015; Great Barrier Reef Foundation, 2018). Others note that such a situation could restrict the funding available to smaller, community-based conservation initiatives less equipped to engage in delivering specific marine biodiversity benefit.

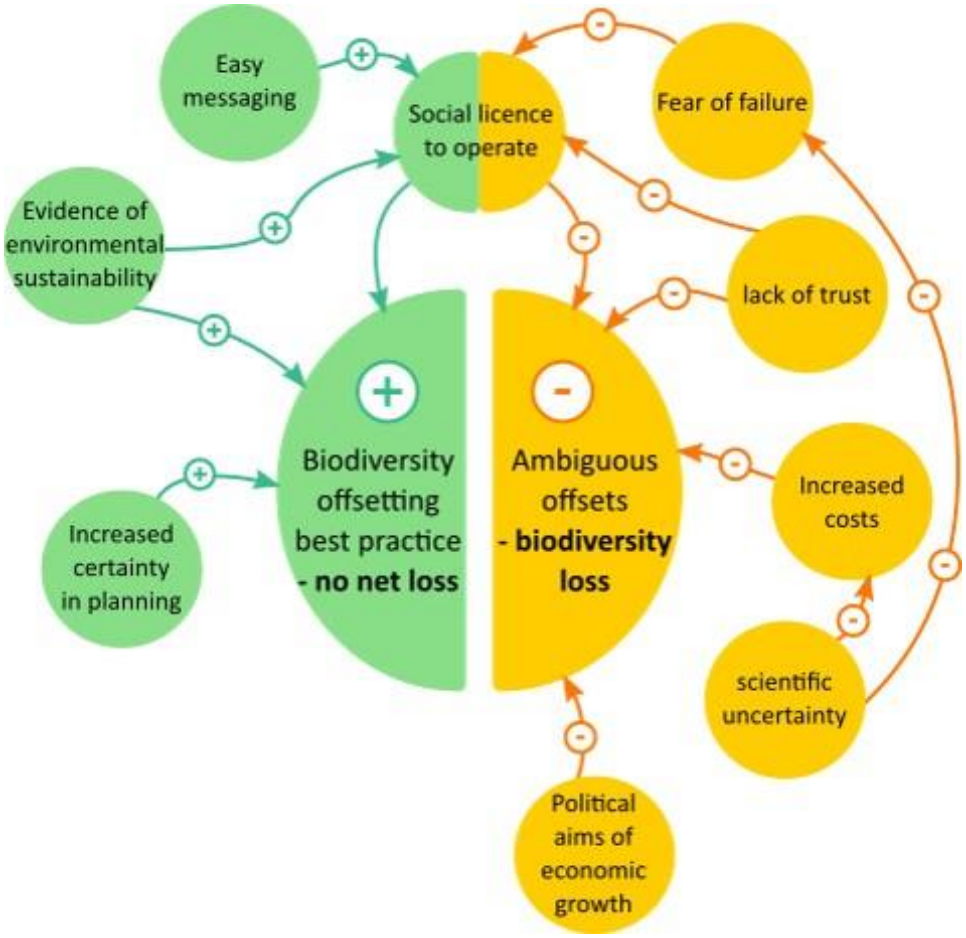

Figure 1. The varying influences on the operationalisation of biodiversity offsetting in marine environments. Green indicates influences perceived as supporting biodiversity offsetting best practice, and orange indicate those influences described as acting against the interpretation of best practice. These were identified through a thematic analysis of the perceptions of actors involved in the development and implementation of marine offsetting in Australia.

5. Conclusion – towards biodiversity protection

Our results show that the technical challenges of biodiversity offsetting in complex marine contexts coupled with expectations to approve economic development and protect the environment are leading to their ambiguous use. This ambiguous use is such that it does not follow biodiversity offsetting best practice and it is broadly accepted that current marine-based practice is not meeting the stated aims of biodiversity offsetting and is leading to an overall loss in biodiversity. Whilst this is acknowledged as undesirable, the approach is accepted as a necessary component of development consent decision-making. Our results presented here reveal a complicated range of socio-political factors that in combination lead to the ineffective use of marine offsets in Australia as described by interview participants.

The ambiguity accepted by offset users creates risks, via inconsistent approaches, which were described as driven by personality or politically driven agenda. For example, one participant suggested that offsets can be used as part of a "*punishment*" (CON1) of industry by regulators for political purposes. One way to reduce ambiguity is to develop and apply metrics or biodiversity calculators to define offsetting liabilities. However, our results highlight that this standardisation of offsetting best practice also creates risks for users and is therefore resisted. The reasons for this resistance range from the vastly increased offsetting liabilities, the need to foster a SLO, and the challenges posed the need to create an effective, legitimate administrative system to manage the implementation of best practice. In the analysis presented we highlight how these factors, in the absence of a strong policy basis, interact and prevent the application of biodiversity offsetting adhering to the principles required to successfully meet stated aims of environmental protection.

