RESTORATION DECADE ALLIANCE

Australian Restoration organisations supporting the United Nations Decade on Ecosystem Restoration 2021–2030

RDA position statement

A national approach to attaining **nature positive restoration** in Australia

October 4 2024

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Foreword

The globe's natural ecosystems, including those in Australia, are on a trajectory of degradation and decline. This negative trajectory must be reversed to protect and restore nature. However, Australia will not be able to shift the ledger away from biodiversity losses and towards biodiversity gains unless there is substantial change in how we work together to (i) stop loss and degradation and (ii) direct substantial resources towards scaling up effective ecosystem restoration.

There is no doubt that there is a long way to go before we can attain a nature positive Australia, but there are glimmers of hope. Some serious restoration work is being undertaken around Australia and it is very possible that these can be scaled up to make a meaningful difference. There is some strengthening of government regulation to protect and restore ecosystems and some action by agencies and a wide range of private and community organisations to conserve and restore diverse native ecosystems. There is already a small but promising shift among many primary producers towards reducing negative impacts on soils, air and waters, driven in part by consumer demand. And, perhaps most importantly, there is already evidence of some willingness among Australians to rebuild a more positive relationship with the rest of nature, shifting our role from being agents of degradation to being agents of renewal and stewardship.

These glimmers of hope are, however, insufficient to make the necessary difference. What is missing to bring these elements together at the scale required, is fit-for-purpose policy, funding and bi-partisan leadership at all political levels and a call to action to all Australians to reduce degradation and undertake effective restoration at scale. This policy, funding and leadership is essential if Australia is to support and grow the environmental recovery economy and reduce our impacts upon nature, thus helping to avert the intertwined crises of climate change and biodiversity loss.

(Dr) Tein McDonald
Chair, Restoration Decade Alliance
02/09/2024

Executive summary

Australia's most recent State of the Environment Report presents an alarming story of environmental loss and degradation in Australia as a result of a range of land and water uses over many decades. Overall, the current state and trend of the environment of Australia is poor and deteriorating as a result of increasing pressures from climate change, habitat loss, invasive species, pollution, resource extraction and unsustainable land and water usage. Changing environmental conditions means that many species and ecosystems are becoming increasingly threatened with extinction. Multiple pressures create cumulative impacts that amplify threats to our environment, and abrupt changes in ecological systems have been recorded in the past 5 years.

Throughout 2023, Australia's Restoration Decade Alliance (RDA) ran a series of workshops and a symposium on the topic 'Towards a National Restoration Plan'. The workshop series attracted a high level of engagement amongst restoration-aligned organisations and others and participants reached strong consensus on the need for a very substantially increased national effort towards achieving ecosystem restoration in Australia. The motivation for this workshop series arose from our awareness of calls by the UN for upscaling restoration globally. These calls focus on the following two major initiatives, both agreed to by Australia, as well as focusing on global commitments at successive UN Framework Convention on Climate Change (UNFCCC) Convention of the Parties (COPs) to integrate climate and biodiversity action.

- **UN Decade on Ecosystem Restoration** that calls for efforts to prevent, halt and reverse the degradation of ecosystems on every continent and in every ocean.
- **Kunming-Montreal Global Biodiversity Framework** (KM GBF) that calls for 30% of degraded land and water areas across the globe to be under effective restoration by 2030.

The RDA supports the broad analysis of problems and solutions proposed in the Wentworth Group's *Blueprint to Repair Australia's Landscapes* (Wentworth Blueprint) and the NRM Regions *Call to Heal Australia's Lands Seas an Waterways.* We offer complementary perspectives that emerge from the specialist experience of RDA's members in on-ground and in-water restoration. Indeed, experts agree that the need for restoration in Australia is far bigger than is being addressed by current programs or level of urgency conveyed by our State and National Governments, and far greater than is understood by the public. Past and ongoing losses of biodiversity in Australia's lands and waters are now so immense that protection alone cannot address the anticipated needs of nature and people, especially in the face of climate change. Strategic, science-informed restoration is needed to urgently accompany protection if we are to progress anywhere near meeting our nation's biodiversity conservation needs and global restoration goals. (See Wentworth Group's *Blueprint to Repair Australia's Landscapes*.)

The Australian Government's Nature Positive Plan for Australia responds to the need for improving our nation's balance sheet in favour of gains for nature rather than losses. While the Plan has much good content, it lacks a vision for mechanisms to address historic degradation. There are significant policy gaps that need to be filled for the Plan to be successfully implemented and a Nature Positive Australia realised.

These gaps include (but are not confined to) the following.

- **Need for more genuine engagement with Indigenous Australians (as a first principle) in Australia's restoration efforts.** Engagement with Indigenous Australians needs to be undertaken early and throughout restoration planning and implementation to incorporate their deep knowledge of Country, empower them as restoration stewards, and as a matter of social justice. Urgent support of efforts of Indigenous peoples to conserve and restore their nature-based cultures (many of which are experiencing huge extinction pressures) is a key step in developing a more nature positive culture for all Australians. In addition we urge the recognition of Indigenous leadership, the establishment of dedicated Indigenous-led organisations, and the formation of meaningful partnerships to integrate Indigenous perspectives into contemporary environmental management frameworks, recognising the invaluable contributions of Indigenous peoples to sustainable environmental management and influencing a more nature positive culture for all Australians

- **Inadequate vision for ecosystem restoration.** There is suboptimal national vision for restoration in Australia compared to many other developed and developing countries. The Nature Positive Plan for Australia considers restoration largely in the context of minimising impacts from new developments without addressing existing degradation caused by cumulative past impacts. This omission risks the task of repairing past damage to ecosystems being used purely as a means for offsetting future negative impacts caused by developments. This would be unacceptable as many species and ecosystems have already been pushed to the brink of extinction by past impacts. Reducing both past and future impacts is called for by the KM GBF and a clear vision is needed for restoring existing degraded ecosystems in their own right.
- **Lack of large-scale funding** is a major barrier to implementing the necessary amount of restoration required across Australia, yet increases in funding to address major shortfalls is feasible if there was the political will (See Wentworth Group Blueprint) There appears to have been a progressive reduction in public funding for nature repair over the recent decade despite Australia's global environmental commitments and stated goals. There is some expectation that formal and informal markets will provide much of the necessary scaling up of funding over the long term, although this has not yet been demonstrated. It is likely that increased and ongoing investment by governments will continue to be needed, hence the establishment of markets should not be considered a replacement for appropriate ongoing levels of public funding. A national nature investment strategy is needed to facilitate growth in the multiple sources of funding required from both public and private sectors, and ensure they are invested effectively over the long term.
- **Insufficient capacity**. Australia's capacity for effective restoration (in terms of both resources and skills) is currently insufficient to meet the urgent need for scaling up and securing a pathway to a nature positive Australia. This urgent need to increase our capacity, however, is not sufficiently recognised in policy. This is despite restoration being formally recognised as being directly supportive of four of the other 22 KM GBF targets and supported by (or synergistic with) 16 other KM GBF targets. The Australian government needs to develop a strong national approach to building both top-down and bottom-up capacity and attaining the required restoration outcomes. Guidelines for specific terrestrial and aquatic restoration solutions need to be developed and these should be linked to implementation planning and revised regional planning.
- **Need for actionable strategy and ambitious and inspiring targets.** The Australian Government has published a target to protect and conserve at least 30% of Australia's terrestrial and inland water areas, and marine and coastal areas by 2030, which aligns well with GKM GBF Target 3 (Protection). However Australia is yet to develop a target for KM GBF Target 1 (Planning and management to avoid Biodiversity loss) and has not committed fully to the KM GBF Target 2 (Restoration). Australia's recently published Strategy for Nature 2024-2030 includes only a modest restoration target of solely having 'priority degraded areas' under effective restoration by 2030. This seems an unnecessarily modest commitment considering the level of community interest in environmental repair and will require more fullsome interpretation if the target is to proven fit for purpose. A rapid assessment of priority areas is needed, based on ambitious aspirations tempered by practicality. This assessment needs to be fed into a restoration implementation plan that can inspire all Australians to help meet the global target to the highest extent practicable.
- **Australia's policy also does not fully align with recommended levels of integration of climate and biodiversity action recommended at successive UN FCCC COPs.** This includes the COP 28 decision to enhance efforts to halt and reverse deforestation and forest degradation by 2030 and the Kunming-Montreal Global Biodiversity Framework (KM GBF) decision to enhance ecosystem carbon sinks and reservoirs by conserving biodiversity.
- **Unresolved design issues in the proposed Nature Repair Market (NRM).**The NRM is seen by the Federal Government as a source of additional necessary funding to scale up restoration in Australia, rather than restoration being solely dependent on government funding or voluntary contributions alone. While this may have some real potential to assist with restoration, there are a number of serious, unresolved issues and uncertainties surrounding the NRM operational mechanisms and therefore the market's role in achieving a nature positive future for Australia. RDA is actively participating in public consultations around those operational mechanisms during their process of development.

- **Complex permitting procedures** in many terrestrial, coastal and marine environments hinder restoration projects and act as a barrier to timely and cost-effective restoration. A review of approvals legislation and procedures is urgently needed at national and state levels to ensure that permits for restoration do not unnecessarily constrain restoration, particularly where restoration proposals fit within regulated, professional guidelines and standards.
- **Shortfalls in research and development.** While strong technical foundations exist in Australia for restoration, advances in restoration research and development have been sorely neglected, with many advances relying solely on innovation by on-ground practitioners rather than a mix of practitioners and researchers. Some existing research appears to have been overlooked by policy makers. This includes research identifying the dire shortage of diverse native seed supply for restoration and ways to overcome that shortage. There is also inadequate ex-situ conservation science for effective translocations of wild faunal populations and overdue research into soil biota. Financial support for research / practice partnerships that target the highest need in land and water restoration is urgently required, along with investment to support field-testing and knowledge transfer processes. The latter should include enhancement of tertiary curricula and in-service training for practitioners. Research dissemination and curricula development needs to be supported with government funding for train-the-trainer programs to upskill personnel involved in extension and outreach services (e.g. agency and NGO extension staff).
- **Reduction in support for engagement.** Positive change in societal attitudes and behaviours is essential for a shift to a nature positive Australia. This requires programs of active community engagement, support and capacity building to encourage communities to appreciate, protect and enhance nature near them and to help stop unlawful or unnecessary local destruction. Importantly, bottom-up community support is also essential to top-down political commitment. Despite the importance of community engagement, for the first time in decades there is currently an absence of policy and investment by the federal government in communicating with communities to encourage and enable increased local participation in restoration and capacity building. The UN Decade on Ecosystem Restoration provides a valuable promotional and engagement opportunity to harness interest from all sectors. We are now three years into that Decade with no sign of any intent by governments in Australia to harness this UN initiative. There remains opportunity for the Australian Government to leverage this initiative if action is rapidly taken as is required as part of our support of the UN Decade resolution.
- **Lack of clear vision for economic and ecological sustainability.** Australia - and the rest of the world - has so far failed to develop economic and population policies that can ensure that healthy economies and societies are maintained without ongoing degradation of nature. This is despite our economies, livelihoods and communities being dependent on a healthy natural environment. Inadequate valuing of the services that nature provides to Australian society is hampering our efforts to prioritise and invest optimally in developing sustainable economic and other policies.

Part 1 Introduction – insights from RDA workshop series

In response to the alarming ongoing decline of Australian ecosystems (State of the Environment Report) and the following calls by the UN for upscaling restoration globally, RDA ran, throughout 2023, a series of workshops and a symposium on the topic 'Towards a National Restoration Plan'.

