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‘Mitigation banks’ for wetland conservation: a major success or an unmitigated disaster?

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Abstract First developed in the USA in the early 1970s, ‘wetland mitigation banks’ provide a framework for conservation activities that are designed to offset residual, unavoidable damage to the natural environment caused by development activities. The concept is now a worldwide phenomenon. In this paper I consider the level of success of wetland mitigation banks in the USA for biodiversity conservation with a view to informing ‘best practice’ in Australia. I conclude that although the concept has merit, even in the USA where the processes have been evolving for over 30 years, the outcomes frequently fall short of the target of a ‘like for like’ swap of habitat. While the outcome for wetland mitigation may not be an ‘unmitigated disaster’ it is, at best, apparently only modestly successful.

Keywords Compensatory habitat · Threatened species · Environmental compliance · Biodiversity conservation offsets · Habitat rehabilitation · Restoration

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Wetland mitigation banks: definition and history

The concept of wetland mitigation banks (cf. biodiversity offsets, setasides, compensatory habitat) encompass conservation activities that are designed to offset residual, unavoidable damage to the natural environment caused by development activities (ten Kate et al. 2004). A suite of tools for wetland mitigation was first formalised in the United States of America (US) under Sect. 404 of the Federal government’s *Clean Waters Act 1972*. Subsequently there has been a diversity of additional regulation by local, state and federal US authorities together with judicial interpretations associated with the regulation of wetlands (Barkmann and Windhorst 2000). Most recently the Army Corps of Engineers and the Environmental Protection Agency have issued the *Clean Water Act 2008*. The associated regulation defines standards and procedures, and aims to replace a previous ‘mish-mash’ of US inter-agency instruments and other policy documents that had been issued over the preceding 17 years. Under Sect. 404 *Compensatory Mitigation Program*, the concept of offsets and species conservation has been broadened to include ‘ecosystem services’ (Ruhl et al. 2008).

Since the first legislation was enacted in the US, mitigation offsets have been increasingly widely taken up by industry (including mining, construction, oil and gas, forestry), governments and investors (ICMM 2005), and the concept has now expanded to become a global phenomenon. In numerous countries (e.g., Brazil, Europe, Canada, ten Kate et al. 2004; Australia, Burgin 2008; Wotherspoon and Burgin 2009a) they are now incorporated into the legal framework (ten Kate et al. 2004). Demonstration projects have also been widely implemented (e.g., Business and Biodiversity Offset Program pilots/case studies in Washington, Ghana, Mexico, Qatar, South Africa and Uganda, Washington Biodiversity Project 2006; Australia, DEC 2006). Despite this apparent on-going commitment to conserve nature, the evidence of the economic benefits that are derived from such conservation (e.g., aesthetics, cultural necessity, ecological services, climate regulation, harvest of plants and animals; Balmford et al. 2002), and such drivers as the *Millennium Development Goals* that arose from the *World Summit on Sustainable Development* in 2002 and the *Convention on Biological Diversity Decision VI/26* (Banana 2005; WSSD 2002), the loss of species and the degradation of habitats continues unabated (Balmford et al. 2002).

Relevance of wetland mitigation banks to Australia

Australia has 'particularly large numbers' of threatened species (IUCN 2006) and the rate of loss is accelerating, in part, due to expanding urbanisation (Burgin 2008). In New South Wales (NSW) the scale of loss has been 'substantial' with approximately 1,000 species, populations and communities vulnerable or endangered (DEC 2006). However, the threat is proportionally greater among aquatic species compared to terrestrial taxa. For example, 23% of 195 Australian native fish species are listed as being of concern (NFA 2004), and 30% of 25 species from the lowland rivers of New South Wales are considered threatened, and 'many others are of grave concern' (DPI 2007). Due to a lack of knowledge of many species of invertebrates, fungi and other microbes that are associated with endemic aquatic ecosystems their status is unknown.

