Social preferences for the design of biodiversity offsets for shorebirds in Australia

Abstract

Understanding the social acceptability of biodiversity offsets is important in order to properly design offset policy. This study used a discrete choice experiment to quantify preferences of the Australian people for a migratory shorebird offset, in the context of an oil and gas development. We used both current and prospective offset policy characteristics, with a view to informing future policy design of the social dimensions related to offset acceptability. We found that the practice of offsetting was accepted by the community as a means to allow economic development. Substituting protection of a species impacted by the development for a more endangered species was a desirable policy characteristic, as was having the offset implemented by a third party or the government, rather than the company responsible for the development. Direct offset activities were preferred over indirect, and there was a strong aversion to locating the offset at a site other than where the impact occurred. The rate at which positive and negative characteristics can be traded off is identified.

Introduction

Biodiversity offsets can compensate for unavoidable environmental impacts resulting from development. The potential for offsets to allow project specific investments to proceed while accounting for environmental damage has drawn international interest from government and non-government agencies, and development companies. Offset policies are being implemented by governments worldwide to formalize the appropriate design of offsets (Mckenney & Kiesecker 2010). While the objectives of these policies are often similar, typically centred on the concept of 'no net loss' (Bull & Brownlie 2015), there is variability in the policy characteristics to achieve this (Mckenney & Kiesecker 2010).

Scientific evidence cautions that offsets must be designed carefully, or they can fall short of delivering their environmental objectives (Dickie et al. 2013; Temple et al. 2012; ICMM IUCN, 2012; Quétier et al. 2014; Treweek et al. 2009). Therefore, ecological feasibility should be the key consideration in offset policy design. Once ecological feasibility is established, it is possible that flexibility will remain in how an offset is designed. The economic and social aspects of design can then be considered. A better understanding of community acceptance could help to set the social boundaries within which offset policies operate, reducing the risk of public resistance to the practice (Burton et al. 2016; Richert et al. 2015).

Research on offsets to date has primarily focussed on their physical design (e.g. Dickie et al. 2013; Department of Environment and Conservation NSW 2011; Quétier & Lavorel 2011; Madsen et al. 2010; Middle & Middle 2010; Hayes & Morrison-Sanders 2007). There is some work on social acceptability: Bougherara et al. (2013) study community acceptance of firms making versus buying offsets in milk production in France. Burton et al. (2016) quantify preferences of the West Australian community for biodiversity offsets, in the context of an oil and gas development impacting on the habitat of a species of a nationally protected migratory shorebird. Paredes (2015) conducted a similar study in Queensland.

In Australia, offsets are governed by both State and Commonwealth policies. Offsets are required when a development cannot avoid or mitigate all environmental impacts. The offset policies aim to achieve equivalence: a proponent must demonstrate that the offset will achieve 'no net loss', typically by protecting or improving equivalent environmental matter elsewhere. State offset policies apply to any residual environmental damage that occurs as a result of development within

the state (e.g. Government of Western Australia 2011); the Commonwealth's Environmental Protection and Biodiversity Conservation (EPBC) Act Offset Policy applies in addition when a 'matter of national environmental significance' is affected by the development (Australian Government 2012). Australian policies, particularly the latter, are prescriptive in terms of permissible offset design: there is a strong emphasis on direct (like-for-like) actions and limited scope to substitute protection for other species, habitats or locations.

Using a discrete choice experiment (DCE) (Hensher et al. 2005), we relax the existing policy setting to investigate the social acceptability of changes in the design of a biodiversity offset for shorebirds. We examined preferences of the Australian community for the type of offset activity, location of the offset, the species and the number of individuals of that species protected, and the party responsible for implementing the offset. Overall economic and environmental tradeoffs were also examined by altering the number of jobs created, where it was hypothesised that more jobs would lead to greater acceptance of an offset.

In the DCE that follows, the hypothetical scenario controls for uncertainty related to the offset. The environmental damages are assumed to be known, and the policy options offered are assumed to deliver the required offset. We acknowledge that there is often uncertainty in these measurements in real offset applications, and the results of this study should be viewed with this in mind.

Methods

Discrete choice experiment

Discrete choice experiments have been widely applied in the environmental non-market valuation literature to quantify the tradeoffs people are willing to make between different environmental attributes (Adamowicz 2004). A sequence of hypothetical questions (choice scenarios) to respondents, each of which contains potential policy options (alternatives), which in turn include statements of the outcomes of those policies. The outcomes are described in terms of the policy's characteristics (attributes). The set of attributes are the same for each alternative in the choice scenario, but they can take on different levels or amounts, varying the outcome of each alternative. Respondents are asked to select their most preferred policy package out of the set of alternatives given. An 'opt-out' is commonly included in the choice scenario so that a respondent is not forced to choose a policy alternative they would not vote for.

In this DCE, the hypothetical policy context was an oil and gas development in the vicinity of a beach on the Kimberley coast in Australia's north-west. Respondents were advised that some environmental impacts could be avoided or mitigated, but there would be residual impacts on the use of the beach as a feeding ground by 1000 Ruddy Turnstones (*Arenaria interpres*), a species of shorebird. These birds are protected under Australia's EPBC Act as a migratory species, and would require an offset to compensate for the impact if the development were to proceed (Australian Government 2012).

Developments in the resource sector commonly require offsets to manage residual impacts, and the migratory status of shorebirds triggers both State and Commonwealth policies, while having cross-border and international relevance. Hence our experimental context reflects current conditions for offset policy in Australia.

Attribute selection

The choice scenarios used attributes that varied the way in which an offset was implemented. Respondents were informed that each offset would achieve no net loss from an ecological perspective, to remove any uncertainty around the success of each option presented. Attributes were selected based on: (1) the policy characteristics currently used, or being considered, in Australian offset design (based on personal discussions); (2) the policy characteristics that were raised in two focus groups (16 participants); and, (3) information gathered from Burton et al. (2016). They included the proportion of direct offsets, location of the offset, who would implement the offset, what species and how many individuals would be protected, and the size of the development (Table 1). An 'opt-out of development' option was also specified. This avoids respondents being forced to make choices between offset packages when they would prefer the development not to proceed.

[Insert Table 1 around here]

In Australia, most offset policies prescribe that the majority of an offset should be direct; that is, a tangible on-ground intervention aimed at improving the environment of the impacted species (Middle & Middle 2010). However, the potential to use other compensatory measures, or 'indirect offsets', also exists, where it can be demonstrated they will provide greater environmental benefit than a direct offset (Australian Government 2012; Government of Western Australia 2011). Indirect offsets relate to activities that aim to improve future management of the impacted species (Middle & Middle 2010). For example, the EPBC Act Offset Policy permits indirect offsets where there is scientific uncertainty regarding the best approach for a direct offset, and research to improve understanding of the relevant ecosystem to guide future management is preferable. Approval of an offset under the policy means that there is a legal obligation to deliver the outcome of 'no net loss', whether that be via direct or indirect activity. Uncertainty in delivering the outcome (directly or indirectly) can be addressed by adjusting the quantity of the activity. However, even with these controls in place, it is possible that people could perceive direct offsets as being more reliable, or otherwise preferable. The proportion of direct offsets varied between 50 and 100%, with indirect offsets defined as research that would improve existing on-ground management of the birds. In reality, it can be difficult to measure the environmental gains of indirect offsets in comparable metrics to direct offsets. For example, indirect offsets might be measured in research outputs or peer reviewed articles, compared to direct offsets being measured by habitat area, survival rates, or species diversity (Gonçalves et al. 2015; Australian Government 2012). Our experiment controlled for this by informing respondents that the ecological outcome was equivalent and achievable by either (or a combination of) a direct or indirect offset, confirmed by independent scientists, and measured in terms of the number of birds protected by the offset.

For a migratory shorebird species, it is possible to intervene at various points in its flyway to improve its welfare (Bamford et al. 2008). An intervention located away from the development site might not affect the welfare of the specific individuals impacted by the development, but it could ensure no net loss to the species overall. Many shorebirds stop to rest and feed at bottleneck sites in eastern Asia during their migration along the East-Asian-Australasian flyway (Iwamura et al. 2013). Conservation gains could be achieved outside of Australia, even if the development impact occurs within Australia (Gonçalves et al. 2015). Shorebird offsets in other regions might be cheaper and more effective if targeting critical habitat bottlenecks. However, issues of governance and a desire for local solutions to local problems may lead respondents to reject offsets away from the impact site. The offset location attribute reflected regions the shorebirds travel through: Western Australia, Northern Territory, New Zealand and China. As with the other attributes, respondents were told that each location was ecologically capable of delivering the offset. That is, the ecological effectiveness of location was held constant so that we could establish the trade-off required for a location away from

the impact site to be socially acceptable: how many more birds are required to be protected, or how much more effective does the offset need to be, if it is located elsewhere.