The workshop series attracted a high level of engagement amongst restoration-aligned participants and others. Strong consensus was reached on the need for substantially reducing degradation and increasing ecosystem restoration to move Australia in a nature positive direction. From the workshop series emerged insights into a range of ecological restoration issues and solutions including the following. (Also see Appendices 1-5)

- **Indigenous Australians need to be genuinely empowered to lead, assist with and advise on restoration efforts.** While supporting Indigenous peoples' efforts is a matter of social justice, there are also many other reasons for empowering Indigenous Australians to lead, assist and advise on restoration. Indigenous communities are, in many cases, aware of the needs of healthy Country, have strong knowledge on ways to integrate the management of lands and waters and already have cultural mechanisms to convey and share knowledge and fill knowledge gaps in degradation issues and reference ecosystems. The creation of an Indigenous-led peak body is regarded as critical to fostering dialogue and collaboration and serve as platforms for Indigenous leaders to articulate their visions and strategies to help integrate Indigenous methodologies into mainstream environmental management practices.
- **Australia's priority projects for restoration investment need to aspire to the highest practicable standards while encouraging and supporting continuous improvement.** It is highly desirable to encourage the uptake of higher quality restoration rather than see widespread roll out of lowest quality efforts on the basis that the latter are lower cost. Investment in quick fixes that have no lasting value is unwise, particularly considering there are usually lower cost but high quality and more long-lasting alternatives to choose from in all scenarios. Such alternatives include the option of progressive improvements over longer timeframes, an approach that can complement the need of ecosystems for gradual ecological recovery over time.
- **Australia's restoration initiatives need to be guided by a strong and ecologically based strategy** that includes a vision, principles, standards and definitions (such as those contained in the very clear guidance documents associated with Target 2 of the KM GBF and the 10 principles of the UN Decade on Ecosystem Restoration). These should be encapsulated in a national restoration plan or implementation strategy, supported by a rapid assessment of priority areas for restoration). Priorities and standards need to be nationally consistent but locally adapted. Without this, restoration in Australia will progress on an ad hoc basis at scales and to standards that are insufficient to address the biodiversity crisis.
- **Inclusion, encouragement and integration are required of two types of KM GBF Target 2 restoration - rehabilitation and ecological restoration.** (Also see Appendix 4.) There are many environmental improvement initiatives already being undertaken (or planned) by governments and communities that include protection and restoration of native plant and animal communities, soil, air and water, active control of invasive species, pollution and waste management. These initiatives, however, far too often remain siloed and their lack of integration could result in further problems rather than offer solutions. Integration under a KM GBF Target 2 banner can support the optimisation of opportunities for nature positive outcomes and may allow the expansion of valuable restoration outcomes at larger scales.
- **Full recognition is needed of the entwined nature of the climate and biodiversity crises.** There is a particular need for governments and all stakeholders in restoration to recognise the functional role of biodiversity in underpinning the integrity of ecosystems and their capacity to sequester and store carbon at relatively low risk over the long term. The importance of retaining and restoring ecological

integrity, especially in carbon-dense terrestrial and marine ecosystems, for both climate mitigation and adaptation should be reflected in government policy and inform restoration priorities.

- **Restoration must be underpinned by halting the degradation of ecosystems and must not be used as a substitute for protection.** The first step in restoration is to address the drivers of degradation. This includes halting land clearing and habitat degradation in Australia's natural and emerging ecosystems, addressing water quality degradation drivers within catchments, halting the increasing spread of invasive species, and undertaking more serious and more biodiversity-compatible efforts to mitigate climate change. Without this, the potential for biodiversity conservation and restoration is extremely limited if not doomed to failure as restoration alone cannot be relied upon to compensate for the ongoing destruction and degradation of intact ecosystems. Similarly restoration needs to be used to enhance current conservation efforts, rather than being used as an alternative or substitute for conservation because no restored site has proven to have equivalent integrity as an undamaged one.
- **Restoration practice specialists, alongside restoration ecologists, should be contracted** to assist government agencies in developing restoration policy, regional planning and methodologies to attain desired restoration outcomes - particularly NGOs long-involved in innovative restoration at large scales and those who have expertise in working with communities. It is inappropriate to expect that researchers alone can develop such policy, plans or methodologies – and to then require practitioners to advocate at their own expense for improvements that can lead to workable outcomes.
- **A gap exists in restoration research and development as well as training and extension services** to support the growing restoration industry and community. Reliable funding is required to encourage research/practice partnerships to develop innovative solutions to technical challenges and develop practical restoration guidelines. Investment is also needed to reinforce (and increase capacity in) existing extension services and implementation support networks (e.g. Landcare coordinators and facilitators). This is needed to disseminate and acquire new knowledge and expertise through two-way processes.
- **There is a need for large-scale native seed production.** The native seed industry sector in Australia is currently not capable of supplying the seed required for scaling up restoration across the continent without substantial public and private investment and the establishment of dedicated seed production areas in all regions where restoration activities are to occur. Seed production areas need to be based on seed collected originally from genetically strong naturally occurring populations, subject to strict governance and guidelines, and seed multiplication to the level required will take many years to achieve. The Australian Native Seed Survey Report and Andres et al. (2023) have outlined the current status of the seed industry and highlights the challenges ahead with the enormous scale of seed production we need to achieve if we are to undertake restoration at scale.

Part 2 Links to international commitments

[Also see Appendix 1]

While there has been a long and growing awareness in Australia of the need for restoration, awareness has been growing apace internationally with increasing recognition of the importance of protecting and restoring biodiversity and ecological integrity for reversing the extinction crisis and limiting warming to as close as possible to 1.5 degrees. Australia has supported multiple relevant international decisions and agreements since 2020 that strengthen the global commitment to restoration

- **Recognition of the rights of Indigenous Peoples with respect to the environment.** The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) was adopted in 2007 establishes a universal framework of minimum standards for the survival, dignity and well-being of the Indigenous peoples of the world. Indigenous peoples, including Aboriginal and Torres Strait Islander peoples, were involved in its drafting. The Australian Human Rights Commission's Guide to the implications of this Declaration state that Indigenous Australians have a wide range of rights including the rights to (i) maintain and strengthen spiritual connection to Country; (ii) control, own and develop Country; (iii) ensure that governments develop systems for the legal recognition and protection of our country; (iv) address dispossession with through some form of compensation; (v) the protection of the environment on Country; protection of cultural heritage and traditional knowledge; and (vi) to determine how and if Country is developed.
- **Alignment of national policy with international commitments.** A recent publication by the IUCN Climate Crisis Commission and the World Commission on Protected Areas reveals the common responsibility of all three Rio Conventions to protect and restore ecological/ecosystem integrity. The Resource Guide to Target 2 KM GBF and draft UNEP guidelines for Target 2 specifically refer to the need to "Identify and prioritise geographical areas where restoration would contribute most significantly to achieving national level targets by 1) minimising the trade-offs and maximising complementarities between restoration commitments under various international, regional and domestic initiatives and with other targets of the KM GBF, and 2) prioritising locations with high biodiversity value and recovery potential, particularly in the face of climate change.
- The call is for each country to 'set a target for the total area of degraded ecosystems to be placed under restoration within the country, as well as the total area of each major ecosystem type to be targeted for restoration'. It is appropriate therefore for Australia's range of policy frameworks to align as fully as possible with these international calls and identify a clear and compelling target for restoration under KM GBF Target 2.
- **Opportunity for KM GBF Target 2 to work synergistically with other KM GBF targets.** The government should utilize spatial planning (Target 1) to retain and recover areas of high ecological integrity, biodiversity importance, buffer and reconnect protected areas (Target 3). New conservation tools, such as other effective area-based conservation measures (OECMs) and connectivity conservation approaches can also be combined with other actions such as invasive species management (Target 6) and reducing impacts of climate change (Target 8) to deliver high synergies and lower-risk restoration outcomes.

Integration of biodiversity and climate change goals

- **Synergistic and integrated climate and biodiversity action.** In each of the last 4 years, the UN Framework Convention on Climate Change (UNFCCC) has made important decisions on the need for synergistic and integrated climate and biodiversity action. Reflecting these decisions in government policy and action in Australia has yet to occur.
- The 2021 joint IPBES/IPCC workshop identified the critical importance of synergistic climate and biodiversity action and in particular the importance of protecting and restoring carbon-dense and species-rich ecosystems.

- The 2023 Climate Conference of the Parties (COP28) emphasised the need for climate mitigation action to 'conserve biodiversity in line with the Kunming-Montreal Global Biodiversity Framework (1/CMA 5, COP 28, para 33). However, The functional role of biodiversity in underpinning ecological integrity and supporting important ecosystem services like carbon retention (a service that is critically important for climate mitigation) is as yet adequately incorporated into policy in Australia. This is particularly the case with respect to the recognition of the importance of retaining and recovering ecological integrity for the following two entwined realities.
    - Helping to retain carbon is critically important if we are to limit warming to 1.5–2 degrees
    - Giving ecosystems a chance to adapt to climate change (e.g. through restoring connectivity across climatic and altitudinal gradients)
- Several of the KM GBF goals and targets are critically important for climate mitigation and adaptation and should be reflected in the Restoration plans and Nationally Determined Contributions (NDCs) and National Biodiversity Strategy and Action Plans (NBSAPs). Goals A and B and Targets 1,2,3,4 and 8 are particularly relevant.
- It is important to ensure that national, regional and local restoration planning fosters improved conservation management and ecological recovery of Australia's carbon dense natural ecosystems, including native forests, mangroves and seagrass. The next 2–3 years will likely see significant change in delivering synergistic climate and biodiversity action primarily driven by changes in international policy.

Part 3 Funding Restoration

[Also see Appendix 2]

The scaling up of restoration relies upon the increasing direction of both financial and human resources. Complementing the work of the Wentworth Group Blueprint to Repair Australia's Landscapes RDA offers the following points to highlight what we also see as some of the most important issues and priorities for such scaling up.

- **Lack of large scale and consistent funding is a major barrier** to national restoration planning and implementation, hence is a major barrier to achieving progress towards nature positive restoration in Australia. Sporadic funding reduces willingness/capacity of restoration practitioners/actors to invest for the longer-term, maintain staff/skills/resources etc. This cycle constrains the scaling of restoration impact/economies of scale. A national nature investment strategy is needed to facilitate and strengthen the multiple sources of funding required from public and private sectors and assist them to be invested effectively over the long term.
- **Ongoing government investment is needed.** The multiple sources of funding for restoration need to include direct government investment in ecological restoration projects for both privately and publicly owned areas through a National Restoration Fund. Government investment needs to navigate early challenges of scaling-up restoration activities, measuring outcomes and incorporating achievements into a holistic measure of the environmental and economic advancement of Australia. Increased funding, tax concessions and rebates are needed to encourage restoration works on private lands with Conservation Covenants over them.
- **Other investment is required.** A national investment fund can be also linked to the Nature Repair Market, Green Sovereign Bonds (Green Bonds) issued by the Commonwealth and purchased by private sector investors, Private Sector land purchase for nature restoration, social enterprise and business investment, as well as philanthropic donations for ecosystem restoration projects.
- **Positive synergies are needed between all levels of government.** A National fund needs to be able to synergise Australian Government funds with State and Territory funding, and avoid abrogation and cost shifting as has happened with other Australian Government led funding programs.
- **Funding is needed to remove barriers to restoration, not just to support on-ground or in-water projects.** It is insufficient to solely fund restoration projects when 'enablers' for restoration are not in place. These include but are not limited to activities such as capacity building across all professional areas associated with ecosystem management and restoration, and ensuring that fit-for-purpose restoration policy, legislation and regulation is in place to avoid any unnecessary constraints to high quality restoration (see Appendix 3). It is also important to ensure sufficient and genetically appropriate seed is available (through regional seedbanks and seed production areas, supported by increased genomics research) in all regions where restoration is prioritised. Because the cost for setting up a well-sized regional seed production area (with diverse species) is high and doesn't lend itself to NRM certificates, an alternative funding approach would be through a government infrastructure development fund (coupled with auction systems) or tax breaks/incentives for investors.
- **Investment needs to be directed to outcomes not outputs.** Investment should ideally be directed where restoration activities can reliably lead to the desired outcomes. This means that well-tested methods are required, along with clear targets and goals (including those involving longer term efforts that continue long after typical funding cycles). However there is also a need for experimentation and some latitude for risk taking where technologies are not already well developed and where environmental conditions are unpredictable.
- **Funds endowment methods need to be improved and supported** to enable investments (National Restoration Fund and others) to occur at the timescales of restoration. While restoration projects can often confidently put an area on a good recovery trajectory after a decade or so of intervention, most restoration projects will need ongoing restoration intervention for many decades, albeit at a lower

level of investment, and all will need some level of ongoing management. This is to both increase the effectiveness of outcomes and also to facilitate the growth of the restoration economy which suffers extremes of resourcing intermittency under whimsical policy shifts.

- **Serious questions persist about the workability of the proposed Nature Repair Market**. Some of these concerns relate to guiding, monitoring and verifying restoration outcomes associated with individual biodiversity certificates, while others relate to the adequacy of mechanisms that ensure private sector investor confidence, which will be essential for the long term viability of the NRM. (See Appendix 4 - Effective Restoration.)
- **Funding cannot be dependent on 'business as usual' that depends on unlimited growth and ongoing destruction of ecosystems.** Funding needs to be part of a transitional phase to economic systems that are compatible with and guided by the conservation of nature, with costs of restoration of impacts on nature absorbed directly into the costs of production rather than requiring other methods to absorb the negative externalities of unsustainable production.

