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Legal frameworks for unique ecosystems – how can the EPBC Act offsets policy address the impact of development on seagrass?

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ABSTRACT

Environmental or biodiversity offset policies allow for impacts occurring at one site to be offset through activities at another site. The federal government has recently released a policy for offsetting the impacts of activities approved under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act). The EPBC Act policy can be used to offset impacts on terrestrial and marine ecosystems, and one of the first applications of the policy has been to offset impacts on seagrass meadows at risk due to the Abbot Point coal terminal expansion. The significant ecological differences between terrestrial and marine ecosystems, such as seagrass meadows, require different management approaches to ensure that impacts are offset. This article analyses the EPBC Act policy to determine whether it adequately caters for offsetting impacts on marine ecosystems, with seagrass used as an example. It concludes with recommendations for policy change directed at ensuring that the unique characteristics of seagrass ecosystems are considered in offset policies.

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Introduction

Introduction

Biodiversity or environmental offsets have been broadly defined as conservation activities intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects. [1] An offset involves compensating for impacts on the environment or biodiversity at one site (the impact site) through activities at another site (the offset site). [2] Using offsets can give proponents some flexibility in complying with conservation targets, after measures have been exhausted to first avoid, minimise, or restore any harm at the impact site. [3]

Offset policies have been developed and used in Australian States to achieve environment goals, [4] and a new policy has recently been implemented to allow for offsets at the federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The *EPBC Act* Environmental Offsets Policy sets out the framework for the use of offsets, which are permitted to be

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used where avoidance or mitigation measures at the impact site alone are insufficient or impracticable. [5] The policy is supplemented by an Offsets Assessment Guide. [6]

The *EPBC Act* policy applies to both terrestrial and marine environments. [7] The inclusion of marine ecosystems in the offsets policy is crucial, given Australia's extensive and unique range of marine ecosystems. It is also consistent with international practice, as offset policies have been successfully used for tidal wetlands in the United States since the early 1990s. [8] Marine offsets have also been used in several Australian States, including Queensland. [9]

This article focuses specifically on the use of policies to offset impacts on seagrass ecosystems. Seagrass are submerged marine plants, with some communities able to tolerate periodic exposure to air. Seagrass is highly sensitive to reductions in water quality, making it vulnerable to impacts from development occurring within the coastal zone. Seagrass ecosystems are included under the *EPBC Act* policy, and one of the earliest applications of the policy was a requirement to offset seagrass loss as part of an expansion of a coal mining port, the Abbot Point coal terminal expansion, in Queensland. [10]

It is timely, due to increased development in Australia on coastlines with substantial quantities of seagrass, to consider whether existing offset policies and laws have been appropriately designed to apply to seagrass ecosystems, and whether any legal changes are required in order to meet the overarching goals of the *EPBC Act*. Although a focus on seagrass conservation is welcome, frameworks initially developed for application to terrestrial or tidal ecosystems may not be appropriate to apply to seagrass due to fundamental ecological differences amongst these systems.

This article commences by introducing some of the key ecological characteristics of seagrass ecosystems. It then discusses offset policies generally, and analyses the challenges associated with applying offset policies to seagrass. The *EPBC Act* offset policy is then considered as a case study. Finally, the article considers how laws and policies related to offsets can more effectively address the ecological challenges involved with creating seagrass offsets, and concludes with a recommendation that governments introduce offset policies specific to seagrass ecosystems.

What are seagrass ecosystems, and why are they important to conserve?

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Seagrass are marine flowering plants that have adapted to live in seawater, and which form extensive meadows in shallow coastal seas. [11] Australia is regarded as the epicentre of biodiversity for seagrass, [12] with 30 species occurring from the temperate to tropical environments. [13] There are approximately 51,000 km of mapped seagrass meadows in the region. [14]

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Seagrasses have high light requirements for growth, and plants are therefore typically found in water shallower than 10 m in depth, although in extremely clear water it may occur at up to 90 m in depth. [15] Given this light requirement, seagrass tends to be found close to shore, generally falling within the legal jurisdiction of State governments. Seagrass may occur in estuaries (ie where rivers meet the sea), in near-shore coastal areas away from rivers, in shallow coral reef environments, or in deeper inter-reef areas in regions with particularly clear water. [16] The upper tidal extent of seagrass is limited to roughly mean sea level, since plants cannot withstand long periods of emersion from seawater.