While the financial obligation for an offset lies with the developer, they do not necessarily have to implement the offset themselves. We included an attribute to reflect this, where the implementer could be the developer, the Government's environment department for the region in which the offset occurs, or a third party company with a proven track record in offsets. It was anticipated that respondents might have less confidence, for example, in the developer implementing the offset (Bull & Brownlie 2015), relative to an independent third party. We did not vary the party responsible for regulating the offset, as the obligation to ensure its success lies with the Australian and West Australian governments.

Offsets are typically aimed at protecting the species impacted by a development, adhering to the strict definition of 'no net loss'; in this case, the Ruddy Turnstone. However, the community might perceive there to be greater benefits by protecting a more endangered species with the offset: the Eastern Curlew (*Numenius madagascariensis*). Including this alternative offers an initial response to the question posited by Bull and Brownlie (2015, p.5) as to "the extent to which loss of biodiversity is accepted in exchange for conservation of biodiversity of a higher priority". The Eastern Curlew has a similar migratory presence to the Ruddy Turnstone, making it a suitable substitute for the purpose of the experimental design. It was made clear to respondents that this species would be protected instead of (and not in combination with) the Ruddy Turnstone.

The number of individuals of the species protected by the offset was varied, so that potentially more birds would be protected relative to the number impacted by development. This allowed us to estimate how many additional birds would need to be protected for people to accept socially undesirable policy characteristics. The Ruddy Turnstone ranged from 1000 to 2000 individuals protected, and the Eastern Curlew from 500 to 2000. The difference in the minima reflected that at least 1000 turnstones had to be protected as that was the number impacted by development, while a smaller number of curlews might be acceptable given their more endangered status.

Finally, there was a split design, with two different survey versions: with either 500 or 1000 new jobs arising from the development. It was anticipated that the difference in economic size of the development would not change the preferences for the attributes of the offset, but may influence selection of the no development alternative.

Survey and experimental design

In the survey, respondents were introduced to the concept of biodiversity offsets and asked about their existing knowledge of them (see Supporting Information for sample characteristics). The steps required by developers to avoid, mitigate, then offset environmental damages to achieve 'no net loss' were described using an example of seagrass habitat. Next, respondents were presented with the hypothetical development and attribute descriptions, and the DCE. The choice scenarios were designed with three policy alternatives and an opt-out alternative. Ngene (Rose et al. 2012) was used to generate an s-efficient design using the parameters estimated in Burton et al. (2016) as priors (see Rose & Scarpa 2008 for an overview of efficient designs), resulting in 24 choice scenarios blocked into four groups of six. Each respondent answered one block of six questions.

The DCE was accompanied by a consequential statement explaining the study results could be used to adapt current offset policy in Australia. Debriefing questions followed the choice experiment, asking respondents about the certainty of their answers and whether they found the choice

scenarios or information provided confusing. Attribute non-attendance questions were not included due to the length of the survey. Another section asked respondents about their attitudes towards the oil and gas industry, including 15 questions aimed at measuring respondents' social license to operate (SLO) for the industry. A SLO is an implicit contract between an industry or company and its stakeholders, where the risk of socio-political challenges to the industry's operations is reduced if it behaves in a manner befitting its stakeholders' values (Prno & Slocombe 2012; see Supporting Information). Finally, socio-demographic information was collected.

There was no personal cost included in this choice experiment. Conventionally, a cost is included to enable calculation of monetary values for changes in attributes. However, asking for a personal expenditure to achieve an offset that is a legal requirement (and the financial responsibility of the developer) was deemed inappropriate. This study was interested in the tradeoffs across attributes, rather than placing a dollar value on offset outcomes *per se*.

The survey was administered online by a market research company. A nationally representative sample (stratified by age, gender and location – see Supporting Information) of 1371 respondents completed the survey during October-November 2014. The survey was conducted in accordance with The University of Western Australia's Human Research Ethics procedures (#RA/4/1/6036).

Data analysis

Data were analysed using Intercooled Stata/IC 13.1 (Statacorp 2013) (see Supporting Information for a description of random utility theory and the multinomial logit model, and Train 2009). We specified an error components multinomial logit model to account for different correlation patterns across alternatives, and in particular between the offset options compared to the opt-out (Scarpa et al. 2006). Individual specific covariates were interacted with the alternative specific constant (ASC) or with attribute variables. The ASC captures the utility associated with a labelled alternative, in this case the opt-out. The full utility function specification is reported in the Supporting Information. Note that alternative modelling approaches that capture additional heterogeneity exist, including mixed logit models with parameters treated as random (Train 2009). Several alternative models were estimated with this data, and while they did better explain the distribution of preferences across individuals in the sample, the results for an average individual were similar and did not alter the policy conclusions which are the focus of this paper.

Results

The greater the SLO granted to an industry by its stakeholders, the lower the risk to the industry's operations (Prno & Slocombe 2012). In the case of the Australian oil and gas industry, the stakeholders are the general public, who could be directly or indirectly affected by the environmental impacts of an oil or gas development. Following the approach of Richert et al. (2015), two measures of the SLO for the industry were derived from the 15 questions: a measure of 'economic legitimacy' (*SLO_Econ*), which is attained when respondents believe the industry will provide economic benefits; and, a measure of 'social legitimacy' (*SLO_Soc*), which is reached when respondents believe the industry will improve community wellbeing and will act in consideration of community interests. These were derived as simple averages of scores from two subsets of questions. The partition into the two measures was confirmed by factor analysis: the Supporting Information provides further detail. In the current context, it was anticipated that a stronger social license would lead to increased acceptance of offsets, and of the developer implementing them.

Table 2 reports the choice model results which show that respondents preferred higher levels of direct offset relative to indirect (*Percent*), and that they had a preference for more *Birds* being protected by the offset. The effect of changing bird species is reflected in two coefficients: the impact of changing species on the marginal value of additional birds protected (*Ruddy TurnstonexBirds*), and a species specific dummy (*Ruddy Turnstone*). The former is negative, indicating that the marginal value of an additional Ruddy Turnstone being protected is less than that of an Eastern Curlew, but the species specific dummy is positive, suggesting that there is an initial preference for Ruddy Turnstone over Eastern Curlew. At the original level of 1000 birds affected, respondents were (statistically) indifferent between the two species, but as numbers increased, the marginal value gained from additional Ruddy Turnstones was less than that for Eastern Curlews, implying they valued the more endangered species more (see Supporting Information for a more detailed analysis).

[Insert Table 2 around here]

The preference ranking of offset location was *Western Australia* (where the impact occurred), *Northern Territory*, *New Zealand* and then *China*. We investigated whether there was an 'own state' preference by interacting the location variables with a dummy variable indicating whether the respondent was a West Australian resident (*WA*). West Australian residents gained greater disutility from shifting the offset out of the impact State compared to residents of other states. Unfortunately the sample of Northern Territory respondents was not large enough (reflecting the small size of the region: 1% of the national population) to estimate a model that would identify if Territory residents had greater preferences to bring the offset *to* the Northern Territory.

On average, the *Developer* was less preferred as the implementer of the offset, and a *3rd party* more preferred, relative to the *Government*. By interacting the developer variable with the SLO variables, we explored whether the level of SLO changes the acceptability of the developer to respondents. This was the case for the social legitimacy variable (*SLO_Soc x Developer*), where the coefficient was positive and significant, but not for economic legitimacy (*SLO_Econ x Developer*), which was negative but not significant.

Given the normalization of the SLO variables (zero mean and a standard deviation of one), respondents who had a social legitimacy score one standard deviation from the mean would have an implied marginal utility for the developer being the implementer of +0.02 (from Table 2, the coefficient for *Developer* plus that for *SLO_Soc x Developer,* i.e.: -0.189+0.211). That is, this group of the sample were essentially indifferent between the government and the developer implementing the offset. Conversely, those who held a lower social legitimacy score would be even more averse to an offset implemented by the developer. A relatively small proportion of the sample preferred the developer over the government (those at the upper end of the distribution of the social legitimacy score). However, this effect is not sufficient to overcome the preference for the 3rd party implementer.

Respondents could potentially reject the offsets offered by selecting the opt-out, which would retain the original ecological conditions, but also no economic benefit in terms of jobs. However, relatively few did: in only 13% of choice occasions was the opt-out selected.