Part 4 Priority (terrestrial) landscapes

Current state of landscapes – loss and deleterious impact

The degree of historic and current environmental loss and degradation in Australia's terrestrial areas is alarming. Still-extensive land clearing is occurring for a range of land uses, with invasive species (particularly feral predators), pollution and climate change increasing extinction pressures upon many species and ecosystems and cumulatively accelerating threats to our environment.

Millions of hectares of apparently intact habitats have lost so much of their original mammal populations, and the ecosystem functions they once performed, that they can be considered degraded, with large scale reintroductions needed.

Australia's restoration challenges can be considered in terms of the broad categories of land use as follows.

- Around 3.45M km^2 (45%) of Australia's native vegetation is used by the **pastoral** industry for grazing sheep and cattle.
- Around 1.04M km^2 of land is **intensively farmed** for cropping etc. and largely cleared of its native vegetation cover.
- Around 1.35M km^2 of **native forests** occur in Australia (a proportion of which is managed by the states for forestry) and there are approx. 18,200 km^2 of **commercial plantations.**
- Around1.7M km^2 (22%) is a **protected area** of which 51% is in Indigenous Protected Areas.
- 1.17M km^2 is **minimally used.**

Across all these land use categories, a level of conversion has occurred, and is required, to support Australia's human population. However, there are vast areas where nature conservation and primary production can be compatible and where production can adopt a greater level of nature conservation and restoration to meet changing consumer demand.

In all areas, including those transformed away from native ecosystems, restorative management is required to address a range of factors affecting native plant communities (invasive plants and feral herbivores such as rabbits and deer) as well as animal populations (feral predators such as cats and foxes). Multiple restoration interventions such as revegetation, habitat restoration, faunal reintroductions (where secured from pest predators) and reinstatement of appropriate hydrological and fire regimes are needed to reinstate functionality in modified and dual-use areas. In particular we find that the following applies to terrestrial ecosystems.

- **In the farming landscape**, the restoration challenge includes protecting, buffering and extending remnant patches, particularly through improving their connectivity through revegetating critical wildlife corridors.
- **In the pastoral zone**, changes in grazing practices are required to (i) protect and restore native pastures and herbaceous and shrub layers, and (ii) prevent stock from accessing and damaging the riparian zone and new restoration plantings.
- **In the forestry sector**, the integrity of our native forests is in desperate need of improvement. Fragmentation and changes to forest structure and composition have placed a suite of forest species in all biomes at high risk. Clearing, logging and fire management interact with climate drivers to increase the severity of and impacts from drought and fire. Fostering ecological recovery of native forests in all biomes is now critically urgent given the severe impacts of and interactions between, past clearing, logging, drought and fire on forest dependent species. Particular opportunities and successful models also exist for decommissioning redundant pine plantations back to native forest.

Potential for restoration of terrestrial areas

- **There is substantial potential for extensive vegetation restoration.** Recovery of native vegetation and habitats at a landscape scale can be attained by biodiverse plantings (including direct seeding) and carbon storage, as well as through harnessing natural regeneration potential wherever it remains. Both require causal factors to be addressed (including repeated clearing and overharvesting) and could be much more widely realised with strategic planning for restoration at a range of scales across Australia that guides investment from a range of sources.
- **There is a great need for the conservation management and restoration to consider a range of biota, not just plants.** This includes the need to consider faunal populations in terrestrial areas, particularly small mammals and other biota including native fungi and soil micro-organisms as well as introduced pathogens. Key pre-requisites for fauna not only include the retention and restoration of habitats of suitable quality (and size for the species' home ranges) but also the management of invasive species, particularly invasive predators such as cats. Restoration of soil biodiversity and soil microbiota in terrestrial areas is highly important considering that soils host 59% of all species and soil microbiota in particular have a strong role in vegetation recovery potential. Research and development in for both fauna and soil biodiversity are running substantially behind the need due severe funding shortages and lack of innovation.
- **Identifying priorities.** The draft Resource Guide to Target 2 KM GBF refers to a need to 'Identify optimal restoration locations and types on the landscape' (FAO 2024). Priorities should be based on an agreed framework and devised through a systematic process. Because restoration for Target 2 can include two types of restoration (see Appendix 4), prioritising the allocation of limited financial and human resources for restoration should take into account the landscape context, current land use, key biodiversity areas (particularly for fauna), the main drivers of degradation and the extant level of ecosystem integrity, among other considerations outlined in Appendix 5.
- **Planning can help ensure restoration actions generate synergies with and co-benefits for other biodiversity targets including social outcomes.** These include benefits to threatened species, carbon storage, invasive species, ecosystem services that benefit agriculture (like pollination , improved soil condition and clean water) as well as social benefits (e.g. employment) and cultural benefits (e.g. renewed community relationships with places we care for). Such planning should be undertaken at all relevant scales to ensure that restoration investment for works on the ground is directed to the highest priority places at a local scale as well as regional, bioregional and national scales. (See **Appendix 5**)

Part 5 Priority (aquatic) waterscapes

[Also see Appendix 3]

(Note that this section reflects the two aquatic Target 2 ecosystem types – (1) Inland waterways and (ii) Coastal and marine ecosystems.)

Current state of waterscapes – loss and deleterious impact

- **No aquatic ecosystem in Australia remains unaffected** by direct losses or indirect degradation caused by anthropogenic drivers. These drivers include increased marine heatwaves, ocean acidification, coastal storms and flooding and erosion, reductions in water flow, loss of habitat in and alongside waterways, estuaries and oceans, and degradation of water quality.
- **Massive economic losses** to commercial and recreational fishing, aquaculture and associated tourism and businesses have accrued through biodiversity degradation, although the impacts of these losses have had limited assessment. Long-term loss of cultural values and impacts on social values include loss of amenity, opportunity and access cannot be calculated.
- **The scale of loss in aquatic environments is not understood by the broader community**; in many locations, shellfish reefs, kelp forests, salt marshes, seagrasses, mangroves and freshwater wetlands have disappeared or been affected by over 90% loss. This has enormous implications for the health, productivity and survival of marine organisms and fisheries.

Potential for restoration of aquatic areas

In most cases, it is not possible to have extensive degraded aquatic areas under effective restoration by 2030 due to (i) the scale of the task, (ii) historic lack of focus by federal, state and local governments, (iii) the limited number of practitioners active in this space, and (iv) the funding, policy and legislative barriers outlined in Part 3. Nonetheless, the adoption of ambitious and achievable targets by 2030 will enable Australia to commence the massive effort required to counteract and reverse degradation and build momentum so that future efforts can start to move Australia in a nature positive direction for waterways. Some key points are as follows.

- **Successful restoration methodologies have been developed for some aquatic ecosystems** in many locations as a result of research-practice partnerships. The scale of work, however, has been minimal compared to the scale of the losses.
- **Estuarine and coastal wetland system restoration requires consideration of climate change adaptation.** Halting further development and removing barriers to allow for landward migration of coastal ecosystems (such as saltmarsh and mangroves) is particularly important in anticipation of sea-level rise. Reinstating hydrological connectivity is therefore also of high priority.
- **Catchment-scale restoration across landscapes is essential to help address stressors and threats to inland and estuarine ecosystems.** To achieve successful recovery of aquatic or water-dependent plants and animals in inland and estuarine environments it is imperative to reduce major stressors in catchments affecting receiving waters. Programs to slow runoff and reduce nutrient discharges from farmlands (as well as revegetation of riparian zones) for example, are needed to reduce erosion and siltation, improve water quality in streams and avoid further instream structure loss.
- **Amending hydrological flows and appropriate linkages is a key step to restoration of a number of freshwater and tidal ecosystems**. In some cases this will mean reconnecting waterways by removing barriers to tidal flushing, freshwater flows or fish passage, while in others it will mean reinstating natural barriers (e.g. the removal of artificial drains). This requires working with land managers, especially to allow periodic inundation and drying of inland wetlands, which will require improved water availability and security.
- **A high number of Threatened flora and fauna species and Threatened Ecological Communities are**

wetland- or river-dependent. To protect and restore threatened communities, fish, waterbird and frog populations, extensive restoration of permanent, semi-permanent, seasonal and ephemeral wetlands is needed - both associated with riverine systems and those independent of riverine systems.

- **Vast numbers of permanent, semi-permanent, seasonal and ephemeral wetlands that are not associated with riverine systems** also occur throughout Australia. These are also in dire need of restoration.

Barriers to restoration in aquatic areas

- **A key barrier to restoration is the lack of accessible national information about aquatic ecosystems.** Australia's wetland information is fragmented, and the 2001 national Directory of Important Wetlands (DIWA) is out-of-date and has not been maintained. Some ecosystems have continental scale mapping available (e.g. mangroves), some states have up-to-date wetland mapping (QLD and Vic), others have spatial coverage for a few regions only. This means we have limited spatial data to guide conservation and restoration priorities and cannot accurately report and track national commitments to conserve and restore freshwater, coastal and marine wetland ecosystems under the KM GBF, Ramsar Convention and, to maintain wetland ecosystem extent under the Sustainable Development Goals (6.6.1). It should be noted however progress that has been made recently by the federal government in developing natural capital accounts/mapping products as part of the Natural Capital Accounting initiative, and National Ocean Ecosystem Account.
- **Scarcity of funding is a major challenge to aquatic restoration.** Funding is a limiting factor for scaling up the extent of restoration, particularly for reconstructing marine ecosystems such as seagrass, mangrove, kelp forest, shellfish reef and coral reefs. (See Appendix 3).
- **The permitting process for marine and coastal restoration is a significant barrier to achieving restoration targets** as restoration is treated as development similar to one that may destroy ecosystems. Although of course checks and balances are required, the current permit regime is curtailing the ability to retore lost habitats and so is not fit for purpose. A further barrier is uncertainty regarding ongoing ownership, tenure, management, liability and/or indemnity of the restored area These concerns point to a lack of effective, transparent policy and legislative frameworks at national, state and local scales.
- **A shortage of capacity and/or expertise in the marine restoration practitioner community and contractors** limits capacity for Australia to implement large-scale coastal/marine restoration projects.

Recommendations

- **Coordination among all three levels of government will be required to create fit for purpose permitting pathways for restoration**. A national taskforce is likely to be required to review this issue across Federal, state and local government followed by policy review and ultimately legislative amendment where necessary.
- **Funding of aquatic restoration must be addressed alongside terrestrial restoration** to avoid preferential treatment of terrestrial areas at the expense of aquatic areas. The contributions of aquatic restoration to climate change mitigation should be considered in restoration accounting, providing an even strong economic case for investment.
- **A national science-based coastal and marine restoration plan is required** that addresses funding sources, links actors to best practices, improves permitting processes and facilitates knowledge sharing and community engagement. It requires state and local rollout.

Part 6 Indicators and measuring success of restoration

The process of restoration requires monitoring of progress against indicators that are identified at the start of any program or project. These not only help measure outcomes but also help refine goals and therefore aid in restoration design.

- The Resource Guide to Target 2 KM GBF clarifies that monitoring and reporting attainments for KM GBF Target 2 (indeed Targets 1–3) focus largely on reporting the gross area subject to a given type of action, by country and/or by broad ecosystem type - and for Target 2 the required monitoring is recommended to be undertaken through FERM. However the key linkages between KM-KM GBF Targets and goals, particularly integrity, connectivity, and resilience, and the Target 2 outcomes of 'biodiversity, ecosystem functions and services, ecological integrity and connectivity' render the use of headline indicators to plan and report progress under Goal A and Targets 1–3 much less straightforward than it perhaps appears at first sight. Indeed, the reporting of gross area alone may be misleading.