Seagrass meadows provide a range of important ecosystem services. Seagrass meadows are utilised as food and habitat for commercially and ecologically important species of fish, invertebrates, turtles, and mammals (eg dugongs). [17] Seagrass also helps to stabilise sediments, and prevent shoreline erosion, whilst also filtering water to remove sediments and nutrients, which helps to improve water quality. Importantly, seagrass ecosystems also sequester carbon dioxide (CO_2) from the atmosphere into the ocean sediments. [18]

Unfortunately, these ecosystem services are in jeopardy. Rapid and widespread declines of seagrass have occurred in previous decades, [19] leading to 14% of seagrass species worldwide being at elevated risk of extinction, with three species already classified as endangered. [20] Seagrass ecosystems are considered to be one of the most threatened on earth, [21] and any further loss of biodiversity will have serious repercussions for marine biodiversity generally, as well as for human populations that depend on the ecosystem services provided. [22]

There are a number of activities that lead to the decline of seagrass ecosystems. These include: direct physical impacts from anchors, propellers, fishing gear, dredging, and land reclamation; and indirect impacts caused by reduced water clarity from dredging. Furthermore, land-based actions at distant locations may impact seagrass. For example, destruction of riparian zones and agricultural run-off are activities that deliver sediments and nutrients to coastal areas and thus diminish water clarity. (These offsite or upstream impacts are hereafter termed diffuse impacts, and are important to consider, given that reduced water quality has been one of the major drivers of seagrass decline worldwide. [23]) Climate change is also anticipated to impact on seagrass, [24] due to warming ocean temperatures, [25] sea level rise, [26] and increased intensity and severity of storms.

There are also a range of activities that may be undertaken to improve the quality and abundance of seagrass. These activities may be classified as:

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- active activities:
  - direct replanting (direct active activities); or
  - using indirect techniques at the seagrass site to improve the likelihood of natural seagrass recruitment and growth, eg deploying materials that promote natural seagrass recruitment, such as hessian bags (indirect active activities); and
- improvement of diffuse impacts, which involves taking actions at distant locations to improve water quality in the coastal zone, such as restoring riparian communities in rivers and streams to prevent shoreline erosion.

Whilst seagrasses have traditionally received less attention than their more charismatic tropical counterparts, coral reefs, [27] conserving and rehabilitating seagrass habitats is emerging as a major conservation goal. This has been motivated partially through the recognition of seagrass as Blue Carbon ecosystems, which act as globally significant carbon stocks, mitigating the effects of anthropogenic CO_2 emissions. [28]

The rationale for using offsetting policies to achieve conservation goals

The rationale for using offsetting policies to achieve conservation goals

Offsetting policies give proponents some flexibility in achieving conservation goals within a broader development project. These policies have been widely adopted, with at least 39 biodiversity offsetting programs in place worldwide, including programs in Australia, Canada, the United States, Germany, Brazil, Colombia, South Africa and China. [29]

An integral aspect of an offset program is identifying the biodiversity value to be offset. A biodiversity value has been defined as:

> The aspect of biodiversity affected by the development or activity at the impact site, or generated at the offset site (eg. a threatened species, a set of ecological functions, or a particular ecosystem type). This is often captured in a metric, which combines information about condition and status. [30]

The biodiversity value is often an area of a particular type of habitat (eg hectares of seagrass), as this acts as a surrogate for the existence of the species that inhabit it. In the case of seagrass meadows, in most instances the biodiversity value to be offset would be a particular area of seagrass meadow of a particular condition, which might be determined by a measure such as the density of shoots. Alternatively, it could be a quantified metric indicating a particular function the seagrass meadow performs, such as providing habitat for a certain number of fish, feeding grounds for a certain number of turtles, or sequestering a certain amount of CO_2 per year. Deciding on the biodiversity value to be offset is a fundamental part of the offset process, as it must be representative of the inherent value of the ecosystem. Furthermore, it must be possible to measure and monitor that value. [31]

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The aim of offsetting policies has mainly been described as no net loss, although some more recent policies require a positive impact or net gain. [32] Offset policies allow for biodiversity losses at the impact site to be compensated for through biodiversity gains at the offset site, and offsets can be used to improve the area or condition of habitat, or to avert future loss (eg avoided deforestation). In the case of offsets for averted loss, biodiversity may still be expected to decline in the area, but the purpose of the offset is to prevent this from happening as rapidly as it otherwise would have. [33] Biodiversity offsets can therefore be characterised as providing a gain above-and-beyond what would have otherwise happened. Hence, the no net loss aspect of offset policies refers to no net loss given business-as-usual rather than no net absolute loss.