By interacting the ASC dummy with the SLO variables, one can identify whether the level of SLO changes the tendency to reject development entirely. Individuals who held higher social license scores (as shown by coefficients on *SLO_Econ x ASC, SLO_Soc x ASC*) tended to hold a lower utility for

the opt-out; or conversely, those who held a low SLO for the oil and gas industry tended to select the opt-out option more often.

We introduced the number of jobs as an interaction variable with the opt-out ASC to allow for the possibility that the probability of rejecting the development entirely may be influenced by its economic impact, but it was not significant (results not reported here).

Tradeoffs across attributes can be estimated through marginal rates of substitution; that is, the rate at which one can substitute the level of one attribute for another, and leave the respondent at the same level of utility. These are calculated by dividing the marginal utility of an attribute by that of the numeraire, which can be any continuous attribute. In this case, we used the number of Ruddy Turnstones. The interpretation of the resulting marginal rates of substitution is the change in the number of Ruddy Turnstones protected that is required to exactly compensate for a change in another attribute. A negative number indicates a change in an attribute that respondents value (i.e. bird numbers can be reduced), while a positive number implies that the attribute change reduces utility, and more birds are needed to compensate for it.

[Insert Table 3 around here]

Table 3 reports the marginal rates of substitution for the attributes measured in terms of numbers of Ruddy Turnstones. If the Eastern Curlew were to be used as the numeraire the numbers would be 61% of those in Table 3, due to the higher marginal value placed on the species. We caution that while precise estimates of bird numbers are presented here, in practise there will be scientific uncertainties around how many birds an offset will actually generate. The numbers here are intended to be indicative of the magnitude of the offset required.

For offset location, if the default is 1000 Ruddy Turnstones in an offset in Western Australia, an additional 353 birds would have to be included to compensate for moving the offset to the Northern Territory, 808 for New Zealand, and 2092 to compensate the movement to China (i.e. the offset in China would require a total of 3092 birds to be seen as equivalent to the 1000 birds in Western Australia). For a resident in Western Australia, these values were higher: the offset in China would require a total of 6752 birds to compensate (i.e. from Table 3: default[1000] + China[2092] + WA x China[3660]).

For direct versus indirect offsets, eight fewer birds would be required for every additional percentage point of direct offset. That is, an increase from 90% to 95% would require 40 fewer birds; a decrease from 90% to 85% would require 40 additional birds to be considered equivalent.

Table 3 also shows that a change in implementer from government to the developer would require an additional 352 birds in the offset for a respondent with mean SLO scores. Individuals with a social legitimacy score that is one standard deviation above the mean would prefer the developer to undertake the offset, and in fact would be content with a slightly smaller number of birds protected (352-393=-41). Although reported, note that the effect that economic legitimacy has on the developer is not significantly different from zero. Acceptance of the use of a third party implementer would be feasible with a lower number of birds protected, relative to government implementation.

Discussion

With biodiversity offsets being increasingly used worldwide to compensate for unavoidable environmental damages resulting from development, it is important for governments to set appropriate policies for offset implementation (Gonçalves et al. 2015). Getting the science right is

obviously critical in meeting the objective of 'no net loss'; however, there might be different methods by which that could be achieved. It is important to ensure that offset policies reflect what is acceptable by community standards. This study explored the community's acceptance of a number of potential policy characteristics, in the context of Australian biodiversity offsets for migratory shorebirds impacted by an oil and gas development. Being a new area of study, it is important to note that the extrapolation of these results to other biodiversity contexts or to policy settings outside of Australia must be viewed with caution.

There was widespread acceptance of the use of offsets in this context, with respondents rarely opting out of development. We had anticipated that a development leading to more jobs created (and corresponding economic benefit to the community), would influence the willingness to allow the project to proceed. For the number of jobs we considered, this was not the case, implying that the scale of the development was not influencing attitudes towards environmental management.

The social license to operate that individuals held for the oil and gas industry influenced the general acceptance of offsetting: those who granted a lower SLO were more averse to the development proceeding, relative to those granting a higher SLO. From a developer's perspective, this would suggest that maintaining a positive relationship with the local community will be important for gaining approval to embark on projects requiring offsets (Richert et al. 2015).

There was a preference for more shorebirds to be protected by the offset, and, once the number of birds exceeded the number impacted (1000 birds), the marginal value for each additional bird was greater for the more endangered Eastern Curlew relative to the impacted Ruddy Turnstone. This suggests that 'trading-up' of species was accepted by the community. Currently in Australia, the Commonwealth legislation does not allow this substitution (Australian Government 2012); however, some State policies suggest it could be possible if the ecological benefit to the substitute species exceeded that of an offset for the impacted species (Government of Western Australia 2011). If the science supports an offset focusing on a more critically endangered species (or habitat), it would be worthwhile having flexibility in offset policies to allow this.

There was a preference for direct versus indirect offsets, suggesting respondents may have been placing a risk premium on indirect offsets to account for uncertainty in research outcomes, despite being told the offset was equivalent via either approach. However, there is also literature which shows that people may care about how policy is implemented, and not just the outcome (Rogers 2013). This finding supports the current Australian position for the majority of an offset to be direct (Australian Government 2012). However, the use of indirect offsets could be compensated for by other factors: increasing the number of shorebirds protected by the offset beyond the number impacted (an additional eight Ruddy Turnstones for every percentage point) was an acceptable tradeoff for increasing the proportion of indirect offset activity. This suggests that where direct offsets may not be practicable, indirect offsets can be considered on the condition that they are ecologically plausible and that some multiplier is used to protect more of the impacted matter (i.e. over and above any multiplier required to improve confidence levels in biodiversity outcomes, see Bull & Brownlie 2015).

As in Burton et al. (2016), respondents preferred the offset to be located close to the site of impact (Western Australia). Utility diminished as the offset moved offshore: China was the least preferred location. Burton et al. (2016) only sampled population from Western Australia, meaning it was not possible to differentiate between an ecological imperative (keeping the offset near the impact) and a geo-social one (keeping the offset in the same state as the respondent). Here, the national sample demonstrated that the effect of diminishing utility with increased distance from the impact site was

present, irrespective of which state they lived in. This implies that, for the Australian locations where perceived ecological and governance risks should be constant, there is a preference to keep the offset close to the impact site due to geographical distance. However, for international locations, the diminished utility could additionally reflect concerns about ecological and governance risks: for example, the ability of the Australian Government to enforce an outcome. While respondents were informed that the ecological outcome was equivalent at all locations, they may not have accepted this due to their own perceptions of risk, or a preference for locations independent of ecological outcomes. This reaction to location was emphasised if the respondent was a West Australian resident, suggesting there may also be some degree of 'local offsets for local people' (e.g. reflecting enhanced use value or a desire to keep the benefits within their State).

It was possible to compensate for the disutility of moving the offset away from the impact site by increasing the number of birds protected. A substantial increase in the number of birds was required, especially if the offset was located overseas (thousands of birds). From a community perspective, offsets are unlikely to be acceptable if they are too distant from the impact site. This is an interesting divergence from an ecological perspective: in the case of migratory shorebirds it would be desirable to use offsets internationally at sites with habitat bottlenecks (Iwamura et al. 2013). Policy design will need to be mindful of these potentially conflicting views, and should consider raising community awareness if international offset strategies are adopted.

Respondents were more accepting of an offset if it was implemented by the government (i.e. the relevant environmental department for the region), relative to the developer themselves. A third party with a proven track record in offsetting was the most preferred implementer. Individuals who held a high SLO, granting the oil and gas industry social legitimacy, would accept the developer as an implementer. This was a very small proportion of individuals, as social legitimacy is difficult for the industry to achieve (Richert et al. 2015). While economic legitimacy is more readily granted to the oil and gas industry, it did not improve the acceptability of the developer as an implementer. This implies that, even when a developer has a generally positive economic legitimacy, the majority would still prefer that an offset policy requires implementation via the transferring of funds from the developer to the government or a third party. We reiterate that preferences for who *implements* the offset were set in the context of Australian governments being responsible for *monitoring* the offset, and that trust in the monitoring body could influence preferences (an issue we did not explore). Currently, Australian policies are not prescriptive as to who should implement an offset.