  Desired outcomes for biodiversity and ecosystem functions and services, ecological integrity and connectivity (as appropriate to the restoration type) are nonetheless still expected by countries including Australia. Systems for monitoring these expected outcomes, and assurance that implemented projects do no harm to these attributes, should therefore be sought and put in place through the registration process for projects being counted in Australia's attainment of Target 2 restoration. For these reasons, we suggest that Australia's program for meeting Target 2 encourage the use of, or require in cases such as NRM biodiversity certificates, one or more of the following monitoring systems, particularly for ecological restoration projects (i.e. those that seek the recovery of biodiversity, ecosystem functions and services, ecological integrity and connectivity (in whole or in part).
  - IUCN Red List of Ecosystems
  - SER Restoration Standards' 5-star system
  - Biodiversity Habitat Index (BHI) (Goal A)
  - UN System of Environmental Economic Accounting (UNSEEA-EA)
  - Accounting for Nature
- Monitoring success in terms of **Indigenous engagement** would not only count (i) the number of capacity building programs but also (ii) the number of ongoing forums where Indigenous perspectives are prioritised. Reporting should also include where appropriate, the degree to which individual projects incorporate Indigenous environmental management practices.

In summary – Australia's national restoration planning should adopt a logical impact-centric framework within which the following procedures are in place.

- Goals define the direction we want to move the system through restoration.
- Indicators measure the distance moved in this direction.
- Actions are prioritised according to the gain in these indicators expected to result from implementation of any given action.
- Actors are engaged, informed and activated to innovate and implement restoration projects that take advantage of community and business intentions and momentum.

This approach requires indicators that assess outcomes at a whole-system level (e.g. a whole ecosystem type or region) and can be applied both in:

- a predictive (leading) manner – i.e. expected ecological outcomes are predicted as a function of proposed or implemented actions; and in,
- an observational (lagging) manner – i.e. actual ecological outcomes are monitored through direct observation.

The approach must also:

- recognise that restoration is both a top-down and bottom-up process(i.e. a varied matrix of initiatives).
- integrate key community and economic outcomes and indicators that are critical in defining restoration priorities and success thereof.
- enable adaptive management and continuous improvement in restoration efforts to improve future efficiency and effectiveness, including appropriate engagement of research capacity, as well as collaboration, investment and shared benefit from restoration activities.

Part 7 Defining 'effective restoration'

[Also see Appendix 4]

KM GBF Target 2 calls for having degraded areas under 'effective restoration' by 2030. It is therefore essential to have a clear idea of what this term refers to and how it relates to existing restoration terminology. The following points and the detailed information provided in Appendix 4 and the Glossary draw on RDA's interpretation of the formal KM GBF guidance documents and the National Standards for the Practice of Ecological Restoration in Australia (Gann et al. 2019).

- **Separate definitions of 'effective rehabilitation' and 'effective ecological restoration'** (the two types of restoration endorsed by the KM GBF) are needed to guide planning and implementation and so that their somewhat different standards and aims are not conflated and lead to suboptimal outcomes or further degradation.
- **Benefits to biodiversity are required for both types of restoration.** To avoid entirely decoupling projects from potential biodiversity gains, the definition of 'effective restoration' should be consistent with the international definition to ensure that 'rehabilitation' projects not only restore ecosystem services but also lead to benefits for biodiversity.
- **Clarification is needed that optimal outcomes are very often attained by the integration of these restoration types in a landscape or waterscape** to (i) directly restore biodiversity in locations where that is possible and desirable and (ii) reduce impacts upon the systems that support biodiversity in areas that are permanently transformed to production or urban settlements.
- **The most ecologically and socially appropriate restoration type for the circumstance should be applied** as per the 'restorative continuum' concept. A key principle should be to aim for the highest practicable outcome rather than defaulting to an undesirably low standard to achieve a higher areal extent of restoration. (High areal extent can be attained through improving the condition and encourage the natural regeneration of remnant vegetation.)
- **All decision makers and responsible parties need to have access to up-to-date knowledge on restoration theory and practice,** whether in the rehabilitation or ecological restoration area. Too many examples exist of restoration outcomes being hampered by poorly designed, poorly funded, poorly timed and poorly scaled projects, resulting in wasted expenditure.
- **There needs to be commitment to meaningful partnerships for the integration of Indigenous knowledge into environmental management.** Partnerships between Indigenous communities and other stakeholders (including government agencies, non-governmental organisations, and the private sector) must go beyond mere acknowledgment of Indigenous knowledge, they should actively support and incorporate Indigenous practices into environmental management strategies wherever possible and appropriate. This collaborative approach can enhance the effectiveness of conservation efforts, promote biodiversity, and foster resilience in the face of climate change.

Part 8 Considerations for identifying 'priority degraded areas' and implications for optimising Australia's contributions to the global KM GBF Target 2

[Also see Appendix 5]

Prioritisation

The draft Resource Guide to Target 2 KM GBF refers to a need to 'Identify optimal restoration locations and types on the landscape'(FAO 2024). This a logical and desirable process for any national restoration planning process. Australia's revised Strategy for Nature refers to prioritised restoration of degraded areas as a "critical complement to the conservation of representative ecosystem types, managing invasive species, reducing the impacts of pollutants, and adapting to climate change"

- **The purpose of prioritisation should be to help guide investment of resources (both human and financial) rather than limit what can be counted in Australia's target reporting in 2030** (See discussion in Appendix 5). That is, any definition or explanation of Australia's Target 2 should not limit Australia's Target 2 reporting to top-down priority areas as, by definition, priorities need to represent a subset of a larger range of sites and will not be able to include all the current community efforts that are highly dispersed across Australia. Rather the wording should encourage *all* ecosystem restoration across Australia to avoid prioritisation reducing the momentum of existing restoration programs and to allow all efforts to be counted in Australia's Target 2 attainments.
- **Primary considerations for identifying priority areas for restoration.** While Australia's revised Strategy for Nature cites key considerations for prioritisation as including "cost-effectiveness, cultural values, level of threat and the identification of locations where restoration effort can make the greatest contribution" RDA suggests that priorities need to be harmonised with biodiversity conservation and repair priorities, taking into account climate goals, connectivity, opportunities for multi-habitat restoration across landscapes and seascapes, ecosystem representativeness and potential for retaining and recovering ecological integrity. This can be summarised as optimising opportunities for:
    - Increasing **integrity** and **connectivity** of habitats at large scales (esp. *to support adaption to climate impacts*)
    - Expanding habitats for **threatened** communities and species
- **RDA's view on other necessary considerations for mapping or listing priority degraded areas** include the following.
    - ***Cultural*** *priorities of Indigenous communities (time imperative)*
    - *Potential synergies with other GBF targets (e.g.* ***climate****)*
    - *Opportunity to reverse associated degradation drivers*
    - *The existence of feasible and reliable methodologies*
    - *Existing initiatives/investments (including faunal reintroductions)*
    - *The interests, capacity and opportunities of restoration actors*
    - *Opportunities to incentivise and model restoration actions*
    - *Opportunities to promote restoration to the general public*

    It can be noted that the above range of considerations can also function as *filters* or criteria for prioritising the direction of limited resources to *actual* projects

Implications for Australia's interpretation of KM GBF Target 2

- **Appendix 5 outlines a case for more fulsome articulation of Australia's restoration target in more ambitious and inspiring ways** wherever possible so that the modest target published in Australia's Strategy for Nature can still function as a fit for purpose national target to galvanise action over the next 6 years. The wording of 'priority areas' should also ensure that Australia's contributions to the global target are not interpreted as confined to a small set of top-down 'priority areas' or leave out much existing restoration work in reserves run by agencies or on private lands by a range of landholders. Without these two i improvements in wording, Australia's very modest formal restoration target runs a high risk of reducing rather than increasing the momentum of existing restoration and our environments will miss out on the impetus that the GBF could add to existing and future restoration efforts.
- **Priorities for Australia's Target 2 should be identified through a systematic rapid assessment** of *candidate* priority areas (for both types of restoration and public and private lands) with spatial mapping accompanied by lists of candidate biomes to avoid errors of inclusion or exclusion. This should ensure that high conservation priority biodiversity benefits from the Target 2 commitments for both restoration types (see Appendix 4). This should also take into account a range of factors including (but not confined to) Indigenous concerns, representativeness, biodiversity importance, climate mitigation and adaptation co-benefits, potential for expanding existing investments, supporting innovation, capacity development and engaging participation.
- **In addition, Australia's commitment should be accompanied** by the following actions by the federal government.
    - **A concerted and ongoing national call to restoration action** should be made to scale up restoration efforts across Australia by governments, industries and communities. This should be articulated through all three levels of government in all jurisdictions and link Target 2 to the UN Decade on Ecosystem Restoration.
    - **A national restoration implementation plan** should be developed and rolled out to provide the guidance (including prioritisation) needed to overcome the wide range of barriers to restoration and to facilitate the scaling up of restoration across the country.
    - **A self-reporting system for all restoration projects on BioCollect** should be established and facilitated to capture data of all effective ecosystem restoration projects in Australia by 2030 to inspire action, gain reliable data for Target 2 reporting and assist with more accurate planning of 2050 goals and targets.

Part 9 Ways forward

There is a global awareness that what we do in this decade will be critical to the future health of ecosystems and the wellbeing of humanity. Together, governments, industries and communities can help turn around the alarming loss and degradation of ecosystems but to achieve success we have to substantially lift our game.

Notwithstanding that Australia has large areas of biodiversity and a relatively small human population to manage it, we are one of few economically advanced and mega-diverse countries in the world. We should therefore be leading by example, building a vibrant restoration economy and export expertise to a world confronting similar problems.

- **The revised EPBC Act and the proposed national restoration implementation plan must both include a broad vision for restoration** to and beyond 2050 that includes restoration of past impacts in their own right and inspire and support Australians to strive to attain as high outcomes as are practicable .
- **There is a need for national restoration priorities and implementation planning to be rapidly developed, and with an appropriate degree of ambition.** The implementation plan needs to provide principles, priorities, goals and indicators for restoration, identify stakeholders and key players and funding sources for restoration in Australia to 2030, building a basis for ongoing work. Responsibility for its implementation must be a requirement by all levels of government, tapping into all avenues of industry and community participation.
- **Fundamental to the success of Australia's restoration agenda is substantially increased financial investment** in restoration from a range of funding sources, guided by a national nature investment strategy. This needs to support not only on-ground projects but a broad range of 'enablement projects' designed to overcome current barriers to restoration including the following.
    - Setting up a national taskforce to review planning impediments for restoration projects (while retaining safeguards to protect nature from developments) and enacting appropriate legislation to streamline restoration approvals.
    - Establishing well-resourced, genetically appropriate seed banks and seed production areas in all regions of high restoration priority.
    - Improving in-service and tertiary training curricula for a wide range of industries to reduce impacts on ecosystems and upskill restoration planners, trainers and practitioners.
    - Designing and implementing a long-term communication program to build cross-generational motivation, knowledge and skills, tapping into the motivational structures provided by the UN Decade on Ecosystem Restoration.

Only through integrated action – inspired by a stewardship ethic, fuelled by innovation and empowered by new economic models – can the vision of a nature positive Australia be realised.

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REFERENCES

Andres, S. E., Atkinson, J., Coleman, D., Brazill-Boast, J., Wright, I. J., Allen, S., and Gallagher, R. V. (2023). Constraints of commercially available seed diversity in restoration: Implications for plant functional diversity. Plants, People, Planet. https://doi.org/10.1002/ppp3.10523

CBD (2024) Consolidated guidance notes for the targets of the Kunming-Montreal Biodiversity Framework

FAO (2024) Delivering restoration outcomes for biodiversity and human wellbeing (Resource Guide to Target 2 of the Kunming-Montreal Global Biodiversity Framework) DRAFT 26 May 2024

Gann GD, McDonald T, Walder B, Aronson J, Nelson CR, Jonson J, Hallett JG, Eisenberg C, Guariguata MR, Liu J, Hua F, Echeverría C, Gonzales E, Shaw N, Decleer K, Dixon KW (2019) International principles and standards for the practice of ecological restoration. Second edition. *Restoration Ecology* 27(S1): S1–S46.

Standards Reference Group SERA (2021) Standards for the practice of ecological restoration in Australia. Edition 2.2, 2021 https://www.seraustralasia.org/standards

FURTHER READING

FAO, SER and IUCN Commission on Ecosystem Management *Standards of practice to guide ecosystem restoration: A contribution to the United Nations Decade on Ecosystem Restoration 2021–2030.*

Ten Principles to Guide Ecosystem Restoration in the UN Decade on Ecosystem Restoration https://www.fao.org/3/cb6591en/cb6591en.pdf

Botanic Gardens Conservation International Global Biodiversity Standards

Appendices

Water ponding for rangeland restoration (also see back page).
Image: Soil Conservation Service NSW.