Overall the major threat to the health, abundance and diversity of aquatic ecosystems is the destruction of habitat (DPI 2007). A wide range of processes threaten the integrity and long-term viability of such systems, including the introduction of species from outside of their normal range (Burgin 2006, 2007; DPI 2007), hook and line fishing, in-stream removal of large woody debris or the introduction of structures and other mechanisms that alter the natural flows, cold water pollution, and degradation of native riparian vegetation. Managing the associated threats to aquatic life, rehabilitation of degraded areas, and assisting in the recovery of threatened species creates major challenges (DPI 2007). However, there are particular problems associated with 'farm dams'. These are wetlands that are manmade, highly modified and/or ephemeral. They are often lost to development without consideration of their amenity as wildlife habitat, and in the construction process, the emphasis tends to be on harvestable rights (DNR 1999). For example, in the NSW *State Environmental Planning Policy No. 52—Farm Dams and other works in Land and Water Management Plans* under the *Environmental Planning and Assessment Act 1979*, the emphasis is exclusively on harvestable rights. For example, without a licence, dam capacity on a property has to remain below 10% of the average regional rainfall for the property (DNR 1999). In determining the fate of dams, either existing or proposed, there is no consideration of their benefit as habitat for native species. Despite this lack of concern for such wetland areas, research undertaken on the farmlands of the University of Western Sydney has demonstrated that farm dams can create important habitat for native frogs, freshwater turtles (White and Burgin 2004) and eels (Dalem 1998).

Modeled on the US concepts of wetland mitigation (see e.g., DEC 2006), in 2006 the NSW government introduced the *Threatened Species Conservation Amendment* (*Biodiversity Banking*) *Bill 2006* to add to the suite of legislation that aims to strengthen the concept for biodiversity offsets. Previous legislation (e.g., NSW *Native Vegetation Act 2003*, NSW *Fisheries Management Act 1994*) have also sought to mitigate biodiversity loss through offsets. For example, within the *Fisheries Management Act*, there are processes in place to encourage 'no net loss' of seagrass habitat due to development. Negotiations may include the transplanting of seagrass, construction of a fishway, or a contribution to the *Conservation Trust Fund* as compensation for damage. A monetary bond may also be required as insurance for the success of the offset.

In previous papers the use of biodiversity offsets to mitigate impacts from urban development on the terrestrial environment, as defined under the 2006

BioBanking legislation was investigated from the view of an environmental scientist (Burgin 2008), and from the viewpoint of an ecological consultant (Wotherspoon and Burgin 2009a). However, we did not consider mitigation of wetland impacts. Since the offset tools were established in the US to mitigate impacts to wetlands as a result of development, and the concepts have been copied worldwide, in this paper I investigate the success of the process in the United States of America as a basis to inform 'best practice' in the Australian context.

Has the wetland mitigation bank approach had a 'no net loss' in the US?

In the US the definition of wetland mitigation is that '…wetland restoration, creation, enhancement, and preservation [is] undertaken expressly for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be environmentally beneficial' (EPA 1995, pp. 58605). It has been reported that the requirement for wetland mitigation has lead to the 'creation of thousands of acres of wetlands and protected sites and considerable biodiversity protection that would not have existed had the law not required developers to offset their impacts on wetlands in this way' (ten Kate et al. 2004, pp. 14). This is because, frequently, the developer is obliged to offset (e.g., protect, restore) larger areas of wetland than has been lost to a specific development (ten Kate et al. 2004).

Despite these apparent substantial gains, many (see e.g., reviews by Kihslinger 2008; NRC 2001; Turner et al. 2001) have argued that wetland mitigation in the US has fallen well short of achieving the goal of 'no net loss' for a range of reasons and in some instances, such as the ten Kate et al. (2004) document that was commissioned by the International Union for the Conservation of Nature, contradictory comment is provided. For example, while claiming success in one section of the document they also stated that there have been over 16,000 hectares of 'conservation banks' developed but 75% or more would probably have been developed even without legislation to mitigate loss. More broadly there is on-going debate about the benefits or otherwise of wetland mitigation (Ruhl et al. 2006).

It has been demonstrated (e.g., Brown and Veneman 2001; Kentula et al. 1992) that wetland mitigation works in the US have not approached 'no net loss' and it has been suggested that even the '40,000 acres conserved' by conservation banking is 'modest' compared to the overall area affected by development. However, even this figure has been challenged. Quoting Julie Sibbing of the US National Wildlife Federation, ten Kate et al. (2004) reported that, in addition to the land area of wetland restoration the figures included, some reported figures also included areas avoided by the projects, preservation of existing wetlands an/or upland buffers around wetlands. It was further suggested that the US Army Corps of Engineers, the overseers of the wetland developments, have failed to keep adequate records to enable the assessment of whether 'no net loss' has been achieved (Kentula et al. 1992), to the point that Trott (2001) suggested that there was 'a complete lack of respect' for the country's natural resources.