In conclusion, the choice experiment has shown a general acceptance of biodiversity offsets by the Australian community in the context of an oil and gas development. It also provides support for increasing the flexibility in some offset policy characteristics. In particular, the trading up of species was considered acceptable. Other policy characteristics would be accepted provided that appropriate compensation was offered by protecting more biodiversity. This was relevant for increasing the proportion of indirect offset activity and moving the offset to a location away from the impact site. Acceptability of offsetting improved if the responsibility of implementation was shifted away from the development company and to a third party.

Supporting Information

'Measuring Social License to Operate' (Appendix S1), 'Estimation of discrete choice models' (Appendix S2), 'Sample characteristics' (Appendix S3), and 'Marginal value of bird species' (Appendix S4) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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465 Train K. 2009. Discrete Choice Methods with Simulation. Second edition. Cambridge University Press,
466 New York.

Treweek J, ten Kate K, Butcher B, Venn O, Garland L, Moran D, Thompson S. 2009. Scoping Study for the Design and Use of Biodiversity Offsets in an English Context. Treweek Environmental Consultants, Final report to Department for Environment, Food and Rural Affairs, London.

494 Table 1. The offset policy attributes included in the choice experiment, with level specifications and
495 variable names.

Attribute	Level	Variable name	(and coding)
Proportion of direct offset activity	50%,60%,70%,80%, 90%,100%	*Percent*	(continuous)
Location of offset	Western Australia	*Western Australia*	(base level)
	Northern Territory	*Northern Territory*	(= 1 if present, 0 otherwise)
	New Zealand	*New Zealand*	(= 1 if present, 0 otherwise)
	China	*China*	(= 1 if present, 0 otherwise)
Offset implementer	Government	*Government*	(base level)
	Developer	*Developer*	(= 1 if present, 0 otherwise)
	Third Party	*3rd Party*	(= 1 if present, 0 otherwise)
Species protected by offset	Eastern Curlew	*Eastern Curlew*	(base level)
	Ruddy Turnstone	*Ruddy Turnstone*	(= 1 if present, 0 otherwise)
Number of birds protected	500*, 1000, 1500, 2000	*Birds*	(continuous)

496 * The level of 500 was only included if the species was the more endangered, but non-impacted, Eastern Curlew as the
497 stated impact of the development is 1000 birds, and hence this has to be achieved for the Ruddy Turnstone.
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512 Table 2. Estimates of an error components logit model for the choice data.

Variable	Coefficient	(SE)	
Percent	0.004	(0.001)	***
Ruddy Turnstone	0.282	(0.105)	***
Birds	8.7E-4	(3.8E-5)	***
Ruddy TurnstonexBirds	-3.3E-4	(6.9E-5)	***
Northern Territory	-0.190	(0.037)	***
WAxxNorthern Territory	-0.490	(0.126)	***
New Zealand	-0.435	(0.054)	***
WAxNew Zealand	-0.623	(0.184)	***
China	-1.127	(0.056)	***
WAxChina	-0.845	(0.185)	***
Developer	-0.189	(0.032)	***
SLO_Econ x Developer	-0.054	(0.036)	
SLO_Soc x Developer	0.211	(0.035)	***
3rd Party	0.101	(0.030)	***
SLO_Econ x ASC	-1.107	(0.171)	***
SLO_Soc x ASC	-0.930	(0.160)	***
ASC	-2.839	(0.240)	***
σ^2	*3.776*	*(0.198)*	***

513 Notes: *** denotes significance at the 99% level of confidence.
514 Log likelihood = -9199.591; number of choice occasions = 8226; number of individuals = 1371.
515 Interaction variable definitions:
516 SLO_Econ: social license to operate economic legitimacy variable, normalised so mean=0, std dev.=1
517 SLO_Soc: social license to operate social legitimacy variable, normalised so mean=0, std dev.=1
518 WA: dummy variable =1 if respondent lives in Western Australia
519 Percent and Birds are continuous variables
520 Ruddy Turnstone, Northern Territory, New Zealand, China, Developer, and 3rd party =1 if present; =0 otherwise.
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532 Table 3. Marginal rates of substitution, using the number of Ruddy Turnstones as the numeraire.

Variable	Coefficient	95% CI	
percent	-8	-12	-5
Northern Territory	353	206	500
WA x Northern Territory	1263	750	1776
New Zealand	808	554	1061
WA x New Zealand	1965	1197	2732
China	2092	163	2521
WA x China	3660	2676	4645
Developer	352	204	499
SLO_Econ x Developer	100	-33	233
SLO_Soc x Developer	-393	-548	-238
3rd party	-188	-301	-75

533 Notes: For the location variables, these represent the marginal rates of substitution for respondents who live in WA, and
534 those not in WA.
535 For the SLO interactions, these represent the change in marginal rates of substitution as the SLO changes by one,
536 equivalent to one standard deviation.
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S1: Measuring Social License to Operate

In measuring the Social License to Operate (SLO) we follow the implementation reported in Richert et al. (2015), which itself was based on the work of Boutilier and Thomson (2011). A set of 15 questions, modified from those used by Boutilier and Thomson (2011) to make them relevant for our context, were presented to respondents. These were hypothesized to be linked to three underlying levels of SLO. It is Boutilier and Thomson's contention that SLO is earned progressively, from Economic legitimacy to Interactional trust to Institutionalised trust, and the questions are designed to identify the level of SLO on these three criteria.

Richert et al. (2015), using a smaller Western Australia sample, found that only two levels were identified in their data, which they term "Economic legitimacy" and "Social legitimacy" (the latter consisting of the two higher levels of Boutilier and Thomson's hierarchy). Economic legitimacy was measured by the first four questions in Table S1 below, while social legitimacy was determined by scores to the remaining 11 questions.

For our data we applied a factor analysis to the responses to the 15 questions, and identified two factors with Eigenvalues exceeding one (values of 8.55 and 1.18: the next highest value was 0.23). Inspection of the scoring coefficients indicated that the two factors were again associated with a grouping of the first four questions, and the second block of 11 questions. This confirms the earlier finding of Richert et al. (2015) that at this level of abstraction (dealing with an industry as a whole, rather a specific company as in Boutilier and Thomson's work), two measures of SLO can be identified.

An important prediction from Boutilier and Thomson (2011) is that the level of SLO awarded by individuals will follow their hierarchy. In our context this means it is unlikely to see individuals awarding a higher score for social legitimacy compared to that awarded for economic legitimacy. Figure S1 is a scatter graph of the two scores (with a small amount of jitter applied, to separate individuals with identical scores). This gives a strong indication that the prediction is true: only 5% of respondents give a higher average score for social legitimacy than for economic legitimacy, although, as is clear from the figure, the full range of values is given for both across the sample.

In the statistical analysis of the choice model we use the scores generated by averaging the answers to the blocks of questions, normalised so that they have a mean of zero and standard deviation of one (i.e. defining the variables *SLO_Econ, SLO_Soc*). Correlation between a simple average of the answers in the two groups and the predicted factors was 0.97 and 0.94. Using the scores generated by the factor analysis generates trivially different results, with no consequences for the conclusions of the paper.

610 **Table S1.** Questions used to determine the degree of social license to operate.

	Please state whether you agree/disagree with the following statements: *(5pt Likert scale, 1= strongly disagree, 5= strongly agree)*
1	"Australia can economically benefit from the oil and gas sector"
2	“Australia needs to have the cooperation of the oil and gas sector to achieve the Country’s most important goals”
3	“The presence of the oil and gas sector in Australia is a benefit to the Australian population”
4	"In the long-term, the oil and gas sector makes a contribution to the well-being of Australia"
5	“The oil and gas sector does what it says it will do in the media"
6	“I am very satisfied by the oil and gas sector in Australia”
7	“The oil and gas sector listens to the Australian population’s concerns"
8	“The oil and gas sector in Australia treats everyone fairly”
9	“The oil and gas sector respects Australia’s way of doing things”
10	“The Australian population and the oil and gas sector have a similar vision for the future of Australia”
11	“The oil and gas sector gives more support to those it negatively affects”
12	“The oil and gas sector shares decision-making with the Australian government”
13	“The oil and gas sector takes into account the interests of the Australian population"
14	“The oil and gas sector is concerned about the welfare of the Australian population”
15	“The oil and gas sector openly shares information that is relevant to the Australian population”