Appendix 1 Links to International Commitments

Background

The 1992 international Earth Summit in Rio in 1993 led to the Rio Convention on Environment and Development and three further Rio Conventions on Biodiversity, Climate Change and Desertification. Since the first meeting of the Conference of Parties (COP) to the Biodiversity Convention in 1994, there have been bi-annual COPs which have progressively advanced the agenda to protect and restore biodiversity. COP 15 introduced the Kunming-Montreal Global Biodiversity Framework (KM GBF) that covers 23 Targets for 2030, including Target 2 – Restoration, which will be further developed at COP 16 this year.

The 2015 Paris Agreement was adopted at COP 21 of the Climate Convention. This agreement recognised the need for climate action to protect biodiversity and ensure ecosystem integrity. In the last few years Climate COPs have gone further by explicitly recognising the linkages between the climate and biodiversity crises and strongly encouraged the protection and restoration of biodiversity to deliver climate mitigation outcomes.

In each of the last four years the United Nations Framework Convention on Climate Change (UNFCCC) has made important decisions on the need for synergistic and integrated climate and biodiversity action. The recent UNFCCC COP 28 decision, on the Global Stocktake on progress towards meeting the goals of the Paris Agreement (PA), CMA 5, (relevant extracts in Attachment A) exhorts state parties to protect and restore natural ecosystems for their biodiversity and climate mitigation and adaptation value. The Global Stocktake is the mechanism under the PA to ratchet up state party ambition on climate mitigation and adaptation.

Comments

The protection and recovery of biodiversity and ecological integrity are pillars of the KM GBF and of central importance to the Convention on Biological Diversity (CBD) as they underpin every ecosystem service on which humanity relies, including carbon sequestration and retention. The protection of biodiversity and ecosystem integrity is an overarching goal of the Paris Agreement critically important for achieving reducing risks to carbon reservoirs in ecosystems. While the entire KM GBF framework would make a strong contribution to protecting and recovering ecological integrity and thus help protect and recover biosphere carbon reservoirs and maximize the resilience and adaptive capacity of ecosystems, several of the KM GBF goals and targets are critically important for climate mitigation and adaptation and should be reflected in both Nationally Determined Contributions (NDCs) and National Biodiversity Strategy and Action Plans (NBSAPs). Goals A and B and Targets 1,2,3,4 and 8 are particularly relevant and outlined in Attachment B below.

The effectiveness of climate mitigation and adaptation action in land, forests, and other ecosystems would be enhanced if, as a minimum, they were guided by and contributed to the KM GBF goals and targets. With 30% of terrestrial and marine ecosystems needing to be protected through high quality conservation measures (Target 3) and a further 30% needing to be restored globally by 2030 (Target 2) in order to recover biodiversity and ecological integrity, it makes sense for these targets to inform climate action in land, forests, and other ecosystems.

Utilizing spatial planning (Target 1) to retain and recover areas of high ecological integrity, buffer and reconnect protected areas, and using new conservation tools such other effective area-based conservation measures (OECMs) and connectivity conservation approaches, would deliver high synergies and lower-risk climate mitigation and adaptation outcomes. The success of these approaches is closely linked to working with Indigenous and local communities to support and enhance climate resilient sustainable development, their rights, and cultural aspirations.

A recent publication by the IUCN Climate Crisis Commission and the World Commission on Protected Areas reveals the common responsibility of all three Rio Conventions to protect and restore ecological/ecosystem integrity. This publication is being used by a rapidly expanding number of civil society organisations to advocate for closer links between the Rio Conventions and by some state parties to foster synergistic climate and biodiversity action in NBSAP's and NDC's.

A 2023 policy discussion paper by Griffith University calling for a joint CBD and UNFCCC work program is also gaining traction. This publication has drawn attention to the importance of protecting and recovering ecosystem carbon reservoirs – moving the conversation away from a mitigation focus on annual net fluxes of carbon into and out of ecosystems towards understanding that the dynamics of ecosystems and their integrity is fundamentally important for retaining and recovering their carbon stocks (reservoirs)– their primary climate mitigation value.

Discussions aimed at building on the 2021 joint Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)/ Intergovernmental Panel on Climate Change (IPCC) workshop that identified the critical importance of synergistic climate and biodiversity action and in particular the importance of protecting and restoring carbon dense and species rich ecosystems are also intensifying. Proposals for amplifying the findings of the joint workshop include pursuing a COP mandated joint special report on synergistic climate and biodiversity action and/or including a dedicated component on synergistic action in the next IPBES work program.

A list of publications relevant to informing synergistic climate and biodiversity action is attached. Note in particular the IPBES/IPCC 2021 workshop findings that protecting and restoring carbon-dense and biodiversity-rich ecosystems offer high synergies between climate and biodiversity outcomes.

The next two to three years will likely see significant change in delivering synergistic climate and biodiversity action primarily driven by changes in international policy being reflected in domestic policy and programs.

What do these international policy developments mean for attaining nature positive restoration in Australia?

It is not unusual to hear natural resource managers express concerns about observed changes in species distribution and the severity and frequency of threats to individual species and ecosystems linked to climate change. Less often, however, do we hear acknowledgement that damaged and fragmented ecosystems are more vulnerable to climate impacts than those that retain high ecological integrity. The critically important functional role of biodiversity in underpinning ecological integrity and supporting important ecosystem services like carbon retention is also not widely understood.

Recognition of how entwined the climate and biodiversity crises are, is critically important if we are to limit warming to 1.5–2 degrees. This is particularly the case with respect to retaining and restoring ecological integrity to help recover natural carbon stocks. Yet this recognition is still in its infancy, as is the recognition that retaining and recovering ecological integrity is essential for ecosystems to have their best chance of adapting to climate change.

At a minimum, it's important to ensure that a National Restoration Plan aligns with Goals A and B, contributes to targets 1–8, of the KM GBF and that it fosters improved conservation management and ecological recovery of Australia's carbon dense natural ecosystems.

Annexture A: Relevant Extracts from UNFCCC CMA 5 COP 28

Mitigation Section

33. Further emphasizes the importance of conserving, protecting and restoring nature and ecosystems towards achieving the Paris Agreement temperature goal, including through enhanced efforts towards halting and reversing deforestation and forest degradation by 2030, and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by conserving biodiversity, while ensuring social and environmental safeguards, in line with the Kunming-Montreal Global Biodiversity Framework;

34. Notes the need for enhanced support and investment, including through financial resources, technology transfer and capacity-building, for efforts towards halting and reversing deforestation and forest degradation by 2030 in the context of sustainable development and poverty eradication, in accordance with Article 5 of the Paris Agreement, including through results-based payments for policy approaches and positive incentives for activities relating to reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries; and alternative policy approaches, such as joint mitigation and adaptation approaches for the integral and sustainable management of forests, while reaffirming the importance of incentivizing, as appropriate, non-carbon benefits associated with such approaches;

35. Invites Parties to preserve and restore oceans and coastal ecosystems and scale up, as appropriate, ocean-based mitigation action;

Adaptation Section

55. Encourages the implementation of integrated, multi-sectoral solutions, such as land-use management, sustainable agriculture, resilient food systems, nature-based solutions and ecosystem-based approaches, and protecting, conserving and restoring nature and ecosystems, including forests, mountains and other terrestrial and marine and coastal ecosystems, which may offer economic, social and environmental benefits such as improved resilience and well-being, and that adaptation can contribute to mitigating impacts and losses, as part of a country-driven gender-responsive and participatory approach, building on the best available science as well as Indigenous Peoples' knowledge and local knowledge systems;

56. Notes that ecosystem-based approaches, including ocean-based adaptation and resilience measures, as well as in mountain regions, can reduce a range of climate change risks and provide multiple co-benefits;

Annexure B: Key Goals and Targets of the KM GBF

Strong and focused implementation of the KM GBF is a logical way to strengthen nature's contribution to the climate and biodiversity crises. Goals and targets of particular importance for climate mitigation and adaption include:

- **Goal A** "The integrity, connectivity and resilience of all ecosystems are maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050 …The genetic diversity within populations of wild and domesticated species is maintained, safeguarding their adaptive potential."
- **Goal B** "Biodiversity is sustainably used and managed and nature's contribution to people, including ecosystem functions and services are valued, maintained and enhanced, with those currently in decline being restored, supporting the achievement of sustainable development for the benefit of present and future generations by 2050."
- **Target 1** "Ensure that all areas are under participatory integrated biodiversity inclusive spatial planning and/or effective management processes addressing land and sea use change, to bring the loss of areas of high biodiversity importance, including ecosystems of high ecological integrity, close to zero by 2030, while respecting the rights of indigenous peoples and local communities."
- **Target 2** "Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity."
- **Target 3** "Ensure and enable that by 2030 at least 30 per cent of terrestrial, inland water, and of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of indigenous peoples and local communities, including over their traditional territories."
- **Target 4** "Ensure urgent management actions to halt human induced extinction … to maintain genetic diversity (and) adaptive potential …"
- **Target 8** "Minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation and disaster risk reduction including through nature-based solutions and/or ecosystem-based approaches, while minimizing negative and fostering positive impacts of climate action on biodiversity."

Appendix 2 Financing Restoration

1. Context

Implementation of any national restoration plan or implementation strategy will require large scale and ongoing funding from diverse sources. These multiple sources will need to be nationally facilitated to ensure all potential sources are accessed and the funds are effectively applied. Facilitation of funding sources could be guided by a **national nature investment strategy** that identifies the appropriate mix and potential policy settings for funding that draws on public, private and blended sources as follows.

Private Sector

- **Nature Repair Market** trading of Biodiversity Certificates
- **Private sector purchase of land** for nature restoration
- **Philanthropic Donations** for nature restoration projects.

Public Sector

- **National Restoration Fund** established by direct government investment
- **Government investment in Nature Repair Market** during start up period.

Blended Sources

- **Green Sovereign Bonds** issued by Commonwealth and purchased by private sector investors
- **Conservation Covenants** established over private land and supported through tax concessions and grants from National Restoration Fund.

The recently established **Nature Finance Council**, chaired by Ken Henry, provides a sound management structure through which to establish a coordinated investment strategy to generate and manage the large amount of funding required to implement nature positive ecosystem restoration projects across Australia over the coming decades and into the future.

2. Private Sector

(i) Nature Repair Market

While the Nature Repair Market Bill has been passed by Parliament, details about how the market will be established, operate, managed and be monitored, are still to be determined. Although removal of the 'offset' provisions from the Nature Repair Market legislation should significantly increase investor confidence in the market, it will still take several years for the market to become fully operational, and its credibility established to provide investor confidence.

(ii) Private sector land purchase for ecosystems restoration

Because a large proportion of ecosystems requiring restoration are located on private and leasehold land it is essential to understand and respond to the drivers that motivate landholder engagement. The benefits of ecosystem restoration need to be demonstrated to achieve engagement of local communities to scale up ecosystem restoration. Tax incentives would provide motivation for the private sector to purchase or commit currently owned land that contains degraded high priority habitats or strategic linkage areas for the specific purpose of ecosystem restoration, as well as conservation. Details of the tax incentives would require a program of consultation to identify effective management provisions and reporting systems.

3. Public Sector

(i) National Restoration Fund - Direct Government Investment

By establishing a National (Nature) Restoration Fund, the Federal Government could make funding available for high priority ecosystem restoration projects on public and private lands. The funding would be contested, and priority given to projects that are consistent with a National Restoration Plan or relevant regional strategies. Eligible projects could be located on land owned and managed by local governments or authorities as well as privately owned land. The amount invested in the Fund would need to form part of a national nature investment strategy and be based on an assessment of the scale of high priority projects and the capacity of the ecosystem restoration services sector to carry out the work on a sustainable basis.

Understanding the economic value of restoration in terms of revenue, skills development and employment opportunities is essential. The contribution to our economy of restored healthy ecosystems and the ecosystem services they provide can also now be documented and valued through the use of the UN System of Environmental Economic Accounting - Ecosystem Accounting framework. An immediate task is to support Australian-specific work on ecosystem valuation and the benefit-cost analyses of ecosystem restoration using approaches outlined in the CSIRO Natural Capital Handbook.

(ii) Commonwealth Investment in Nature Repair Market (during start-up phase)

To make a significant contribution to meeting Australia's commitments to 2030 targets under the Kunming-Montreal Global Biodiversity Framework, the Nature Repair Market will require direct investment by the Federal Government during the start-up phase to purchase biodiversity certificates to establish investor confidence in the market. This can be done under the provisions of Part 6 of the Bill, 'Purchase of biodiversity certificates by the Commonwealth'. The projects would be focused on high priority restoration projects identified in the National Restoration Plan although national priorities might prove less important for some private investors as the market becomes more self-sustaining.