The question remains as to whether the implementation of biodiversity offsetting in complex marine ecosystems merely serves to legitimise decisions to approve economically important but environmentally damaging development projects. It is also unclear whether a shift towards best practice, different perspectives on which are discussed in the paper, will promote the achievement of NNL or make it clear this it is an unrealistic target when set within a development-promoting context. What is clear however, is that if the stated aims of biodiversity offsetting policy are to be applied in marine contexts, recognition of the restrictive scientific basis of its application in such environments is necessary to reduce the current wide margin of discretion leading to its ambiguous use. This could be achieved through a clear legal principle for the demonstration of how the criterion of equivalence has been met. As this analysis shows, such an approach which would mandate best practice would likely be met with resistance. Accordingly, navigation towards a solution, and biodiversity protection, will likely be assisted by critical assessments of the varying perspectives on the implementation of biodiversity offsets in Australia's marine ecosystems.

6. References

Australian Government, 2020. EPBC Act - Public notices [WWW Document]. URL http://epbcnotices.environment.gov.au/referralslist/ (accessed 6.30.20).

Bartley, C., Moffat, K., Zhang, A., Styan, C., 2017. Data-Driven Approaches to Measuring a Social Licence to Operate. pp. 1–9.

Bas, A., Jacob, C., Hay, J., Pioch, S., Thorin, S., 2016. Improving marine biodiversity offsetting: A proposed methodology for better assessing losses and gains. J. Environ. Manage. 175, 46–59. https://doi.org/10.1016/j.jenvman.2016.03.027

Bayraktarov, E., Saunders, M.I., Abdullah, S., Mills, M., Beher, J., Possingham, H.P., Mumby, P.J., Lovelock, C.E., 2016. The cost and feasibility of marine coastal restoration. Ecol. Appl. https://doi.org/10.1890/15-1077

BBOP, 2012. Standard on biodiversity offsets. Washington, DC.

Bell, J., 2016. Implementing an outcomes-based approach to marine biodiversity offsets: lessons from the Great Barrier Reef. Australas. J. Environ. Manag. 1–16. https://doi.org/10.1080/14486563.2015.1081837

Bell, J., Saunders, M., Lovelock, C., Possingham, H., 2014. Legal frameworks for unique ecosystems – how can the EPBC Act offsets policy address the impact of development on seagrass? Environ. Plan. Law J. 31, 34–46.

Böhnke-Henrichs, A., Baulcomb, C., Koss, R., Hussain, S.S., de Groot, R.S., 2013. Typology and indicators of ecosystem services for marine spatial planning and management. J. Environ. Manage. 130, 135–45. https://doi.org/10.1016/j.jenvman.2013.08.027

Bos, M., Pressey, R.L., Stoeckl, N., 2014. Effective marine offsets for the Great Barrier Reef World Heritage Area. Environ. Sci. Policy 42, 1–15. https://doi.org/10.1016/j.envsci.2014.05.002

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3, 77–101.

Brinkmann, S., Kvale, S., 2014. Interviews: Learning the craft of qualitative research interviewing, 3rd ed. Sage publications, Inc., Thousand Oaks, US.

Brodie, J., 2014. Dredging the Great Barrier Reef: Use and misuse of science. Estuar. Coast. Shelf Sci. 142, 1–3.

Brown, M.A., Clarkson, B.D., Theo Stephens, R.T., Barton, B.J., 2014. Compensating for ecological harm - The state of play in New Zealand. N. Z. J. Ecol. 38, 139–146.

Brown, P.H., Lant, C.L., 1999. The effect of wetland mitigation banking on the achievement of No-Net-Loss. Environ. Manage. 23, 333–345. https://doi.org/10.1007/s002679900190

Brown, S.C., Veneman, P.L.M., 2001. Effectiveness of compensatory wetland mitigation in Massachusetts, USA. Wetlands. https://doi.org/10.1672/0277-5212(2001)021[0508:EOCWMI]2.0.CO;2

Brownlie, S., von Hase, A., Botha, M., Manuel, J., Balmforth, Z., Jenner, N., 2017. Biodiversity offsets in South Africa – challenges and potential solutions. Impact Assess. Proj. Apprais. 35, 248–256. https://doi.org/10.1080/14615517.2017.1322810

Bull, J.W., Gordon, A., Watson, J., Maron, M., 2016. Seeking convergence on key concepts in No Net Loss policy. J. Appl. Ecol. 53, 1686–1693. https://doi.org/10.1111/1365-2664.12726

Bull, J.W., Suttle, K.B., Gordon, A., Singh, N.J., Milner-Gulland, E.J., 2013. Biodiversity offsets in theory and practice. Oryx 47, 369–380.