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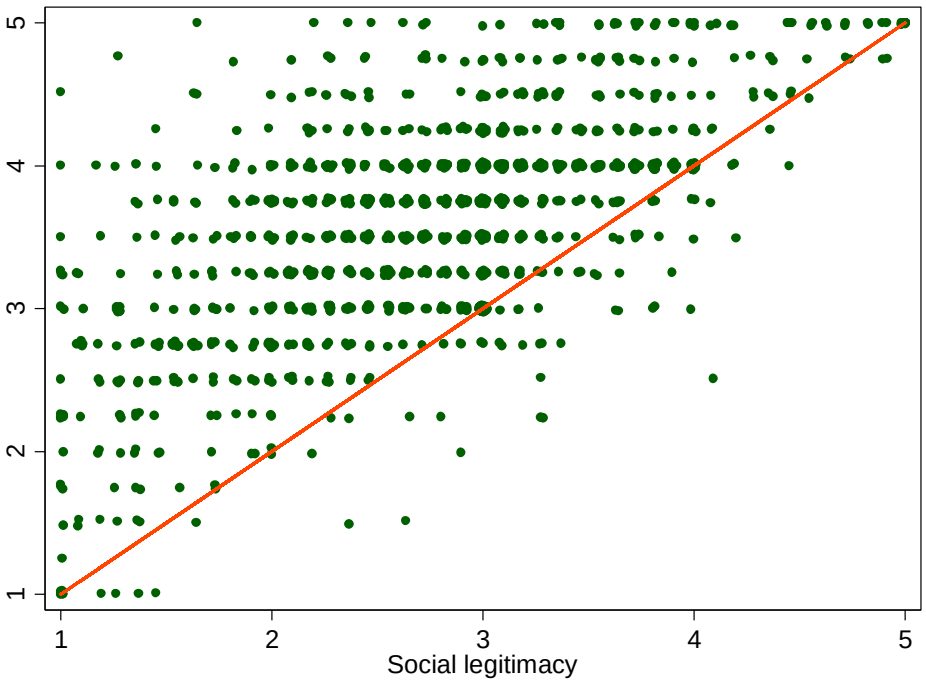

612

613 **Figure S1.** Scatter plot of individual scores for Economic and Social legitimacy. Average of the
614 relevant scores (n=1371).

615

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S2: Estimation of discrete choice models.

The core concept underpinning the estimation of discrete choice models is that of a utility function, which links an individual's subjective judgement of welfare gained from an outcome to a number of observable characteristics of that outcome, usually through a linear additive function:

$$U_{ij} = \beta X_j + \varepsilon_{ij} \quad \text{(Equation S1)}$$

That is, the utility obtained by individual *i* from outcome *j* is determined by a linear function of a vector of attributes *X*, weighted by parameters *β*, and an unobservable 'random' element ε. This random utility specification accounts for the possibility that not all aspects that determine choice have been quantified by the researcher. If an individual is faced with *J* alternatives, and an assumption that the random element follows a Type I Extreme value distribution, then the probability that they select option *n* is given by:

$$P(Y = n) = \frac{\exp(\bar{\beta} X_n)}{\sum_j \exp(\bar{\beta} X_j)} \quad \text{(Equation S2)}$$

Where $\bar{\beta}$ are normalised parameters, to account for the influence of the error variance.

Equation S2 is the standard conditional logit formulation, and information on which options are chosen, and the attributes associated with all options, allows one to identify the normalised parameters, which represent the marginal utilities associated with the attributes, and hence a measure of the sign and intensity of preference for those attributes.

The standard model assumes that the Independence of Irrelevant Alternatives (IIA) holds; that is, the relative probability of selecting two alternatives is not changed by the presence or absence of other alternatives. Imagine a situation where the probability of selecting from between two offset options (A and B) is 60% and 30% respectively, while the probability of selecting the opt-out is 10%. IIA implies that if option A was not available, the relative probability assigned to B and C would be unchanged, i.e. the new probabilities would be 75% and 25%. However, it's not unreasonable to assume that the two offset alternatives are closer substitutes for each other than the opt-out, and that option B would gain the majority of the probability associated with option A. This implies that there should be correlations in the error process across alternatives, which breaks the IIA relationship. We estimate the error components model assuming a panel structure: as Scarpa et al. (2006) note, whether this is appropriate compared to a model with independence in errors across choices is an empirical matter, and we find an improvement of some 850 log likelihood points between the two models. Hence, we take the panel model to be appropriate.

The utility function for individual i for the model reported in Table 2 is as follows,

$$\begin{aligned} U_{Ai} &= \beta x_{Ai} + \varepsilon_i + \mu_{Ai} \\ U_{Bi} &= \beta x_{Bi} + \varepsilon_i + \mu_{Bi} \\ U_{Ci} &= \beta x_{Ci} + \varepsilon_i + \mu_{Ci} \\ U_{SQi} &= \beta z_{SQi} + \mu_{SQi} \end{aligned} \quad \text{(Equation S3)}$$

650 where A, B and C indicate offset options.

$$\begin{aligned}\beta x_{\#i} = {} & \beta_0 Percent + \beta_1 RuddyTurnstone + \beta_2 Birds + \beta_3 RuddyTurnstone \times Birds + \\ & \beta_4 NorthernTerritory + \beta_5 WA_i \times NorthernTerritory + \\ & \beta_6 NewZealand + \beta_7 WA_i \times NewZealand + \\ & \beta_8 China + \beta_9 WA_i \times CHINA + \\ & \beta_{10} Developer + \beta_{11} SLO_{Econ,i} \times Developer + \\ & \beta_{12} SLO_{Soc,i} \times Developer + \beta_{13} 3^{rd}\ Party\end{aligned}$$

651 (Equation S4)

652 $$\beta z_{\mathrm{SQ}i} = \beta_{14} ASC + \beta_{15} SLO_{Econ,i} \times ASC + \beta_{16} SLO_{Soc,i} \times ASC$$ (Equation S5)

653 $$\varepsilon_i \sim N(0, \sigma^2)$$

654 And the error components μ are Gumbel-distributed.

655 The marginal rate of substitution (*MRS*) for a particular attribute (j) can subsequently be calculated
656 by:

657 $$MRS_{\beta_j \beta_1} = \beta_j / \beta_1$$ (Equation S6)

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672 **S3: Sample characteristics.**

673 **Table S3.1:** Sample demographics (n=1371).

Percentage of respondents by location			
Australian Capital Territory – Canberra	2.5%	Australian Capital Territory – regional	n/a
New South Wales – Sydney	18.9%	New South Wales – regional	11.6%
Northern Territory – Darwin	0.5%	Northern Territory – regional	0.1%
Queensland – Brisbane	8.9%	Queensland – regional	10.9%
South Australia – Adelaide	6.7%	South Australia – regional	2.0%
Tasmania – Hobart	1.2%	Tasmania – regional	2.0%
Victoria – Melbourne	19.7%	Victoria – regional	6.9%
Western Australia – Perth	6.5%	Western Australia – regional	1.7%
Percentage of respondents by gender			
Male	48.2%		
Female	51.8%		
Percentage of respondents by age group			
18-29	15.5%		
30-44	31.5%		
45-59	27.1%		
60-74	19.9%		
75+	6.1%		

674

675 **Table S3.2:** Respondents' familiarity with the notion of an offset prior to completing this survey
676 (n=1371).

Didn't know what an offset was	36.4%
Had a vague idea of what an offset was	47.7%
Knew what an offset was	15.9%

677

678 **Table S3.3:** Type of offsets respondents were aware of, for respondents who knew/had an idea of
679 what an offset was (n=872; respondents could select more than one option).

Carbon offset	54%
Biodiversity offset	54%
Marine biodiversity offset	18%

680

681 **Table S3.4:** What respondents thought about the information that was provided to describe the
682 offset strategies (n=1371).

Thought it was confusing	15.0%
Thought the description was inaccurate	4.7%
Thought it was an informative and accurate description	55.9%
Would have liked more information	24.4%

683

684 **Table S3.5:** Whether respondents thought that the attributes used to describe the offset strategies
685 were useful to help them make choices when answering the offset scenario questions (n=1371).