4. Blended Funding

(i) Green Sovereign Bonds

The Commonwealth has commenced issuing Green Sovereign Bonds for the purpose of generating funds to support net zero target projects.

However, the Green Sovereign Bonds program provide an excellent opportunity to be expanded to include a category of Nature Repair Green Sovereign Bond that is specifically intended to fund ecosystem restoration and protection projects. These projects should be prioritised within the framework of a National Ecosystem Restoration Plan and coordinated by the relevant federal government department ensuring the required expertise in ecosystem restoration and biodiversity management.

The Nature Repair Green Sovereign Bonds could be available in 2024 for purchase by corporations, asset and fund managers, superannuation funds, philanthropic and other organisations, and individuals wishing to invest in a national program of biodiversity restoration.

The Nature Restoration Green Sovereign Bonds would provide a high level of confidence to investors due to the 'Credible Commitment' provided by the Commonwealth. The period of issue for Green Sovereign Bonds needs to be aligned with the typical time frame for completion of biodiversity restoration projects, some of which can be in the order of 30 to 50 years depending on starting condition.

(ii) Conservation Covenants

Conservation Covenants over private land are currently managed by each state and territory. The statutory requirements for the establishment and administration of the Conservation Covenants varies between states. Increase provision of funding to the relevant departments (federal, state and territories) will achieve better coordination and more effective outcomes for ecosystem restoration and biodiversity conservation programs.

Appendix 3 Degradation levels and restoration challenges in Australia's waterscapes

Introduction

No aquatic ecosystem in Australia remains unaffected by direct losses or indirect impacts caused by marine heatwaves, losses and changes in water flow and degradation of water quality. In particular, shellfish reefs, giant kelp, saltmarshes and freshwater wetlands have disappeared or been affected by over 90% loss in many cases. This is not understood by the Australian community and - as a result - impetus for restoration is hugely underestimated by the public and by governments.

Restoration of aquatic ecosystems - including the fauna that occur in them - has occurred in a growing number of locations and has been successful. The scale of work, however, has been minimal in comparison to the scale of the losses (Saunders *et al*. 2024).

Due to historic lack of focus by Federal, State and local governments on this issue and the limited number of restoration practitioners operating at scale in this space, the ability to achieve 30% of degraded aquatic areas under restoration by 2030 is in most cases unachievable. Nonetheless it is essential to recognise that huge effort and commensurate support is still required to make progress in counteracting and reversing degradation. Australia needs to build momentum through ambitious but achievable targets for 2030 so that future efforts can benefit from these actions.

Seagrass

Seagrass losses in Australia follow global patterns, with a reported loss of at least 291,783 ha, representing 5.5% of estimated areal extent, since the 1930s (Statton *et al.* 2018). These losses include several large-scale declines in Shark Bay, West Australia, Western Port, Victoria, and metropolitan Adelaide, which lost 154,800, 17,800, and 5,200 ha of seagrass habitat respectively (Tanner et al. 2014; Arias-Ortiz et al. 2018; Statton et al. 2018). These losses, and the associated losses in ecosystem structure and services, have major ecological, socioeconomic, and political ramifications (Smale et al. 2019).

For example, the recent estimated loss of 36% of seagrass meadows in Shark Bay, Western Australia, followed extreme temperature events and resulted in declines of various herbivorous species such as green turtles and dugongs, seagrass-associated fish populations, and closure of scallop and blue swimmer crab fisheries (Nowicki et al.,2017; Kendrick et al., 2019). Similarly, carbon and nutrient cycling was disrupted (Smale et al. 2019).

Declining seagrass habitats are recognized as a significant threat to fisheries production, with estimates that seagrasses contribute AUD $31.5 million per year to Australia's commercial fisheries (Janes et al. 2019). Thus, seagrass losses represent a major financial cost that could escalate in the event of complete habitat destruction.

In the tropics of Queensland, historically, seagrasses have shown a remarkable capacity to recover from large disturbance events without direct intervention (Rasheed et al. 2014; Coles et al.2015). This is likely due to a combination of relatively well-connected seagrass populations (Grech et al. 2018) and life history strategies of tropical species allowing for rapid colonization and growth (Rasheed, 1999 2004). However, in recent times this situation has changed, with the relative frequency of La Niña climate events and severe storms leading to sustained losses (McKenna et al. 2015) and cases where natural seagrass recovery is unlikely. These conditions are predicted to become more common with climate change (Rasheed & Unsworth 2011), making knowledge of how to restore these tropical species increasingly important.

Restoration Substantial progress has been made globally and in Australia in developing methods and technologies for the restoration of seagrass meadows. Methodologies include reintroduction propagules as well as facilitation of natural regeneration for some species. However, restoration takes a sustained commitment to on-ground effort and resources so only relatively small areas have been restored in Australia to date. Scaling up seagrass restoration is possible with concomitantly increased funding and community engagement.

Saltmarsh

Saltmarshes across Australia cover an area of over 13,000 km², with greater species diversity in southern Australia (Commonwealth of Australia, 2016). Loss of saltmarshes is one of the key-contributing agents to the loss of amenity and condition of our coastal resources (Table 1).

Tidal marshes are regarded as one of the 10 major terrestrial and marine ecosystems in Australia most vulnerable to exhibiting tipping points, where relatively small changes in the environment lead to disproportionately large ecosystem losses (Peter *et al.* 2017).

An Australia-wide assessment of 1000 estuaries and embayments undertaken by the National Land and Water Resources Audit of 1997-2002 indicated that 30% were modified to some degree. The most highly degraded were in New South Wales, where 40% were classified as 'extensively modified' and only 10% were 'near pristine'(National Land and Water Resources Audit, 2002). Saltmarsh losses are part of this degradation. Since that review (some 22 years on), urban populations have continued to grow rapidly, and increasing pressures for industrial and agricultural development in the coastal zone have resulted in ongoing degradation of Australia's estuaries and embayments. This degradation has had serious effects on biodiversity, carbon sequestration (Lawrence et al, 2012) and commercial and recreational fishing (Creighton et al., 2015). Specific quantitative information on the loss of critical habitat is available from a number of habitat or region-specific studies to expand upon the National Land and Water Resources Audit's (2002) Australia-wide assessment.

Saintilan and Williams (2000), for example, reviewed loss of coastal saltmarsh in eastern Australia since World War II, and reported losses as 100% for parts of Botany Bay, New South Wales over the period 1950-1994 and 67% for the Hunter River (excluding Hexham) from 1954–1994. Harty and Cheng (2003) reported a loss of 78% of saltmarshes in Brisbane Water, near Gosford, New South Wales, between 1954 and 1995. Sinclair and Boon (2012) showed that the state-wide loss of coastal wetlands (mainly mangroves and saltmarsh) in Victoria since European colonisation has been variously 5–20% by area across the state, with the greatest losses occurring in heavily urbanised areas such as around Port Phillip Bay (~50% loss) and in agriculturally developed regions such as Gippsland (e.g. 60% loss from Anderson Inlet in South Gippsland).

Since European settlement around 35,000ha of saltmarsh has been lost in Queensland (Neldner et al. 2015) mainly through the construction of ponded pastures, salt ponds and urban development. The largest losses have been in Central Queensland in the Fitzroy River Delta, Broad Sound and Port Curtis areas and in South-East Queensland (Bruinsma 2000, Duke et al. 2003, Wegscheidl et al. 2015).

Restoration Restoration of saltmarsh has proven successful through natural recolonisation after reinstating the appropriate elevation levels and tidal flushing, with reintroductions also proving useful where needed. It is critical to plan, however, the reservation of low-lying coast all around Australia from any further development to provide the space for sea-level rise induced migration of saltmarshes everywhere. 0Such areas could provide the footprint for saltmarsh recovery targets of the future, avoiding conflicts in land use likely if this space has not been provided for nature to move with our changing climate.

Table 1. Rate and caused of loss of saltmarsh across Australia. (**Source:** Macreadie *et al*. 2017). The numbers in parentheses refer to the following references: 65 Creese *et al*.(2009); 66 Wilton *et al*. (2002); 67 Bucher (1991); 68 Nelder *et al*. (2014); 69 Nelder *et al*. (2012); 70 Coleman (1998); 71 Saintilan & Williams(2000); 72 Harty (2004); 73 Prahalad (2014); 74 Sinclair & Boon (2011);75 Boon *et al.* 2011); 76 Paling *et al*.(2008).

State/ Territory	Area (km^2)	Rate of loss ($km^2\ yr^{-1}$)	Rate of loss ± SD (% total area yr^{-1})	Causes of Loss	Reference(s)
New South Wales	73 (65)	0.0931	0.01 ± 0.51%	Incursion of terrestrial species, mangrove encroachment, reclamation.	(66)
Queensland	5,322 (67)	1.3510	0.0184%	Agriculture, urban and industrial development	(68, 69)
South Australia	84 (67)	0.0824	4.4516%	Mangrove encroachment, urban development	(70, 71, 72)
Tasmania	37 (67)	0.0406	0.2963%	Expansion of *Melaleuca ericifolia,* land clearing, levees (approx. 90%).	(73)
Victoria	279 (74)				(74, 75)
Scenario I*		0.0423	0.0146%	Grazing, reclamation for agriculture, vehicle damage.	
Scenario II*		0.3334	0.0914		
Western Australia	2,965 (67)	13.54	18%	Cyclone	
Northern Territory	5,005 (67)	Unknown	Unknown		(76)

Freshwater wetlands

Some estimates place the loss of Australian wetlands as more than 50% of those that existed over 200 years ago (Finlayson, 2000). These estimates are based on the following, however freshwater wetland losses are notoriously difficult to quantify, and these estimates are considered conservative and the reality of losses is likely to be more than recorded.

- ***Swan Coastal Plain, Western Australia*** *70% filled or drained (Halse 1998)*
- ***Coastal region, New South Wales*** *75% lost (Goodrick 1970)*
- ***South-east, South Australia*** *98% drained (Jones 1978)*
- ***State of Victoria*** *33% lost (CNR 1995)*
- ***River Murray, south eastern Australia*** *35% of seasonally inundated wetlands now permanently filled (Pressy 1986)*

In terms of the NSW Coastal loss in area, Rogers *et al* (2016) identified pre-European distribution of available fish habitat of approximately 477,000 ha, of which 87,000 ha was identified as prime fish habitat. Approximately 62,000 ha of prime fish habitat was impacted by drainage of the coastal floodplains in association with flood mitigation works which intensified in the mid-1950s and were largely completed by 1971, equating to a complete loss of approximately 72% of prime fish habitat.

A high number of Threatened flora and fauna species and Threatened Ecological Communities are wetland or river dependent. To protect and restore threatened communities, fish, waterbird and frog populations, extensive restoration of permanent, semi-permanent, seasonal and ephemeral wetlands is needed – both associated with riverine systems and those independent of riverine systems.

Restoration High quality restoration work has been carried out in Australia's freshwater wetlands by specialist wetland restoration NGOs and by agencies. Sufficient technologies have been developed to scale up freshwater wetland across Australia including through the reversal of artificial drainage already used for agriculture.

Barriers are numerous, including the need to convince and work with private land managers to restore land and flooding and drying regimes and to navigate government policy and water resource sharing/ regulation to ensure that surface and groundwater resources are managed in a way that continues to sustain and/or deliver water to wetlands.

As water scarcity has intensified, in many catchments wetland restoration increasingly turns natural wetlands and floodplains into banked-off, highly managed, artificially isolated water storages rather than natural features that can ebb and flow with nature and the seasons which is critically important to the species who rely on them. Questions remain about how to ensure that ecologists retain the intellectual lead on what best-practice, nature-based wetland restoration looks like, rather than engineers and water managers. This way we respect the landscape, seek to reinstate natural landforms and recover missing ecological processes.