While the concepts of no net loss and net gain are worthy objectives, in practice, they have been difficult to achieve. [34] In fact, there is little evidence to demonstrate that the objectives of offset policies have been achieved. There are several main factors limiting the success of offset policies. First, it may be logistically difficult to measure the value being offset (eg if the value is a function of the ecosystem, such as primary production). Secondly, there is often uncertainty surrounding whether gains in biodiversity or ecosystem services have actually been achieved. Finally, there are unavoidable delays in conservation gains being achieved. [35] For example, it may take up to nine years for newly planted vegetation in grassy eucalypt woodlands to restore previous ecosystem values. [36] For seagrasses, the timescale is much greater, and the time lags for full recovery of the meadow to achieve particular ecosystem functions (eg carbon burial) are likely to be in the order of 10-50 years. [37]

It has been suggested that to achieve the objective of no net loss, the following factors should be present as a precondition to using an offset policy:

- the values lost can be restored elsewhere with confidence;
- the clearing does not constitute an immediate risk to a species or population;
- an adaptive management approach will be used (eg the offset will be monitored and reviewed if necessary);
- offsets must be secured for a timeframe commensurate to the period of the loss; and
- the offset requirements will be complied with. [38]

Sound offset policies should provide for the above factors, using an adaptive management approach, and the use of time discounting, accounting for uncertainty, and biodiversity banking (ie establishing a market for trade of biodiversity credits to allow landholders who make improvements that enhance or protect biodiversity on their property to earn credits, which can then be sold as an offset). [39] In some cases, where all the factors cannot be met (eg there is a low chance of offset success), multipliers need to be used to ensure that the expectation, or mean outcome, is no net loss. For example, a proponent may have to provide 3-4 ha of habitat for every hectare lost, with these multipliers often expressed as a 3:1 or 4:1 ratio. Where these issues have proved challenging in terrestrial environments, this article argues that they will be even more difficult to achieve in the marine realm.

The ecological challenges of applying offsetting policies to seagrass ecosystems

The ecological challenges of applying offsetting policies to seagrass ecosystems

In addition to the factors discussed above that limit the success of offsetting policies in general, there are particular challenges involved with applying offset policies to the marine environment. Fundamental biophysical differences between the marine and terrestrial realms suggest that offsetting frameworks developed for terrestrial environments cannot be applied successfully to marine ecosystems. In particular, marine ecosystems exist in a fluid three-dimensional medium, which presents significant challenges for management, measurement and monitoring. Additionally, they often exhibit faster rates of response and higher sensitivity to environmental variability, demonstrate alternate stable states, and have significantly larger spatial scales of ecological connectivity. [40]

For seagrasses, any loss of extent or condition may be particularly difficult to recover due to the existence of alternate stable states. Seagrass have high light requirements, and the amount of available light diminishes as it travels through water, meaning that light is reduced at depth, and also in more turbid (ie murky) water. As seagrass is lost, sediments become destabilised, which leads to sediment resuspension, increasing turbidity and reducing light. This creates a negative feedback loop that creates an alternate stable state, whereby reduced light conditions prevent the re-establishment of vegetation. [41] This hysteresis means that the environmental conditions for recovery need to be significantly better than the environmental conditions that caused degradation.