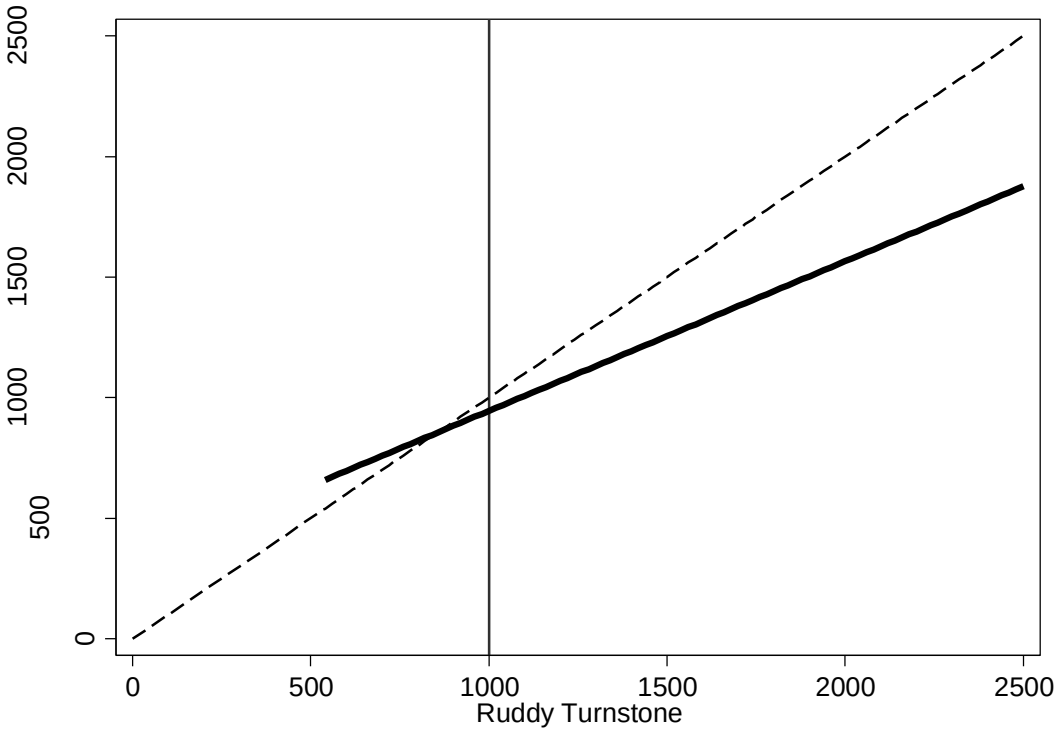
Yes	93.8%
No	6.2%

686

687

688 **S4: Marginal value of bird species**

689 The estimates in Table 2 indicate a difference in the marginal value associated with increasing
690 numbers of Ruddy Turnstone and Eastern Curlew, with Eastern Curlew holding higher value. That is,
691 a greater increase in utility is associated with an additional Eastern Curlew compared to an
692 additional Ruddy Turnstone. It is useful to look at the relationship between the two attributes across
693 the full range of possible values. Figure S4 below shows the number of Eastern Curlews required in
694 an offset (y axis) to generate the same value as a given number of Ruddy Turnstones (x axis). The 45^0
695 line is included. What is notable is that at 1000 Ruddy Turnstones the number of Eastern Curlews is
696 lower, but only marginally so (and statistically the value is not different from 1000). As the numbers
697 of Ruddy Turnstone increase, the matching number of Eastern Curlew increases, but not as fast, as
698 indicated by the higher marginal utility estimate. Thus, it is NOT possible to substitute the 1000
699 Ruddy Turnstone with a smaller number of Eastern Curlew, and maintain the same utility level: the
700 same minimal number of birds must be protected of both species. It is only for additional birds,
701 above the baseline number affected by the development (1000), that increased value is placed on
702 the Eastern Curlew. Alternatively, one could suggest that respondents are 'anchored' on the
703 number of birds directly affected.



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705 **Figure S4.** Number of Eastern Curlew and Ruddy Turnstone that give the same utility level, based on
706 parameter estimates in Table 2.

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S5: Shorebird offsets survey

The University of Western Australia Research Project

Community acceptance of marine biodiversity offsets

Thank you for considering participation in this research project, involving completion of an online survey about attitudes towards the environmental management of developments that may occur in the marine environment.

The research project is being conducted by researchers at The University of Western Australia.

You have been selected to participate at random, and your involvement is voluntary. Completion of the questionnaire will take approximately 20 minutes. Continuing to the next screen of the questionnaire will be taken as your consent to participate.

Your responses will be anonymous and will not be used individually. Whilst your participation is voluntary, please be aware that, to guarantee your anonymity, it will not be possible to remove your responses from the database once you have submitted your online survey.

If you have any questions, please feel free to contact me via the ORU email address below: XXXX.

Kind Regards,
Dr. Michael Burton
The School of Agricultural & Resource Economics,
The University of Western Australia,
Crawley WA 6009
Project Reference Number: RA/4/1/6036

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time. In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Research Ethics Office at the University of Western Australia on (08) 6488 3703 or by emailing to hreo-research@uwa.edu.au

**********[indicates new screen]*

Before we begin the survey, please answer these few questions:

Q1) What is your gender?

- ❍ Male (1)
- ❍ Female (2)

Q2) Which of the following age groups applies to you?

- ❍ 18-29 (1)
- ❍ 30-44 (2)
- ❍ 45-59 (3)
- ❍ 60-74 (4)
- ❍ 75 and over (5)

****

Q3) What is your residential location?

○ Australian Capital Territory – Canberra	○ Australian Capital Territory – regional
○ New South Wales – Sydney	○ New South Wales – regional
○ Northern Territory – Darwin	○ Northern Territory – regional
○ Queensland – Brisbane	○ Queensland – regional
○ South Australia – Adelaide	○ South Australia – regional
○ Tasmania – Hobart	○ Tasmania – regional
○ Victoria – Melbourne	○ Victoria – regional
○ Western Australia – Perth	○ Western Australia – regional

****

MARINE BIODIVERSITY OFFSETS

The purpose of this survey is to determine the Australian community's preferences regarding marine biodiversity offsets. The survey comprises of 4 main parts:

PART 1: You will be given some background information on marine biodiversity offsets.
PART 2: We will describe a development and its impact on the environment. Then, you will be presented with a series of possible offset scenarios. These are questions where you will be asked to consider a set of options that contain different offset strategies from which you choose your most preferred.
PART 3: We will ask your opinion on some environmental issues.
PART 4: We will ask some questions about you, to make sure we have a representative sample of the Australian community.

****

PART 1

Marine Biodiversity is defined as the variability among living organisms in a marine

environment.

In other words, it's all of the different species of plant and animal life in the oceans and coastal waters such as mangroves, lagoons, salt marshes, or estuaries.

Offsets are measures that compensate for the adverse impacts of an action on the environment.

In other words, if some sort of development or activity is undertaken that will damage the environment, the developer that is responsible must 'offset' that damage by doing something to protect or conserve the environment in the same proportion.

Images: Green turtle, seals, clown fish - courtesy of the WA Department of Environment & Conservation's Marine Sciences Program; shorebird - courtesy of the CSIRO.

Q1) How familiar were you with the notion of an offset before this survey?

❍ I didn't know what an offset was (1)
❍ I had a vague idea of what an offset was (2)
❍ I knew what an offset was (3)

Answer if knew/had an idea of what an offset was:

Q2) What type of offsets were you aware of before this survey?

❑ Carbon offset (1)
❑ Biodiversity offset (2)
❑ Marine biodiversity offset (3)
❑ Other - please specify: (4) _____

Q3) Have you previously completed an online survey that has asked you about marine biodiversity offsets?

- Yes → SCREENOUT, display message "Thank you for your interest in this survey. We need a certain subset of the population to answer the questions, and don't require your services at this time." + link to reward
- No
- Unsure

****

Offsets implementation

Any activity that might have adverse impacts on the environment must go through a government approval process.

During that process, the developer must demonstrate that they have done absolutely everything possible to:

Step 1: Avoid environmental damages in the first place (example) For example, building in a location where it will not disturb wildlife)
Step 2: Mitigate or repair any damages that can't be avoided (example) For example, treating polluted water before it runs off into the ocean)
Step 3: If there are **remaining damages**, the developer must ***offset*** them.

Overall, the sum of avoidance, mitigation, and offset strategies must lead to **no net loss to the environment**.

i.e. Step 1 Avoid
+
Step 2 Mitigate = No net loss to the environment
+
Step 3 Offset

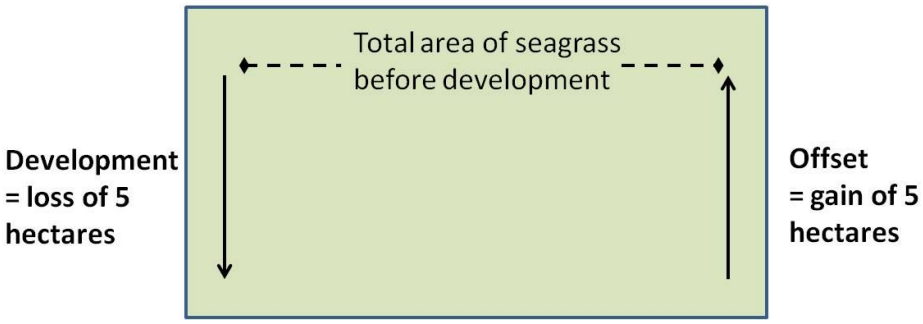
For example, consider a coastal development that, even after avoidance and mitigation, will damage 5 hectares of seagrass. The seagrass is an important habitat for turtles and dugongs, so it must be replaced.