The observation of Kaiser (2001) that wetlands are no match for the original, and often a 'poor substitute', is supported by others. For example, Kentula et al. (1992) reported on 58 permits issued between 1977 and 1987 in Oregon which included impact on 82 wetlands (74 ha) while 80 (42 ha) were created. This constituted a 43% loss of wetland habitat. The same trend was observed across 35 permits issued in Washington between 1980 and 1986, and in data analysed from 391 project files for the period between 1983 and 1994 and 114 field sites in Massachusetts. Almost 55% of the projects did not comply with regulations. Of these no attempt had been made to build 22%, 30% were of insufficient size or hydrology, and 65% did not meet size requirements. Of those that constructed, 71% impacted on forested wetlands. In addition, approximately half of the construction works that were required to have scrub/shrub systems that were built did not include a wetland component (39%), wet meadows (37%) or some other wetland type (24.5%). Plant communities differed significantly from the wetland areas lost across species number, cover and composition, and even after 12 years there was no increase in the size of plant communities associated with mitigated areas.

In contrast to smaller projects, large wetland projects were built to the appropriate specifications although their plant communities were not similar to the wetlands that had been replaced (Brown and Veneman 2001). In other areas many projects (e.g., San Francisco Bay, Race 1985, pp. 1432) 'never reached the level of success purported and others have been plagued by serious problems'. While it has been reported that losses have slowed (Baker 1999), negative reports have continued to flow. For example, Turner et al. (2001) suggested that approximately 80% of wetlands built for mitigation did not become fully functional. In Canada, Harper and Quigley (2005) found that less than 15% of 124 developments associated with fish habitat were compliant with conditions. Such failures in the US and elsewhere (e.g., Canada, Uganda), have resulted in 'considerable debate' around whether to continue the practice (ten Kate et al. 2004).

Cost benefit of wetland mitigation banks

Under the guise of mitigating 'unavoidable harm' to wetlands, an industry has been created that specialises in enhancing or restoring wetlands in order to sell 'wetland mitigation credits' (Bayon 2002). This is despite the claim that even the best managed wetland and habitat banks do not generally supply the full range of services provided by the native ecosystems that are lost and replaced by the offset, and there are not the techniques available to replicate others, the market for environmental services continues to develop (Ellison and Daily 2003; ten Kate et al. 2004) with continued take-up in countries worldwide (Burgin 2008; Wotherspoon and Burgin 2009a). In the US, large sums of money can be made from mitigation banking as a result of developers seeking to offset habitat lost with lands elsewhere (Bayon 2002). Based on data from the General Accounting Office and estimates from the National Academy of Science, Bayon (2002) reported that between 1993 and 2000 more than 24,000 acres, and probably more than a billion US dollars was spent to obtain permits. One example of the potential profits to be made is evidenced by the Stillwater Plain Conservation Bank. The California Department of Fish and Game identified that there were an 'extremely high' proportion of unique and endangered wetlands on a private landholder's property, commensurate with the development of 150 credits on the 900 acres. In 2001, the first of these credits sold for between $65,000 and $70,000 each (Bayon 2002). Such established opportunities for trading, tend to result in a loss of wetland resources in one area for the benefit of another, potentially in a different landscape and habitat type.

Flawed logic

There is a major flaw in the concept of offsetting one wetland with another for conservation when it results in wetland loss in one area and the construction, rehabilitation or maintenance of wetlands in a different habitat type, with no connection to the lost wetlands. This does occur in the US For example, there tends to be a depletion of remnant wetland habitat in urban areas with the offsets often occurring in rural landscapes (Ruhl and Salzam 2006). Such loss would probably be most acute when the offset is associated with relic habitat, or an endangered species. Frequently the very reason that they are 'endangered' is due to previous removal or degradation of habitat. The concept of 'no net loss' implies that the species wetland/s will be recreated elsewhere within the landscape to compensate for the inevitable loss that will occur when the wetland is relinquished for development. This concept of a trade between areas does not result in a net gain (Carruthers and Paton 2005).

Gibbons and Lindenmayer (2007) pointed out that when offset schemes fail to require sites to be improved commensurate with the loss invoked by the development, that are switched with sites that have no capacity for improvement, or represent sites that are not under threat of decline, the outcome will be a loss of endemic ecosystem commensurate with the area cleared. Since the Stillwater Plain Conservation area was not in danger of immediate loss because it was uneconomic to develop the area for housing (Bayon 2002), the trading of wetlands under threat elsewhere with credits on this land can not be considered as a gain for conservation of native habitats.