Although seagrass rehabilitation is considered technically feasible, [42] there are few examples of successful large-scale seagrass rehabilitation projects either internationally or in Australia. [43] One of the major barriers to these projects is cost, as seagrass revegetation efforts typically come with an extremely high price tag, with the cost of active planting estimated at A$10,000-166,000 per hectare in 2005. An extremely expensive example is Albany Harbour (Western Australia), where a mechanical planting technique was used to restore 3 ha of seagrass, costing A$2.5 million over five years. [44] In contrast, active indirect onsite restoration techniques, such as deploying materials that promote the recruitment of seagrass, come at a much lower cost, [45] as can community-led volunteer efforts. [46]

Another major barrier to offsetting impacts on seagrass is uncertainty in achieving outcomes. Conservation targets may not be easily reached as the success of replanting is typically low, [47] and multiple factors influence the success of revegetation or lack thereof, including abiotic, biotic and socioeconomic considerations. [48] A review of seagrass restoration projects completed since 1990 concluded that current seagrass restoration techniques cannot be depended upon to achieve 2:1 habitat compensation objectives in New South Wales and, in fact, most seagrass replanting efforts in New South Wales have failed. The main reasons for this failure included a lack of location-specific information on seagrass growth and insufficient development of planting techniques to ensure the success of projects. A possible solution would be the adoption of an adaptive strategic research-based

approach focussed on filling in the information gaps regarding seagrass planting, as well as particular emphasis on the project planning and site selection stages in any restoration projects. [49] Additionally, where seagrass has been lost due to human impacts, such as degraded environmental conditions, those environmental conditions must first be remediated (eg by implementing sewage treatment plans, or revegetating shorelines to prevent erosion of sediments into waterways). [50]

Large-scale recovery of seagrass is also impacted by the fact that degradation may be caused by diffuse impacts rather than by direct impacts. Many of the impacts to seagrass occur from diffuse sources [51] – ie the action that negatively affects seagrass occurs far from the seagrass itself (eg impacts on water quality upstream). One of the primary drivers of seagrass decline is run-off and sedimentation from the watershed. Therefore, in order to rehabilitate the seagrass, actions must be taken to remediate land or riverine-based sources of pollution. Identifying and understanding the linkages between the watershed and coastal ecosystems, and how to remediate negative influences of the watershed on adjoining seagrass meadows, are an important area of ecological and conservation research. [52] This is a significant distinction between seagrass and terrestrial ecosystems, as the impacts on terrestrial ecosystems (eg loss of vegetation) typically occur at, or very close to, the same site as the actions (eg land clearing). Therefore project areas in seagrass offset schemes may need to incorporate geographically distant areas, and it is important that a seagrass offset policy extends to activities inland that have the potential to cause diffuse impacts to marine ecosystems. Unless these diffuse impacts are taken into account, protecting the seagrass bed itself from direct impacts may do little to rehabilitate the seagrass ecosystem, and this must be considered when selecting sites of rehabilitation and deciding on appropriate rehabilitation and other offsetting strategies.

As a final consideration, there is significant variability amongst seagrass meadows. They occur in a variety of habitats, and include

a variety of species, depending on the ecological context. This must be considered when planning targets for offsets, particularly if the offset policy requires a like-for-like offset. Other factors that must be considered include:

- What is the target value for restoration? Is it simply a particular area of habitat, or does it incorporate additional information such as species composition or density of plants?
- How is the condition of the seagrass (eg how healthy it is) quantified? Will the offset require the proponent to improve the health of a seagrass meadow from a stressed condition?
- Will the particular ecosystem functions/services of the seagrass need to be replicated? For example, if a seagrass meadow sequesters a particular amount of carbon, or provides a food value for turtles/dugongs etc.
- How ecologically connected is the seagrass meadow to other seagrass meadows and nearby habitats such as mangroves? Is there exchange of individuals (by seeds or vegetative fragments) between meadows and/or different habitats? This is important when active indirect methods are used for restoration, as well as for maintaining genetic diversity and facilitating recovery from disturbance. [53]
- Which approach to restoration would be more appropriate in the circumstances – active direct replanting, active indirect actions such as deploying materials that promote seagrass colonisation, or mitigating diffuse impacts with the aim of improving the environment to facilitate natural seagrass recovery?
- What is the likelihood that the offset area will be negatively impacted by environmental variability? For example, how likely is it that the rehabilitated site will be destroyed by floods or storms before it is mature and therefore more resilient to such natural impacts?