The developer must offset the damage by replanting seagrass and ensuring that an equivalent area of seagrass is available for the turtles and dugongs as there was before the development.

Step 1: the developer moves a pipeline so that it doesn't run through the seagrass bed

Step 2: a water treatment plant is used to ensure water runoff from the development is clean

Step 3: some dredging of the seabed is required, so 5 hectares of seagrass will be disturbed
→ an offset is required



In the approval process, any proposed offsets are examined by the government to see whether they offer appropriate compensation for the remaining damages. If the offsets are not suitable, then the activity or development is not allowed to go ahead.

Note that **offsets are planned for** – in other words, the possibility of damage to the environment is considered before a development is undertaken. The proposed offsets to compensate for those damages are part of the approval process.

Offsets <u>are not</u> the same thing as compensating for unexpected events or accidents, such as oil spills.

Q.) Complete the following statement by selecting the option that most closely reflects your opinion:

"I think that offsets are an appropriate way for developers to compensate for environmental damage…":

- "… without having to avoid and mitigate the damages first."
- "… only after all possible avoidance and mitigation steps have been taken."
- "… in no situation whatsoever – a development should not be approved if damage cannot be prevented."

****

PART 2

Now we'd like you to think about a hypothetical development proposal that will require a marine biodiversity offset:

There is a species of migratory shorebird called the **Ruddy Turnstone** which is protected under Australian legislation.

There are nearly **500,000** Ruddy Turnstones worldwide. Almost 10% of these birds follow a migration pattern where they breed in Siberia, and each year migrate south to feeding grounds in Australia, China and New Zealand.

Ruddy Turnstone (Photo: LT Mike Levine)

Q.) Were you aware that some bird species migrate from Northern countries to Australia as part of their life cycle?

- Yes
- No

****

An **oil and gas** exploration and production company is planning to construct and operate a gas plant in the vicinity of a beach along the **Kimberley coast** of Western Australia.

The development will lead to **1000 [5000] new jobs** for Australian workers.

Some environmental impacts can be avoided or mitigated but there are **residual impacts** on the use of the beach as a feeding ground by **1000 Ruddy Turnstones**.

The impacts include artificial lighting and an increase in the number of people using the beach, which will disturb the birds. Frequent disturbance reduces the birds' ability to feed and store energy, leading to a higher mortality rate during their migration north.

The 1000 Ruddy Turnstones won't be able to feed on the beach anymore. The developer will have to **offset** these impacts if the project is to go ahead, to ensure that there is **no net loss**

to the species.

Q10 Had you heard of the Ruddy Turnstone before?
- ❍ Yes (1)
- ❍ No (2)

Q11 In your opinion, how important is it to protect Ruddy Turnstones?
- ❍ Very unimportant (1)
- ❍ Somewhat Unimportant (3)
- ❍ Neither Important nor Unimportant (4)
- ❍ Somewhat Important (5)
- ❍ Very Important (6)

Q12 Have you ever been bird watching before?
- ❍ No, never (1)
- ❍ Yes, but only occasionally (2)
- ❍ Yes, frequently (3)

****

To offset the environmental impacts, the developer has to consider a number of offset features.

These include:

- What type of offset to use
- The location where the offset will be implemented
- Who will be responsible for implementing the offset
- What bird species the offset should protect
- How many birds should be protected

We will describe each of these over the next few screens.

****

TYPE OF OFFSET

There are two different ways to offset the impacts of the development on the Ruddy Turnstone: through direct or indirect offsets.

- ❖ **Direct offsets** mean that the offset provides protection or conservation through **new on-ground interventions** aimed at improving the environment.

- ❖ **Indirect offsets** use **research** to improve **existing on-ground management** techniques of the birds to ensure there is no net loss to the species.

- ❖ Direct and Indirect offsets can be used **in combination** to ensure there is **no net**

loss to the environment.

For example, to protect the 1000 birds, we could directly offset for 800 birds (80%), and indirectly offset 200 birds (20%).

The **direct offset** will involve the developer protecting a particular area of beach in order to ensure the survival of the birds.

A suitable substitute beach will be identified:

- At a site that the shorebirds might have used previously, but that has been degraded over time (from other causes not related to the development); and
- That can be made a suitable habitat again for the birds by fencing off an area so that people can't disturb them.

The **indirect offset** would consist of funding a research program aimed at managing existing pressures on the birds more efficiently.

Q.) How appropriate do you think it is to use each type of offset in an offset package?

Direct offsets:
Indirect offsets:
[Likert scale answer 1-5 from Very inappropriate through to Very appropriate]

****

LOCATION OF THE OFFSET

The offset could be located at a number of sites that are used by the Ruddy Turnstones.

At each of these sites there are degraded beaches where a direct offset could be used, and existing pressures that could be managed by an indirect offset.

The sites include:

- In Western Australia: a few kilometres away from the gas development site.
  This site would be used by the **same 1000 Ruddy Turnstones** that are impacted by the development

- In the Northern Territory:
  This site would still protect 1000 Ruddy Turnstones, but **they would not be the same individuals** impacted by the development.

- In New Zealand:
  This site would still protect 1000 Ruddy Turnstones, but **they would not be the same individuals** impacted by the development.

- In China:

This site would still protect 1000 Ruddy Turnstones. As all Ruddy Turnstones that come from Australia and New-Zealand stop in China, **they can either be the same individuals impacted by the development or other individuals**.

Q.) Have you ever visited or lived in:

- The Kimberley region in WA
- The Northern Territory
- New Zealand
- China
- None of the above

Q.) Please rate the confidence that you have in each of the following Government Environment Departments to follow through with its conservation commitments:

Western Australia's Government Environment Department:
Northern Territory's Government Environment Department:
New Zealand's Government Environment Department:
China's Government Environment Department:
[Likert scale 1-5 Not at all confident to very confident]

****

WHO IMPLEMENTS THE OFFSET

Different parties could be responsible for implementing the offset.

They include:

- The **development company**:
  The developer could use their own trained staff to implement the offset

- The local **Government Environment Department**:
  The developer could pay a government department to implement the offset on their behalf.
  The Government in the location that the offset takes place would be the one responsible for implementing the offset.
  For example, an offset in Western Australia would be implemented by the WA State Government, while an offset in China would be implemented by the Chinese Government.

- An **independent Third Party**:
  The developer could pay an independent company to implement the offset. This third party company will have a proven record in implementing other offsets.

Note that, whoever implements the offset, the developer must guarantee that the funds to

undertake the offset are available upfront to account for risks such as bankruptcy.

Q.) Please rank these groups in terms of your confidence in their ability to successfully complete an offset program, where 1=most confident and 3=least confident:

- Development Company
- Local Government Environment Department
- Independent Third Party

****

SPECIES PROTECTED BY THE OFFSET

The developer could propose to protect either the Ruddy Turnstone or another species of migratory shorebird.

Although the Ruddy Turnstone is a protected species, it is not a species at very high risk of extinction given there are nearly 500,000 of them.

Instead of offsetting the impact on the Ruddy Turnstone, the developer could offer to protect a different, but **more endangered species.**

The **Eastern Curlew** is more endangered with a population of only 38,000 worldwide.

As is the case for the Ruddy Turnstone offset, to protect the Eastern Curlew the developer could:

- Use the same types of direct and indirect offsets.
- Locate the offsets on the Kimberley coast in Western Australia, in the Northern Territory or in China. The Eastern Curlew does not migrate to New Zealand, so an offset cannot be located there.
- Implement the offset themselves, or pay a Government Environment Department or Third Party.

Eastern Curlew (Photo: A McDougall, Department of National Parks Recreation, Sport and Racing)

Q.) Had you heard of the Eastern Curlew before?

- Yes (1)
- No (2)

Q.) In your opinion, how important is it to protect Eastern Curlews?

- Very unimportant (1)
- Somewhat Unimportant (3)
- Neither Important nor Unimportant (4)
- Somewhat Important (5)
- Very Important (6)

****

NUMBER OF BIRDS PROTECTED

If the developer is protecting the Ruddy Turnstones, they need to offset for at least 1000 birds, which is the number of birds impacted by the development.