Where the offset allows for new habitat to be created, or compensation in some other form other than a 'like for like swap', the gains are unlikely to compensate for the loss to development (Hilderbrand et al. 2005). In this situation there is inevitably a lag between the destruction of the wetland and an equivalent replacement, if this ever occurs. This has been demonstrated in the US, where it has been often observed that the species composition of the constructed wetlands were different from the original wetland habitat (e.g., Ambrose and Lee 2004; Balzano et al. 2002), and across a range of wetlands, Brown and Veneman (2001) observed that up to 12 years after the plant community had been introduced there had been no increase in its size.

Major areas of science that should underpin decisions in the introduction and restoration of wetlands due to mitigation offsets are ecology, restoration biology and genetics. Compared with other areas of science such as physics, chemistry and mathematics, the ecological, genetics and restoration sciences are undeveloped, and the underpinning science is much more imprecise and complex. While genetics is better developed than ecology or restoration science, its importance in conservation is largely ignored (Burgin 2002). This complicates what appears to be a 'deceptively simple' concept (ten Kate et al. 2004) and pragmatically there is likely to be greatest emphasis on conserving 'ecological communities' because they are relatively simple to evaluate (e.g., air photos, GIS classification, species lists) compared to assessing ecosystem services (Burgin 2008) despite recent changes to the US regulations that allows these processes to be considered (Ruhl et al. 2008). However, based on the observations of a large number of researchers (e.g., Ambrose et al. 2006; Brown and Veneman 2001; Johnson et al. 2002; Minkin and Ladd 2003; Sudol and Ambrose 2002; Turner et al. 2001), even at the ecological community level of wetland mitigation there is often a short fall that could not be considered to have conformed to the definition of '..wetland restoration, creation, enhancement, and preservation undertaken expressly for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be environmentally beneficial' (EPA 1995, pp. 58605).

Major success or unmitigated disaster?

When loss of wetlands due to development can be justified to be 'unavoidable' (in NSW the decision may be made in the Land and Environment Court), it is appropriate for offsets to be negotiated. However even in the US where the concept of wetland mitigation is most well developed, the outcomes frequently fall short of 'like for like' (see e.g., Baker 1999; Brown and Veneman 2001; Kihslinger 2008; Turner et al. 2001). Despite the hype, the reality is that under the guise of mitigating 'unavoidable harm' to wetlands there has been the creation of a major industry based on an environmental currency with a variety of business types specialising in enhancing or restoring wetlands in order to sell these credits (Bayon 2002). Stokstad (2008) suggested that the current US regulation pushes the limits of scientific knowledge. Under this circumstance, to ensure the possibility for a 'like for like' swap, the precautionary principle should be the *status quo*. The evidence reviewed in the preparation of this paper strongly implies that it is not widely a consideration.

However, the loss of biodiversity is of widespread concern and any effort to overcome such loss has to be applauded. Unfortunately the 'no net loss' of wetland habitat and associated species generally remains a concept. Scientific and management issues associated with environmental loss are yet to be overcome, although it has been suggested that, at least in the US, larger sized offsets are more likely to be successful than smaller ones (e.g., Brown and Veneman 2001). However, even if the correct decisions are made in negotiating wetland mitigation, the best current outcomes appear to be a slowing of the rate of biodiversity decline. The outcome for wetland mitigation may not be an 'unmitigated disaster' but it is, at best, modestly successful.

The NSW *Threatened Species Conservation Amendment (Biodiversity Banking) Bill 2006* which used Sect. 404 of the US *Clean Water Act 2008* as inspiration, if not as a model, was designed largely to provide opportunities for offsets of vegetation loss in Western Sydney where native habitat continues to decline due to expanding urbanisation (e.g., housing, industrial development, transport infrastructure) and less than 10% now remains (Wotherspoon and Burgin 2009b): an 'unmitigated disaster'. Based on the US experience in wetland mitigation, offsets to biodiversity loss in Western Sydney and elsewhere should be found within the area. Burgin and Wotherspoon (2009) have identified that such opportunities exist in the area on lands excess to requirements for infrastructure associated with fair grounds, sporting and education facilities, riparian zones and other flood plain areas, open space parks, and railway reserves where the native vegetation has been lost or it is heavily degraded. Such areas could support biodiversity, often without the requirement for change to land use in the offset area. Once the lands have been identified for mitigation, extensive baseline surveys and agreements need to be developed, while on-going monitoring of the process of mitigation, and post-implementation monitoring should be directly tied to the final ecological performance criteria identified during the agreement phase.

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