The EPBC Act offset policy and seagrass ecosystems

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Given the considerable challenges involved with offsetting impacts on seagrass ecosystems, it is not surprising that policies have not been widely used in this context in the past. However, one of the first applications of the new *EPBC Act* policy was to offset loss of seagrass meadows, and it is therefore timely and appropriate to consider how effectively the existing offsetting policy takes into account the challenges discussed above.

Both State and federal governments may have some responsibility for the protection and conservation of seagrass ecosystems. Jurisdiction for coastal waters is vested in the State up to 3 NM from land. Depending on whether seagrass is located near-shore or in deep water, either the State and/or Commonwealth government may have jurisdiction. Many seagrass ecosystems are located near-shore, and therefore fall under the jurisdiction of State governments; however, the federal government may also have an interest where seagrass falls under the application of the *EPBC Act* (eg where it is located in the Great Barrier Reef Marine Park or a World Heritage area, or in a protected Ramsar wetland, or is a habitat for a threatened species). This article focuses on the *EPBC Act* policy, although it is acknowledged that State policies may also be relevant.

Offset policies at the Commonwealth level – legislative context

Offset policies at the Commonwealth level – legislative context

The *EPBC Act* Environmental Offsets Policy came into effect in October 2012, and applies generally to both terrestrial and aquatic (including marine) environments. The policy may be used in both project-based assessments and strategic assessments under the *EPBC Act*. [54] Projects will generally require assessment under the *EPBC Act* where the action is likely to have a significant impact on one of the matters listed under Pt 3 of the *EPBC Act*, which include declared World Heritage properties, listed Ramsar wetlands, listed threatened species and communities, Commonwealth Marine areas, and the Great Barrier Reef Marine Park. [55] Significant impact is not defined under the *EPBC Act*, although a definition of impact was inserted to the Act following litigation [56] to clarify that the Act applies to both direct and indirect impacts of actions. The federal government has also released significant impact guidelines to assist with determining whether an action is likely to have a significant impact. [57] These guidelines state that impact extends to include offsite impacts, with an example of impacts on wetlands or ocean reefs from sediment, fertilisers or chemicals which are washed or discharged into river systems provided. [58] Therefore a broad range of actions will require assessment and approval under the *EPBC Act*. In the context of seagrass ecosystems, where seagrass ecosystems are protected under the *EPBC Act* (eg as habitat for a threatened species, or as part of the Great Barrier Reef Marine Park), approval may be needed for activities that will result in:

- direct physical impacts, such as proposed removal of seagrass;
- indirect impacts, such as reductions in water clarity due to proposed dredging; and/or
- impacts offsite or upstream, such as proposed agricultural activities that will result in run-off to an area of seagrass.

By way of a brief summary of the *EPBC Act*'s processes, project-based assessments consist of three distinct phases – referral, assessment, and approval. [59] At the referral stage, a person proposing to take an action they think may be a controlled action must

refer the action to the Minister. [60] At the

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referral stage, the Minister will make one of four decisions. The Minister may determine that the action would have clearly unacceptable impacts on a matter protected by Pt 3, and cannot proceed. At the other end of the spectrum, the Minister may determine that the action is not a controlled action, and can proceed, either absolutely or in a particular manner. Alternatively, the Minister may decide that an action is a controlled action, and therefore warrants further consideration through assessment. At the referral stage, the Minister must consider all adverse impacts the action has, will have, or is likely to have on a matter protected, and must not consider any beneficial impacts the action has, will have, or is likely to have on a matter protected (eg on the Ramsar wetland). [61]

If an action is found to be a controlled action, it proceeds to assessment. The Minister must decide on an approach for assessment, [62] with these approaches allowing for varied levels of scrutiny and public involvement. Finally, once the assessment is completed, the Minister must decide whether to approve or refuse to approve the action. [63] The Minister may approve a proposal subject to conditions, where the conditions are necessary for protection of the matter protected, [64] and these conditions may include a requirement that the proponent offset the impacts on protected matters.