If the developer is protecting the more endangered Eastern Curlew, they need to offset for at least 500 birds.

However, the developer could choose to protect more.

- The number of **Ruddy Turnstones** protected could be **1000, 1500 or 2000**.
- The number of **Eastern Curlews** protected could be **500, 1000, 1500 or 2000**.

****

Please, read the following guidelines before proceeding further:

- You will be presented with 6 possible offset scenarios to compensate for the impact on the birds. Each question should be treated independently.

- In each scenario, you will be shown 3 options that each present a possible offset strategy that the developer is proposing.
  The strategies are characterized by:
  - The proportion of direct and indirect offsets used
  - The location of the offset
  - Who will implement the offset
  - The species protected by the offset
  - How many birds are protected by the offset

- In each case independent scientists have approved the offset strategy and confirmed that it will result in no net loss to the environment. Moreover, each option would have approximately the same cost for the developer.

- A 4th option will also be shown in each scenario, where the development is not permitted to go ahead.

- In each scenario, you will be asked to choose the offset strategy that you most prefer from the 3 available, or, if you don't like any of the strategies, you can choose the 'no development' option.

- In making your decision, remember that the development will create 1000 [5000] new jobs for Australian workers.

- We will be surveying a large number of people to work out the preferences held across the Australian community. The findings that emerge from this study may be used to adapt the current policy regarding the implementation of offsets in Australia.

****

SAMPLE SCENARIO

Below is an example of the type of question you will be presented with (you don't need to answer this one).

When answering the scenarios, don't forget to:

- Consider each option (looking down each column)
- Choose your most preferred option based on the assumption that these are the only options available to you.
- Treat each scenario independently. You don't need to remember or anticipate the choices you make across the six questions.

	Option 1	Option 2	Option 3	Option 4
Proportion of direct and indirect offset	Direct 90% Indirect 10%	Direct 50% Indirect 50%	Direct 70% Indirect 30%	No development (= loss of 1000 new jobs)
Offset location	Western Australia	China	Northern Territory	
Offset implementer	Developer	Government	Third Party	
Species protected	Ruddy Turnstone	Eastern Curlew	Ruddy Turnstone	
Number of birds protected	2000	500	1500	

You will be asked to choose your most preferred of the 4 options.

For example, if you chose Option 1, it would mean that you prefer this offset rather than the offsets provided in Option 2 or Option 3, or No development.

In this example, Option 1 is an offset that:

- Is made up of 90% direct and 10% indirect offsets to achieve no net loss
- Is located in Western Australia, near the development site
- Is implemented by the development company
- Protects 2000 Ruddy Turnstones, which are the species impacted by the development

Insert the 6 choice scenarios

Q.) Consider the following options. Assuming these are the only options available to you, which one would you choose?

- Option 1 (1)
- Option 2 (2)
- Option 3 (3)
- Option 4 (4)

Move your mouse over the links below if you want to read the explanations related to the characteristics of the offset strategies:

- Proportion of direct and indirect offset
- Offset location
- Offset implementer
- Species protected
- Number of birds protected

[pop-up boxes with explanations]

****

Answer if option 1 always chosen:

Q.) You always preferred the 'no development' option over the potential offset strategies. Please provide your reason why:

- ❍ I object to the idea of offsetting (1)
- ❍ I need to know more about offsetting before I would feel comfortable deciding on which offset strategies are most suitable (2)
- ❍ I don't trust the science underlying the practice of offsetting (3)
- ❍ I don't trust the Australian Government to monitor and ensure success of an offset (4)
- ❍ I object to the idea of more coastal development, regardless of whether offsets are used (5)
- ❍ I found the choices difficult or confusing, so I preferred the 'no development' option (6)
- ❍ Other: (7) _____

****

Next, we have a few questions on what you thought about the offset scenarios

Q.) Please indicate how certain you were of the answers you gave in the offset scenarios, from "Not certain at all" (1) to "Very certain" (10)

_____ How certain were you of the answers you gave in the offset scenarios? (1)

Q.) Did you think that the scenarios were confusing to answer?

- ❍ Yes (1)
- ❍ No (2)

****

Q.) What did you think about the information that was provided to describe the offset strategies?

- ❍ It was confusing (1)
- ❍ I thought the description was inaccurate (2)
- ❍ I thought it was an informative and accurate description (3)
- ❍ I would have liked more information (4)

Q.) Do you think the features [Pop-up: Proportion of direct/indirect offsets; Location; Implementer; Species protected; Number of birds protected] used to describe the offset strategies were useful to help you make choices when answering the offset scenario questions?

- ❍ Yes (1)
- ❍ No (2) – please explain why not: [Comment box]

****

Q.) Please indicate on the following scale how likely you think it is that the results of this

study will influence future policy decisions regarding marine offsets in Australia from "Not at all likely" (1) to "Very likely" (10)

_____ How likely do you think it is that the results of this study will influence future policy decisions? (1)

****

PART 3

Now we'd like to ask some questions about your attitudes towards the environment, the oil and gas sector in Australia, and government management of environmental issues.

	Not at all (1)	Not much (2)	I am not sure (3)	A little (4)	A lot (5)
Q1) Are you concerned about environmental problems in general? (1)	❍	❍	❍	❍	❍
Q2) Are you concerned about marine biodiversity loss? (2)	❍	❍	❍	❍	❍
Q.) Do you think the oil and gas sector contributes towards marine biodiversity loss?	❍	❍	❍	❍	❍
Q.) Do you think that the use of marine biodiversity offsets will improve the oil and gas sector's ability to protect marine biodiversity?	❍	❍	❍	❍	❍

****

Q4) How much do you know about the oil and gas sector in Australia?

- ❍ I know nothing about it (1)
- ❍ I know the names of some of the companies, but not what they do (2)
- ❍ I know a little about the activities of the oil and gas sector (3)
- ❍ I know a lot about the activities of the oil and gas sector, including how their activities interact with people and with the natural environment (4)

****

Please state whether you agree/disagree with the following statements:
Arrange in table format, 5pt scale strongly disagree to strongly agree.

"Australia can economically benefit from the oil and gas sector"

“Australia needs to have the cooperation of the oil and gas sector to achieve the Country’s most important goals”

“The oil and gas sector does what it says it will do in the media"

“I am very satisfied by the oil and gas sector in Australia”

“The presence of the oil and gas sector in Australia is a benefit to the Australian population”

“The oil and gas sector listens to the Australian population’s concerns"

"In the long-term, the oil and gas sector makes a contribution to the well-being of Australia"

“The oil and gas sector in Australia treats everyone fairly”

“The oil and gas sector respects Australia’s way of doing things”

“The Australian population and the oil and gas sector have a similar vision for the future of Australia”

“The oil and gas sector gives more support to those it negatively affects”

“The oil and gas sector shares decision-making with the Australian government”

“The oil and gas sector takes into account the interests of the Australian population"

“The oil and gas sector is concerned about the welfare of the Australian population”

“The oil and gas sector openly shares information that is relevant to the Australian population”

****

PART 4

Almost finished! In this section of the survey, we will ask some questions about you. The information collected will be kept anonymous.

Q4) Do you have any children?

- ❍ Yes – including children who are still dependent (1)
- ❍ Yes – all children are now independent (2)
- ❍ No (3)

Q5) What is your highest level of education?

- ○ High school
- ○ Trade/technical certificate or equivalent
- ○ University degree
- ○ I would rather not say

****

Q6) Do you work in any of the following fields?

- ○ Environmental management, research or consulting
- ○ Public sector, including Local, State, Territory or Commonwealth governments
- ○ Mining industry, including the oil and gas sector
- ○ Hotel and tourism industry
- ○ None of these fields

Q7) Do you belong to any environmental or conservation groups?

- ○ Yes
- ○ No

Q8) What is your gross annual household income before tax?

- ○ Under $13,000 (under $250/week)
- ○ $13,000-$25,999 ($250-$500/week)
- ○ $26,000 - $41,599 ($500-$800/week)
- ○ $41,600 - $62,399 ($800-$1200/week)
- ○ $62,400 - $88,399 ($1200-$1700/week)
- ○ $88,400 - $129,999 ($1700-$2500/week)
- ○ $130,000 - $181,999 ($2500-$3500/week)
- ○ $182,000 and over ($3500+/week)
- ○ I would rather not say

****

Thank you very much for your time! If you have comments you want to make about the survey, or the issues raised in it, please add them below:

Comment box.