Burgin, S., 2009. 'Mitigation banks' for wetland conservation: a major success or an unmitigated disaster? Wetl. Ecol. Manag. 18, 49–55. https://doi.org/10.1007/s11273-009-9147-5

Clare, S., Krogman, N., 2013. Bureaucratic slippage and environmental offset policies: The case of wetland management in Alberta. Soc. Nat. Resour. 26, 672–687. https://doi.org/10.1080/08941920.2013.779341

Clare, S., Krogman, N., Caine, K.J., 2013. The balance discourse: A case study of power and wetland management. Geoforum 49, 40–49. https://doi.org/10.1016/j.geoforum.2013.05.007

Commonwealth of Australia, 2018. Reef 2050 long-term sustainability plan.

Commonwealth of Australia, 2016. Reef 2050 plan - Investment framework.

Commonwealth of Australia, 2015. Reef 2050 plan — Investment baseline.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253–260. https://doi.org/10.1038/387253a0

Crowder, L., Norse, E., 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning. Mar. Policy 32, 772–778. https://doi.org/10.1016/j.marpol.2008.03.012

Fugard, A.J.B., Potts, H.W.W., 2016. 'Shine bright like a diamond'? A reply to Braun and Clarke. Int. J. Soc. Res. Methodol. 19, 745–746. https://doi.org/10.1080/13645579.2016.1205794

Gaskell, G., 2000. Individual and group interviewing, in: Qualittative Researching with Test, Image, and Sound: A Practical Handbook. Sage, London, pp. 38–56.

Gibbons, P., Macintosh, A., Constable, A.L., Hayashi, K., 2017. Outcomes from 10 years of biodiversity offsetting. Glob. Chang. Biol. 24, e643–e654. https://doi.org/10.1111/gcb.13977

Great Barrier Reef Foundation, 2018. Reef Trust Partnership [WWW Document]. URL https://www.barrierreef.org/science-with-impact/reef-partnership (accessed 9.13.18).

Green, J., Thorogood, N., 2018. Beginning data analysis, in: Seaman, J. (Ed.), Qualitative Methods for Health Research. SAGE, Los Angeles, pp. 249–284.

Gunningham, N., Kagan, R.A., Thornton, D., 2004. Social license and environmental protection: Why businesses go beyond compliance. Law Soc. Inq. 29, 307–341. https://doi.org/10.1111/j.1747-4469.2004.tb00338.x

Harper, D.J., Quigley, J.T., 2005. No net loss of fish habitat: a review and analysis of habitat compensation in Canada. Environ. Manage. 36, 343–355. https://doi.org/10.1007/s00267-004-0114-x

Jacob, C., Pilgrim, J., Bochove, J. Van, Bennun, L., Livingstone, S., White, T., 2020. Marine biodiversity offsets: Pragmatic approaches toward better conservation outcomes 1–12. https://doi.org/10.1111/conl.12711

Kentula, M.E., 2000. Perspectives on setting success criteria for wetland restoration. Ecol. Eng. 15, 199–209. https://doi.org/10.1016/S0925-8574(00)00076-8

Lindenmayer, D.B., Crane, M., Bekessy, S., Blanchard, W., Evans, M.C., Maron, M., Gibbons, P., 2017. The anatomy of a failed offset 210, 286–292. https://doi.org/10.1016/j.biocon.2017.04.022

Lipsky, M., 2010. Street-level bureaucracy: Dilemmas of the individual in public service. Russel Sage Foundation. https://doi.org/10.1007/SpringerReference_76056

Maron, M., Bull, J.W., Evans, M.C., Gordon, A., 2015a. Locking in loss: Baselines of decline in Australian biodiversity offset policies. Biol. Conserv. 192, 504–512. https://doi.org/10.1016/j.biocon.2015.05.017

Maron, M., Gordon, A., Mackey, B.G., Possingham, H.P., Watson, J.E.M., 2015b. Interactions between biodiversity offsets and protected area commitments: Avoiding perverse outcomes. Conserv. Lett. n/a-n/a. https://doi.org/10.1111/conl.12222

Maron, M., Walsh, M., Shumway, N., Brodie, J., 2016. Reef Trust offsets calculator. Brisbane, Queensland, Australia.