Importantly, the offsets policy states that an offset is a beneficial impact, and therefore cannot be considered at the referral stage. Offsets may only be considered at the assessment and approval stages. At the assessment stage, the decision-maker has to first determine what the nature of the impacts on protected matters is likely to be. The decision-maker is then required to consider the following in order of priority:

- whether impacts on protected matters be avoided through redesign or alternatives;
- whether impacts on protected matters be mitigated through measures to reduce the impacts; and
- after proposed avoidance and mitigation measures are considered, and there are still residual impacts, whether offsets offer a suitable approach. [65]

At the approval stage, the proposed offset will be balanced with the other factors mandated by the *EPBC Act*, including ecologically sustainable development, and economic and social benefits. [66]

Requirements for offset projects at the Commonwealth level

Requirements for offset projects at the Commonwealth level

The *EPBC Act* offsets policy sets out a series of principles to be referred to in determining whether an offset is suitable. Under these principles, suitable offsets must:

- Deliver an overall conservation outcome that improves or maintains the viability of the protected matter. Importantly, the offset must relate to the same specific matter that is impacted (eg same species).
- Be in proportion to the level of statutory protection that applies to the protected matter. For example, the higher the conservation status of a protected matter, the higher the level of offset that will be required.
- Be of a size and scale proportionate to the residual impacts on the protected matter.
- Effectively account for and manage the risks of the offset not succeeding.
- Be additional to what is already required by law.
- Be efficient, effective, timely, transparent, scientifically robust and reasonable.
- Have transparent governance arrangements, including around measurement, monitoring and enforcement. [67]

Importantly, offsets must also be built around direct offsets, but may include other compensatory measures, and these offsets must be secured legally. Direct offsets are defined under

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the policy as those that provide a measurable conservation gain for a protected matter impacted by a proposal, and may be achieved by creating or improving habitat, reducing threats to the protected matter, increasing the heritage values of a heritage place, and/or averting the loss of a protected matter or its habitat that is under threat. Compensatory measures are defined as indirect benefits (eg research funding), and only 10% of the offset may consist of compensatory measures. [68]

The definition of direct offsets in the *EPBC Act* is probably broad enough to allow for proponents to engage in active activities such as replanting or improving conditions for seagrass onsite, or to address diffuse impacts as the offset activity. For example, improving water quality upstream of a seagrass ecosystem could have the effect of reducing threats to the protected matter. Furthermore, the policy allows for an offset site to be geographically distant to the area of impact, noting that the offset site should be as close to the impact site as possible, but geographically distant sites will be considered where it is demonstrated that a greater conservation benefit for the impacted protected matter can be achieved by providing an offset further away. [69] However, the impact

on seagrass meadows of actions to mitigate diffuse impacts might not be easily measured, and further scientific research is required to understand those processes.

Offsetting impacts on seagrass under the EPBC Act policy

Offsetting impacts on seagrass under the EPBC Act policy

The *EPBC Act* offsets policy expressly applies to both terrestrial and aquatic (including marine) environments, [70] and one of its earliest applications has been through the imposition of a requirement to offset the impacts from development on seagrass from the Abbot Point coal terminal expansion in Queensland, Australia. [71] This proposal will have direct impacts on seagrass meadows due to removal, and this impact was assessed under the *EPBC Act*. However, offsite impacts may also occur due to sediment plumes caused by removal/dredging, and these impacts were not assessed.

The Abbot Point coal terminal is located 25 kms north-west of Bowen in Queensland, and has been in operation since 1984 with an initial carrying capacity of 15 Mtpa. In 2008, following several previous expansions, the terminal operators advised the Queensland government of their intention to apply for approval to expand the operating capacity of the terminal to 110 Mtpa. [72] The proposal was also referred to the Commonwealth Minister, and was determined to be a controlled action due to potential impacts on World and National Heritage properties (the Great Barrier Reef), listed threatened species and communities, listed migratory species, and a Commonwealth Marine area. [73] The area has extensive seagrass meadows, which in 2008 covered 42% of the near-shore habitats between Branch Creek and Bowen, and extended up to 10 km offshore. [74] The meadows have been identified as likely to play a number of important ecological roles, including supporting endangered and threatened species such as dugongs and turtles, and providing nursery grounds for commercial fisheries species. [75]

The expansion was approved by the Commonwealth Minister on 4 October 2012 subject to a number of conditions, including a maximum disturbance limit of 0.1 ha of seagrass communities. [76] In other words, the proponent is permitted to clear 0.1 ha of seagrass. Generally, for all protected habitat (including seagrass meadows), the proponent is required to:

- Undertake preclearance surveys of the habitat.