Shellfish Reefs

A review of the historical and current status of shellfish reef ecosystems in Australia undertaken by Gillies et al. (2018), which assessed 14 species of bivalves capable of developing complex reef or bed ecosystems in intertidal and subtidal areas, identified that (i) current knowledge on the extent, biodiversity and ecosystem services of these ecosystems across Australia is extremely limited, and (ii) the extent and condition of Australia's two most common shellfish ecosystems, Sydney rock oyster (*Saccostrea glomerata*) and Australian Flat Oyster (*Ostrea angasi*), declined dramatically from the mid-1800s to early 1900s in concurrence with extensive harvesting for food and lime production, ecosystem modification, disease outbreaks and a decline in water quality. Out of 118 historical locations containing *O. angasi* reef ecosystems across Australia, only one location still contains this ecosystem today (Georges Bay, Tasmania), whilst only six locations (from 60 historical locations) are known to still contain *S. glomerata* reef ecosystems. These findings indicate that <1% of *O. angasi* reef systems and 8% of S. glomerata reef systems still remain (Gillies *et al*. 2018), mirroring global trends in the widespread loss of shellfish reef ecosystems (Beck *et al*. 2011). A further study by Gillies et al. (2020) assessed the conservation status of the Oyster Reef Ecosystem of Southern and Eastern Australia (comprising *S. glomerata* and *O. angasi)* in line with the IUCN Red List of Ecosystems risk assessment process, and ranked the risk of collapse of this ecosystem as Critically Endangered with a high degree of confidence.

Other studies of shellfish reef ecosystems in particular geographic areas across Australia chart a similar trajectory of decline. For example, Alleway and Connell (2015) found that native oyster reefs historically extended across more than 1,500 km of South Australia's coastline (whereas no native oyster reefs occur there today), Thurstan *et al*. (2020) outline the loss of *S. glomerata* reefs in central and south-east Queensland over the last two centuries, and Christensen *et al*. (2023) describe the systematic removal of vast oyster shell beds (likely *O. angasi*), estimated to be equivalent to 1,600–2,400 hectares of living reef, from the Swan-Canning Estuary in south-western Australia throughout the 1920s to 1950s.

Recent mapping of the sole remaining remnant *O. angasi* reef in Tasmania shows individual reefs can span >8 ha, with the entire ecosystem (6 reef areas) covering ~13.5 ha (Jones & Gardner 2016). However, a 1889 map of the oyster fishery in Gulf St Vincent, South Australia, indicates much larger reef systems once existed, spanning >290,000 ha. Such large-scale reef ecosystems were also evident across 18th century Europe, where a similar Flat oyster (*Ostrea edulis*) formed reefs up to 1,536,000 ha in size, with a median spatial extent of 30 ha per reef system (derived from 52 sources published between 1715 and 1910; Thurstan et al. in review).

The Oyster Reef Ecosystem of Southern and Eastern Australia has recently been nominated to be assessed as a threatened ecological community under Australia's Environment Protection and Biodiversity Conservation Act 1999. If listed, this will raise considerable awareness about the need to address this loss and potentially lead to a recovery plan. A decision is anticipated by October 2025.

Restoration Despite the limited information on historical shellfish ecosystems, scores of shellfish reef restoration projects have been initiated across Australia by NGOs, natural resource management agencies and community groups, with many attaining highly promising levels of success. These include a national shellfish reef restoration initiative, Reef Builder, under which native shellfish reefs have been restored at 21 locations nationally to date (The Nature Conservancy, 2024a, b). Returning reefs to 60 locations nationally would restore them to 30% of their pre-existing locations, and is within reach with commensurate funding support and capacity building. As is the case for many other aquatic ecosystems, however, the areal extent of restoration is very small to date compared to estimated historical extents and the need. Gillies *et al*. (2018) list a number of existing government policies and conservation mechanisms, if enacted, would readily serve to support the future conservation and recovery of Australia's shellfish ecosystems.

Mangroves

Mangroves occur throughout Australia's coastal region, particularly in the north and east, covering an area of about 11,500 km^2. It is estimated that around 17 per cent of Australia's mangroves have been destroyed since European settlement. Australia-wide, 47–78% of saltmarshes and mangroves have been lost since European settlement, and they continue to deteriorate (Serrano *et al*. 2019).

Historic losses of extent after European settlement in the 19th century in Australia have been estimated at 13,800 km^2 for tidal marsh (47–50% loss of original extent), 11,500 km^2 for mangroves (52–78% loss of original extent) and 32,000 km^2 for seagrass (20–26% loss of original extent).

Restoration As mangroves absorb significant amounts of carbon, their restoration can be a key contributor to global action on climate. Mangrove restoration is accelerating with increases in funding including from the Australian government. Methodologies for mangrove restoration have built upon many decades of trial and error, showing that success requires a knowledge of best practices, realistic goal setting, adequate project planning and stakeholder engagement time. Highly important is the identification of areas with suitable hydrology, nutrient, and sedimentation conditions. As with seagrass and in the case of saltmarsh, planning is needed to set areas aside for migration of mangroves with sea-level rise.

Giant Kelp

Kelp forests dominate the rocky coasts of temperate Australia and are the foundation of the Great Southern Reef (Bennett *et al*. 2016). Much like terrestrial forests, these marine forests create complex habitat for diverse communities of flora and fauna. Kelp forests also support coastal food-webs and valuable fisheries and provide a suite of additional ecosystem services. In many regions of Australia and around the world, kelp forests are in decline due to ocean warming, overgrazing, and pollution (Layton *et al*. 2020).

In Tasmania, forests of Giant Kelp (*Macrocystis pyrifera*) forming dense surface canopies have declined by up to 95% over the past 60 years (Johnson *et al*. 2011), with estimates of kelp forest loss in the hundreds of hectares (e.g. 380 ha lost, C Brown *pers comm*). However, recent analyses of historical nautical charts have revealed that total losses of Tasmanian Giant Kelp forests over the last century (since the late 1800s) are likely to be orders of magnitude greater than previously described (C. Chong-Montenegro *et al*., in preparation).

It is likely that anthropogenic stressors (e.g. marine predator overfishing leading to trophic cascades) have been driving kelp forest declines as fisheries developed in Tasmania. This has been compounded by the warming of the East Australian Current and the subsequent range expansion of long-spined sea urchins (*Centrostephanus rodgersii*), which aggressively overgraze Giant Kelp forests (Johnson *et al*. 2011).

Restoration. The science and practice of kelp forest restoration is currently undergoing substantial expansion and is reviewed in Layton et al. 2020). A range of kelp restoration methods exist, and can be adapted to specific situations, but outcomes are best optimised by ameliorating the drivers of kelp decline (e.g. urchin removal) and achieving ongoing natural recruitment of kelp. Scalability of kelp forest restoration to the seascape-scale remains a considerable challenge to future restoration efforts, requiring considerably increased investment.

Coral Reefs

Coral reefs in Australia's tropical waters face global challenge of climate change leading to ocean acidification and coral bleaching. The Great Barrier Reef in particular is subject to a range of local and regional challenges such as pollution, reduced water quality, and impacts of industry (including dredging and coal and gas infrastructure). Other issues include Crown of Thurns Starfish dominance and microplastics.

Ocean acidification from increasing carbon dioxide in the atmosphere is already affecting the physiology and behaviour of marine animals and plants, creating both winners and losers, and ecosystem changes. The 2020 Status of the World's Coral Reef Report showed 14% of the world's coral reefs have died since 2009, and coral bleaching caused by marine heatwaves have driven this loss. This pressure is predicted to continue with climate change.

Mass bleaching events are caused by increased sea temperatures and their frequency, intensity and area is increasing over time. On the Great Barrier Reef they have been documented with full-scale surveys by the Australian Institute of Marine Science (AIMS) in 1998, 2002, 2016, 2017, 2020, 2022 and 2024. In Western Australia, mass bleaching events were documented by AIMS n 1998, 2011-2013 and 2016, with many smaller bleaching events around those times. In 2008 and 2011, coral bleaching at the Great Barrier Reef was caused by an influx of freshwater affecting local reefs exposed to the flood plumes.

Restoration. Reducing global greenhouse gas emissions is the most important action to minimise the impact of climate change on the Reef and offer hope for restoration. However, there is also a critical need for deploying a range of restoration and adaptation approaches at scale to support the health and recovery potential of coral reefs. The science of coral and reef restoration is in its infancy and therefore efforts to date are often small scale and can be expensive. Scaling up will depend not only on available finance but also ongoing research and development, complemented by serious reductions in global warming.

Murray Darling Basin waterways

Aquatic ecosystems of the Murray-Darling Basin (MDB) are generally in poor condition due to impacts from a range of threats, and many of these valuable ecological assets continue to decline. The major threats to MDB fishes have long been identified (Cadwallader, 1978) and urgent and their effective remediation of them has been recognised as essential for the recovery of fishes (Baumgartner *et al*. 2019; Koehn *et al*. 2020). The MDB is one of the most regulated river basins in the world (Grill *et al*. 2019) and most impacts relate to Irrigation and its infrastructure (MDBC 2004; Koehn and Lintermans 2012; Koehn *et al*. 2020).

Over-allocation of water, flow regulation and environmental damage have all been identified as issues that urgently need to be addressed (Walker 2006; Kingsford 2000; Lester *et al*. 2011; Walker 2019). Wong *et al*. (2007) listed the MDB as one of the most at-risk river systems in the world. Monitoring that indicates that most MDB rivers and catchments are now in poor ecological condition (e.g. Davies *et al*. 2008, 2010), also evidenced by the greatly diminished state of native fish populations (losses estimated to be > 90% in the past 150 years) together with recent massive fish kills in the Darling River (Vertessy *et al*. 2020; Koehn 2022) and explosions in alien carp populations (Stuart *et al*. 2023).

Alterations to flow regimes come in many forms but this summary helps paint the picture:

- Only 40–50% of main stem rivers remain free-flowing (Liermann *et al*. 2012), with many of these also having altered hydrology by regulation or extraction.
- End-of-system flows are now zero for 40% of the time, compared with 1% of the time under natural flow conditions (CSIRO 2008).
- Extensive river reaches have been converted from lotic to lentic environments by weirs and reduced flows (Maheshwari *et al*. 1995; Walker 2006) and low water levels and critical no flow periods have increased significantly in previously naturally perennially flowing rivers (e.g. Darling River; Mallen-Cooper and Zampatti, 2020).
- The effects of anthropogenic flow alterations were exacerbated during the 'Millennium Drought' (1997–2010) (Murphy and Timbal 2008; van Dijk *et al*. 2013).

Climate change is projected to have a range of impacts on MDB aquatic habitats and their biota, exacerbating many existing threats (Pittock *et al*. 2010; Pittock, and Finlayson 2011; Balcombe et al. 2011; Pratchett *et al*, 2011). The MDB will be hotter and drier, having already warmed by 1°C since 1910 and the warming will continue (Whetton and Chiew 2021). Changes to temperatures will impact fish metabolism and spawning, and may result in changes to their distributions (Bond *et al*. 2011). Water availability is decreasing (Prosser *et al*. 2021) and likely to reduce across the entire Basin with a greater reduction in the south of the Basin (CSIRO 2008).

Average annual runoff is projected to decrease 9% by 2030 and 23% by 2070 (CSIRO 2008). There will be large increases in frequency in the length and severity of multi-year droughts and hence low flow and zero flow periods. Together with a decrease in freshes of up to 55% there is likely to be an increase in associated events such as major cyanobacterial blooms, low dissolved oxygen concentrations and blackwater (Verhoeven *et al*. 2023).

There is high variability, however, with projected changes in mean annual runoff ranging from – 40% to +10% in the southern MDB and – 45% to +30% in the northern MDB (CSIRO 2008). The direction of change in summer rainfall is less certain with the magnitude of extreme high rainfalls expected to increase (Timbal *et al*. 2015). Severe drought conditions (Vertessy *et al*. 2019), together with increased fires and post-bushfire run-off will also cause increased fish kills (Legge *et al*. 2020). It is well-recognised that climate change has not been adequately addressed in the Basin Plan (Pittock *et al*. 2015; Prosser *et al*. 2021; Zhang *et al*. 2023) with future climate-induced flow reductions negating some of the benefits of projected environmental water allocations.

Native freshwater fish populations have greatly diminished as indicated by the following measures.

- Native fish populations have declined by >90 % over the past 150 years (MDBC 2004; Koehn and Lintermans, 2012).
- Almost half the native species are now of conservation concern, being listed as rare or threatened under state or national legislation (Lintermans, 2023).
- Many smaller fish species, especially wetland specialists, are at greatest risk (Lintermans *et al*. 2020) and Yarra pygmy perch (*Nannoperca obscura*) appear now to be extinct in the MDB. Several fish communities of the MDB have been listed as threatened under both State (Victorian and New South Wales) and Commonwealth legislation.
- There have been rapid declines in key, popular recreational and commercial 'flagship' species such as silver perch (*Bidyanus bidyanus*), freshwater catfish (*Tandanus tandanus*) and trout cod (*Maccullochella macquariensis*) (Reid *et al*. 1997; Clunie and Koehn 2001a, b).
- Almost all commercial fisheries have collapsed and are long closed (Rowland 1989, 2005).
- Fish kills are increasing in magnitude and becoming more frequent including from post-fire run-off (Lyon and O'Connor 2008; Legge *et al*. 2020).
- Alien species (12 species) now comprise a quarter of MDB fishes with carp dominating fish biomass in many river reaches (Stuart *et al* 2021).