May, J., Hobbs, R.J., Valentine, L.E., 2017. Are offsets effective? An evaluation of recent environmental offsets in Western Australia. Biol. Conserv. 206, 249–257. https://doi.org/10.1016/j.biocon.2016.11.038

McKenney, B.A., Kiesecker, J.M., 2010. Policy development for biodiversity offsets: a review of offset frameworks. Environ. Manage. 45, 165–176.

Moffat, K., Lacey, J., Zhang, A., Leipold, S., 2016. The social licence to operate: A critical review. Forestry 89, 477–488. https://doi.org/10.1093/forestry/cpv044

Niner, H.J., Milligan, B., Jones, P.J.S., Styan, C.A., 2017a. A global snapshot of marine biodiversity offsetting policy. Mar. Policy 81, 368–374. https://doi.org/10.1016/j.marpol.2017.04.005

Niner, H.J., Milligan, B., Jones, P.J.S., Styan, C.A., 2017b. Realising a vision of no net loss through marine biodiversity offsetting in Australia. Ocean Coast. Manag. 148, 22–30. https://doi.org/10.1016/j.ocecoaman.2017.07.006

Owen, J.R., Kemp, D., 2013. Social licence and mining: A critical perspective. Resour. Policy 38, 29–35. https://doi.org/10.1016/j.resourpol.2012.06.016

Pickett, E.J., Stockwell, M.P., Bower, D.S., Garnham, J.I., Pollard, C.J., Clulow, J., Mahony, M.J., 2013. Achieving no net loss in habitat offset of a threatened frog required high offset ratio and intensive monitoring. Biol. Conserv. 157, 156–162. https://doi.org/10.1016/j.biocon.2012.09.014

Pilgrim, J.D., Brownlie, S., Ekstrom, J.M.M., Gardner, T.A., von Hase, A., ten Kate, K., Savy, C.E., Stephens, R.T.T., Temple, H.J., Treweek, J., Ussher, G.T., Ward, G., 2013. A process for assessing the offsetability of biodiversity impacts. Conserv. Lett. 6, 376–384. https://doi.org/10.1111/conl.12002

Pilgrim, J.D., Ekstrom, J.M.M., 2014. Technical conditions for positive outcomes from biodiversity offsets An input paper for the IUCN Technical Study Group on Biodiversity Offsets. Gland, Switzerland.

QSR International Pty Ltd, 2018. NVivo qualitative data analysis software.

Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., Stringer, L.C., 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. J. Environ. Manage. 90, 1933–49. https://doi.org/10.1016/j.jenvman.2009.01.001

Richert, C., Rogers, A., Burton, M., 2015. Measuring the extent of a social license to operate: The influence of marine biodiversity offsets in the oil and gas sector in Western Australia. Resour. Policy 43, 121–129. https://doi.org/10.1016/j.resourpol.2014.12.001

Salzman, J., Ruhl, J.B., 2000. Currencies and commodification of environmental law. Stanford Law Rev. 53, 607–694.

Shumway, N., Watson, J.E.M., Saunders, M.I., Maron, M., 2018. The Risks and Opportunities of Translating Terrestrial Biodiversity Offsets to the Marine Realm. Bioscience. https://doi.org/10.1093/biosci/bix150

Vaissière, A.-C., Levrel, H., Pioch, S., Carlier, A., 2014. Biodiversity offsets for offshore wind farm projects: The current situation in Europe. Mar. Policy 48, 172–183. https://doi.org/10.1016/j.marpol.2014.03.023

Vaissière, A.-C., Levrel, H., Scemama, P., 2016. Biodiversity offsetting: Clearing up misunderstandings between conservation and economics to take further action, Biological Conservation. https://doi.org/10.1016/j.biocon.2016.11.036

Walker, S., Brower, A.L., Stephens, R.T.T., Lee, W.G., 2009. Why bartering biodiversity fails. Conserv. Lett. 2, 149–157. https://doi.org/10.1111/j.1755-263X.2009.00061.x

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Appendix A – Legislative background to biodiversity offsetting in Australia

Table A2. Key elements of policy framework for marine biodiversity offsetting in Australia