- Prepare a number of environmental management plans that maximise the protection and conservation of protected matters. These plans are required to outline measures for the avoidance and mitigation of harm.
- Prepare a management and monitoring framework, considering all cumulative impacts of the action. The proponents are required to monitor progress, and use an adaptive management approach. In relation to seagrass, the proponent is specifically required to monitor impacts from construction.

Additionally, the proponent is required to prepare a Biodiversity Offset Strategy, with a section dedicated to seagrass. The proponent is required to offset any disturbance impacts to seagrass, as identified in the preclearance surveys, with the total disturbance not exceeding 0.1 ha. The offset policy must also identify any mechanisms and opportunities for the ongoing protection and conservation of seagrass habitat that supports listed threatened species and migratory species. [77]

The offsets must be a minimum of 8:1 (ie the offset area must be eight times larger than the area lost), with the specific requirement depending on the proposed improvement in quality of the offset site, the averted loss achieved by securing the site, and the risks associated with the proposed offset activity. [78]

To date, the Biodiversity Offset Strategy for the Abbot Point coal terminal has not been finalised, so it is unclear whether it will adequately compensate for the loss of seagrass associated with the project. The outcomes of the strategy will be observed with interest, to ascertain whether the existing offsets policy can effectively address impacts on the seagrass ecosystem. It will also be relevant to observe whether the strategy uses active or passive measures, or improvement of diffuse impacts, or a combination of these.

Furthermore, the approval condition only requires the proponent to offset the impact of the 0.1 ha of seagrass meadow that they are permitted to clear (ie the direct impacts). It seems unlikely that this 0.1 ha represents the entirety of impacts to seagrass from the project, which will also include the indirect impacts from increased dredging, as well as resultant sediment resuspension on the wider seagrass ecosystem. These impacts should be included in the referral with a requirement for offset, although the only way to assess these diffuse offsite impacts would be through use of a whole-of-ecosystem model that considered the effects of transport of fine sediments and nutrients.

How can the EPBC Act and the EPBC Act offset policy better accommodate seagrass ecosystems?

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Marine ecosystems such as seagrass meadows have unique ecological characteristics, and this article has shown that the application of offset policies developed for terrestrial ecosystems will not necessarily achieve desirable environmental outcomes. Even though the *EPBC Act* policy is expressed to apply to marine ecosystems, there are a number of scientific and policy factors that must be considered for offset policies to effectively compensate for impacts to seagrass.

The best outcome for the conservation of seagrass habitats would be development and implementation of offsetting policies specific to seagrass, as some marine ecological processes are fundamentally different to those in terrestrial ecosystems. Such a policy would need to be accompanied by guidelines for choosing offset sites, as this involves complexities not necessarily present in choosing sites for terrestrial offsets. It may be more appropriate to prioritise rehabilitating degraded areas rather than replanting in bare areas, as research shows this is more likely to be successful. [79]

The general principle used in offsetting policies that a preference should be given to avoidance and mitigation, with offsetting used as a last resort, should be retained in a seagrass-specific policy. Some impacts can be avoided and mitigated through the imposition of conditions. For example, a

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condition allowing dredging only at certain times of the year would have the impact of reducing the negative consequences of turbidity, thus mitigating damage to seagrasses. [80] With a proper understanding of the key threats to seagrass ecosystems, decision-makers should be able to appropriately develop conditions to limit the impacts before even considering the need for offsets.

One of the most important factors to consider in developing an offset policy for seagrass is how to address diffuse impacts. As noted above, one of the main distinctions between seagrass and terrestrial ecosystems is that major threats to seagrass often come from activities offsite, and that activities onsite may also have an influence offsite (eg turbidity plumes). These actions should therefore be assessed for their impact on seagrass meadows.

Importantly, although the *EPBC Act* applies to actions that have direct, indirect, and offsite impacts on protected matters, it is unclear that all actions of this type are being assessed and considered under the *EPBC Act* process. For example, it is doubtful that all farming activities that result in run-off flowing to protected areas of seagrass meadows are referred and assessed under the Act. Indeed, activities of this type may not individually be considered as having a significant impact. However, if these activities over the landscape are viewed as a whole, the cumulative impact on ecosystems downstream, such as seagrass ecosystems, may be significant. Consequently, amendment of the *EPBC Act* offset policy alone may not lead to improved outcomes for seagrass ecosystems, as more fundamental changes to the application of the legislation may be needed. Perhaps the potential for strategic assessment of these actions may need to be explored to ensure that seagrass ecosystems are not affected by the death by a thousand cuts phenomenon due to offsite activities. [81]

In terms of offset activities, seagrass ecosystems (and other marine ecosystems) differ from terrestrial ecosystems in that improvement of offsite conditions may improve the condition of seagrass meadows. A seagrass offset policy will need to utilise a creative approach that allows for remediation of diffuse impacts as an offset activity. For example, an impact on a seagrass ecosystem in one location could theoretically be offset by a proponent improving water conditions upstream of a seagrass ecosystem in another location. Further scientific research is needed to model catchment to sea linkages, and to consider if and how expenditure on rehabilitation of catchments can positively influence coastal ecosystems in a quantifiable way.

Additionally, if offsetting policies are used in relation to seagrass, they should be drafted to secure outcomes rather than actions. For example, a proponent could be required to successfully establish or re-establish a seagrass ecosystem, as opposed to a requirement simply to replant vegetation. This would fit within a broader adaptive management framework, whereby the offset site is continually monitored, and conditions are altered if needed to ensure that the offset is successful. [82] There is still a need for further research in this area, and an adaptive management approach will facilitate this. This also accords with the precautionary principle, which is part of the decision-making framework under the *EPBC Act*. [83]

To support an adaptive management approach, it would be preferable for governments to not use seagrass offsets widely until the success rate is known with some degree of certainty. Recent research by seagrass ecologists and managers suggests that restoration after the loss of seagrass meadows should never be considered as the first alternative when planning for the mitigation of coastal development projects or to justify mitigation as a compensation measure for economic activities.

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Priority should instead be given to sites for natural rehabilitation from a degraded state. [84] It would be preferable for governments to initially permit only a limited number of seagrass offset projects to be carefully monitored as study sites, so that the success of seagrass offsets can be evaluated prior to using these policies more widely. Given the current costs and uncertainties involved with

rehabilitating seagrass ecosystems, this would be a sensible policy decision.

Finally, there is currently little coordination between the various levels of government in terms of developing and implementing offsets, and a proponent may need to satisfy offset requirements under both policies. The *EPBC Act* policy does state that a state or territory offset will count toward an offset under the *EPBC Act* to the extent that it compensates for the residual impact to the protected matter identified under the *EPBC Act*. [85] However, this issue requires further exploration.

Conclusion

Conclusion

Environmental or biodiversity offset strategies seek to achieve the noble goal of no net loss or net gain as an outcome of development. In practice, this goal has been difficult to achieve. In relation to marine ecosystems, and seagrass meadows in particular, there are a number of challenges that must be considered before offset policies can effectively allow proponents to attain the goal of no net loss or net gain.

The importance of seagrass ecosystems is becoming better understood, and it is welcome to see this recognition in the application of offset policies. However, it is important that specific policies are developed that recognise the unique nature of seagrass ecosystems, and also allow for the most beneficial activities to be used as offsets, noting that this may not always involve planting. The issues put forward here may also apply broadly to other marine ecosystems, such as coral reefs, which are similarly located in the coastal zone and strongly influenced by reductions in water quality.

In summary, seagrass ecosystems are critically important yet highly threatened habitats, which provide a suite of valuable ecosystem services. Environmental offsets for seagrass ecosystems should be used as a last line of defence when damage from development is considered to be necessary and unavoidable. Several offset policies relevant to seagrass are currently in place in Australia at both the State and national level. Consistency amongst these policies in-line with the most recent scientific advancements on seagrass rehabilitation will improve the likelihood that offset programs will deliver the promise of protecting environmental values. At present further research is required to determine which rehabilitation strategies will be most effective. In particular, whether environmental remediation at distant locations can be used to mitigate diffuse impacts and to provide quantifiable improvements to the area or condition of seagrass is required. Legal frameworks should be developed to accommodate these unique characteristics of seagrass ecosystems.

Footnotes

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