Jurisdiction	Relevant policy and guidelines	Policy aim	Relevant marine ecological receptors	References
Federal	EPBC Act Environmental Offsets Policy (2012)	Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	Wetlands of international importance (listed under the Ramsar Convention) Listed threatened species and ecological communities (e.g. certain areas of sea grass or kelp, turtles, dugongs, whales and dolphins). Migratory species protected under international agreements (e.g. sawfish, shark and ray species) Commonwealth marine areas Great Barrier Reef Marine Park	(Australian Government, 2012)
Great Barrier Reef (GBR) Marine Park	Reef 2050 Plan Net Benefit Policy	Net Benefit	Great Barrier Reef (GBR)	(Australian Government, 2017; Commonwealth of Australia, 2018)
New South Wales	Policy and guidelines for fish habitat conservation and management (2013)	No net loss of key fish habitats in NSW	Key fish habitats	(Fairfull, 2013)
Queensland	Environmental Offsets Act (2014); Environmental Offsets Regulation (2014); Queensland Environmental Offsets Policy (v1.2 (2014)- v1.8 (2020))	Offsets must achieve an equivalent or better environmental outcome	Marine plants or works in a declared Fish Habitat Area	(Fisheries Queensland, 2012; State of Queensland, 2020, 2015, 2014)

Jurisdiction	Relevant policy and guidelines	Policy aim	Relevant marine ecological receptors	References
South Australia	Policy for Significant Environmental Benefit (2015, updated 2019)	Net environmental gain - to achieve an overall environmental gain over and above the scale of the impact. This must involve measurable conservation outcomes resulting from specific actions.	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	(Department of Environment Water and Natural Resources, 2019, 2015)
Victoria	Planning and Environment Act (1987); Guidelines for the removal, destruction or lopping of native vegetation (2017)	Offsets are designed to compensate for the biodiversity value of native vegetation only, not its other values	Native vegetation (e.g. seagrass)	(Department of Environment and Primary Industries and State Government Victoria, 2013; State of Victoria Department of Environment, 2017)
Tasmania	-	-	-	-
Northern territory	-	-	-	-
Western Australia	WA Environmental Offsets Policy (2011); WA Environmental Offsets Guidelines (2014)	Protect and conserve environmental and biodiversity values for present and future generations. This policy ensures that economic and social development may occur while supporting long term environmental and conservation values. Environmental offsets are actions that provide environmental benefits which counterbalance the significant residual environmental impacts or risks of a project or activity.	Significant impacts requiring an offset – any significant residual impact of this nature will require an offset. These generally relate to any impacts to species, ecosystems, or reserve areas protected by statute or where the cumulative impact is already determined to be at a critical level.	(Government of Western Australia, 2014, 2011)

References

Australian Government, 2017. Reef Trust Offsets: How the Reef Trust Manages Offsets Funds October 2017.

Australian Government, 2012. Environment Protection and Biodiversity Conservation Act 1999: Environmental Offsets Policy. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Commonwealth of Australia, 2018. Reef 2050 Plan: Net Benefit Policy. https://doi.org/10.1017/CBO9781107415324.004

Department of Environment and Primary Industries, State Government Victoria, 2013. Permitted clearing of native vegetation: Biodiversity assessment guidelines.

Department of Environment Water and Natural Resources, 2019. Policy for significant environmental benefit. https://doi.org/10.1002/ejoc.201200111

Department of Environment Water and Natural Resources, 2015. Policy for significant environmental benefit. Adelaide, South Australia. https://doi.org/10.1002/ejoc.201200111

Fairfull, S., 2013. Fisheries NSW Policy and guidelines for fish habitat conservation and management. Wollongbar. https://doi.org/ISBN 978 1 74256 283 4

Fisheries Queensland, 2012. Marine fish habitat offset policy.

Government of Western Australia, 2014. WA Environmental Offsets Guidelines. Perth, WA.

Government of Western Australia, 2011. WA Environmental Offsets Policy. Perth, WA.

State of Queensland, 2020. Queensland Environmental Offsets Policy (Version 1.6).

State of Queensland, 2015. Environmental Offsets Act 2014.

State of Queensland, 2014. Environmental Offsets Regulation.

State of Victoria Department of Environment, T., 2017. Guidelines for the removal, destruction or lopping of native vegetation.

Appendix B – Methods supplementary material

Table B1. Topic guide used for semi-structured interviews.

Aims and objectives 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: • Current practice • Drivers and barriers to current practice • Perceptions of success • Views on achieving NNL in the marine environment
1. Introduction
– Introduction of interviewer and project and participant selection – 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 – Any questions – Start recording
2. Background
Aim: to establish context of perspective and experiences
– Contact with biodiversity offsetting and marine biodiversity offsetting – 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? – What did it introduce to processes? Use of mitigation hierarchy, offset design, compliance monitoring, precautionary principle etc. – Purpose/drivers for use of offsets – reasons for increased use – 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 – Disadvantages/risks – Environmental outcomes (NNL)? – 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 – Is NNL practicable in the marine environment? Coastal vs offshore, could it be achieved in another way? – 'Unlimited' nature of biodiversity in marine environment
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 – Risks/opportunities of current practice.