Fish habitats have been impacted in the following ways.

- Cold water released from dams impact spawning, recruitment and growth in over 3,000 km of MDB rivers (Lugg and Copeland, 2014).
- There are more than 5,000 major barriers including barriers caused by dams, weirs, culverts, locks and barrages (Lintermans, 2023) and more than 10 000 minor barriers that cause disruption to river connectivity and fish passage (Baumgartner *et al*. 2014). A total of 3748 of such potential barriers, comprising bridges, culverts and causeways, were identified in a stream network of 18 363 km in the Qld Wet Tropics (Frederieke *et al*. 2015). There are 1035 tidal floodgates in NSW although this number is now known to be an underestimate (C Copeland pers comm) (Williams, *et al* 1997).
- There has been damage to and loss of habitats for wetland species (Closs et al. 2006; Sharpe 2011) including significant loss of off-stream lakes and wetlands that provide waterbird and fish nursery habitats. While the quantum (e.g. area) is not readily available, only 11 of a potential 567 golden perch (*Macquaria ambigua*) larval nursery sites have been considered to be still operating in western NSW (Sharpe, 2011).

- Flow alterations have greatly reduced flows into wetlands reducing their number and area (Sharpe, 2011), impacting vegetation and waterbird habitats (Kingsford and Thomas 1995; Kingsford *et al*. 2011) and changing their ecological character (Pittock *et al*. 2010).
- There are also significant long-term declines in total waterbird abundances are associated with reductions in cumulative annual flow (Kingsford *et al*. 2017).

Restoration Restoration of rivers and streams depends on a vast range of factors, not least the catchment-scale reduction of nutrient inputs and the reinstatement of mechanism to slow runoff, reinstating natural hydrological flows, stream connectivity and fish passage. Successful restoration has been demonstrated in multiple river reaches through holistic approaches including removal of flow barriers, managing fish takes, installing upslope nutrient filters, revegetating cleared riparian zones, resnagging the riverbed and particularly, involving and engaging with communities.

Closing comments on loss, degradation and restoration potential of Australia's aquatic systems

Australia has lost a devastating amount of marine and coastal ecosystems over the past 200 years which translates to a loss of habitats, and a loss of species. In addition it means we've lost the ability to store vast amounts of carbon, ways to treat water, protect coastlines from erosion, and critical 'highways' for fish to breed or seek refuge.

Research and development in ecological restoration is progressing globally, with important advances being made in freshwater wetland, stream, saltmarsh, mangrove, seagrass, kelp forest, shellfish reef and coral reef ecosystems. Research is finding that aquatic ecosystem restoration , is one of the most critical activities to mitigate and adapt to climate change, with 'blue carbon' coastal ecosystems storing ten times more carbon per unit area than most terrestrial ecosystems. However the areal extent of restoration to date has been miniscule compared to the area needed.

One of the key barriers is that restoration projects are subjected to the same permit processes as a development application. This causes unanticipated costs, challenges in gaining permits, and delays in the start date of projects (the permitting time sometimes taking three times the project implementation time) and sometimes prevents some projects from going ahead (Bell-James, 2023, C. Price, OzFish *pers. comm*. 2024).

Saunders *et al*. (2024) found an urgent need for large scale ecological restoration to reverse habitat loss and recover ecosystem functions and services. Their national scale engagement with restoration practitioners, decision makers, industry, researchers, community groups, and Indigenous groups identified key barriers and aspirations for the future.

The study recommended the application of ten guiding principles to overcome current barriers and guide transformative change to achieve large-scale restoration. A national roadmap recommends a state and local rollout of a national science-based coastal and marine restoration plan that addresses climate change mitigation targets in addition to providing economic recovery. *"We need a large-scale coordinated approach that co-designs projects, opens funding pipelines, and supports the development of fit-for-purpose permitting processes. The approach should actively bring in all levels of communities, Indigenous groups, the private sector, non-governmental organisations and governments."*(Saunders M, CSIRO 2024)

The changes and the identified threats represented in this summary - and the experience of restoration researchers and practitioners involved in preparing it - form a solid basis from which to set restoration targets under the current program. A rapid assessment is presented in Table 2 (below) proposing some suggested targets for aquatic ecosystem restoration by 2030.

References

Alleway H, Connell S (2015) Loss of an ecological baseline through the eradication of oyster reefs from coastal ecosystems and human memory. Conservation Biology, 29(3), 795-804.

Balcombe, S. R., Sheldon, F., Capon, S. J., Bond, N. R., Hadwen, W. L., Marsh, N., and Bernays, S. J. (2011). Climate-change threats to native fish in degraded rivers and floodplains of the Murray–Darling Basin, Australia. *Marine and Freshwater Research* 62, 1099–1114. doi:10.1071/MF11059

Baumgartner, L., Zampatti, B., Jones, M., Stuart, I., and Mallen-Cooper, M. (2014). Fish passage in the Murray–Darling Basin, Australia: not just an upstream battle. *Ecological Management & Restoration* 15, 28–39. doi:10.1111/emr.12093

Baumgartner, L. J., Gell, P., Thiem, J. D., Finlayson, C. M., and Ning, N. (2019). Ten complementary measures to assist with environmental watering programs in the Murray–Darling river system, Australia. *River Research and Applications* 36, 645-655. doi:10.1002/rra.3438

Bell-James, J. (2023) From the Silo to the Landscape: The Role of Law in Landscape-scale Restoration of Coastal and Marine Ecosystems. *Journal of Environmental Law,* Volume 35, Issue 3, November 2023, Pages 419–436, https://doi.org/10.1093/jel/eqad027

Bennett, S., Wernberg, T., Connell, S. D., Hobday, A. J., Johnson, C. R., and Poloczanska, E. S. (2016). The 'Great Southern Reef': social, ecological and economic value of Australia's neglected kelp forestsMarine and Freshwater Research, 67(1), 47-56.

Bond, N. R., Thomson, J., Reich, P., and Stein, J. (2011). Using species distribution models to infer potential climate change-induced range shifts of freshwater fish in south-eastern Australia. *Marine and Freshwater Research* 62, 1043–1061. doi:10.10171/MF10286

Boon, P. I. et al. (2011) *Mangroves and coastal saltmarsh of Victoria: distribution, condition, threats and management*. (Institute for Sustainability and Innovation, Victoria University, Melbourne.

Bucher, D. J. & Saenger, P. (1991) An inventory of Australian estuaries and enclosed marine waters: an overview of results. *Australian Geographical Studies* 29, 370–381.

Cadwallader, P. L. (1978). Some causes of the decline in range and abundance of native fish in the Murray–Darling River System. *Proceedings of the Royal Society of Victoria* 90, 211–224.

Christensen J, Martin DJ, Bossie A, Valesini FJ (2023) Middle Holocene Oyster Shells and the Shifting Role of History in Ecological Restoration: How a Dynamic Past Informs Shellfish Ecosystem Reconstruction at an Australian Urban Estuary. Global Environment, 16(3), 414-448. [e0190914]. https://doi.org/10.3197/ge.2023.160301.

Closs, G. P., Balcombe, S. R., Driver, P., McNeil, D. G., and Shirley, M. J. (2006). The importance of floodplain wetlands to Murray–Darling fish: What's there? What do we know? What do we need to know? In Phillips, B. (Ed.) *Native Fish and Wetlands in the Murray–Darling Basin: Action Plan, Knowledge Gaps and Supporting Papers*. Proceedings of a workshop held in Canberra ACT, 7–8 June 2005. pp. 14–28. Murray–Darling Basin Commission, Canberra.

Clunie, P., and Koehn, J. (2001a). *Silver Perch: A Recovery Plan. Final report to the Murray–Darling Basin Commission, Canberra.* Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.

Clunie P., and Koehn, J. (2001b). *Freshwater catfish: A Recovery Plan. Final report to the Murray-Darling Basin Commission, Canberra.* Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.

Coleman, P. S. J. (1998) Changes in a mangrove/samphire community, North Arm Creek, South Australia. *Trans R Soc S Aust* 122, 173–178

Creese, R. G., Glasby, T. M., West, G. & Gallen, C. (2009) *Mapping the habitats of NSW estuaries. ISSN* 1837–2112. Port Stephens, NSW, Australia.

Creighton C, Gillies CL and McLeod IM (eds) (2015) *Australia's saltmarshes: a synopsis to underpin the repair and conservation of Australia's environmental, social and economically important bays and estuaries.* Centre for Tropical Water & Aquatic Ecosystem Research (TropWATER) Publication, James Cook University, Townsville,63pp.

Davies, P., Harris, J., Hillman, T., and Walker, K. (2008). *SRA Report 1: A report on the ecological health of rivers in the Murray–Darling Basin, 2004–2007*. Prepared by the Independent Sustainable Rivers Audit Group for the Murray–Darling Ministerial Council. Murray–Darling Basin Commission, Canberra.

Davies, P. E., Harris, J. H., Hillman, T. J., and Walker, K. F. (2010). The Sustainable Rivers Audit: assessing river ecosystem health in the Murray–Darling Basin, Australia. *Marine and Freshwater Research* 61, 764–777. doi:10.1071/MF09043

Finlayson CM (2000) *Loss and degradation of Australian wetlands*. Environmental Research Institute of the Supervising Scientist. (Paper presented at LAW ASIA Conference: Environmental law issues in the Asia-Pacific region. Internal Report 351.

Frederieke J., Kroon A C and Seonaid Phillips B (2015) Identification of human-made physical barriers to fish passage in the Wet Tropics region, Australia. *Marine and Freshwater Research* 67(5) 677-681 https://www.publish.csiro.au/mf/MF14397

Gillies CL, McLeod IM, Alleway HK, Cook P, Crawford C, Creighton C, Diggles B, Ford J, Hamer P, Heller-Wagner G, Lebrault E, Le Port A, Russell K, Sheaves M, Warnock B (2018) Australian shellfish ecosystems: Past distribution, current status and future direction. *Plos One.*

Gillies, C.L., Castine, S.A., Alleway, H.K., Crawford, C., Fitzsimons, J.A., Hancock, B., Koch, P., McAfee, D., McLeod I.M, zu Ermgassen P.S.E. (2020). *Conservation status of the Oyster Reef Ecosystem of Southern and Eastern Australia.* Global Ecology and Conservation 22: e00988. doi.org/10.1016/j.gecco.2020.e00988.

Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., Babu, S., Borrelli, P., Cheng, L., Crochetiere, H., Ehalt Macedo H., Filgueiras, R., Goichot, M., Higgins, J., Hogan, Z., Lip, B., McClain, M. E., Meng, J., Mulligan, M., Nilsson C., Olden, J. D., Opperman, J. J., Petry, P., Liermann, C. R., Sáenz, L., Salinas-Rodríguez, Schelle, P., Schmitt, R. J. P., Snider, J., Tan, F., Tockner, K., Valdujo, P. H., van Soesbergen, A., and Zarfl S. C. (2019). Mapping the world's free-flowing rivers. *Nature* 569, 215–221. https://doi.org/10.1038/s41586-019-1111-9

Harty, C. (2004) Planning strategies for mangrove and saltmarsh changes in Southeast Australia. *Coastal Management 32*, 405–415, doi: 10.1080/08920750490487386

Johnson CR, Banks SC, Barrett NS, Cazassus F and others (2011) Climate change cascades:shifts in oceanography, species' ranges and subtidal marine community dynamics in eastern Tasmania. *J Exp Mar Biol Ecol* 400: 17–32

Kingsford, R.T., and Thomas, R. F. (1995). The Macquarie Marshes in Arid Australia and their waterbirds: A 50-year history of decline. *Environmental Management* 19, 867–878. https://doi.org/10.1007/BF02471938

Kingsford, R. T., Walker, K. F., Lester, R. E., Young, W. J., Fairweather, P. G., Sammut, J., and Geddes, M. C. (2011). A Ramsar wetland in crisis – the Coorong, Lower Lakes and Murray Mouth, Australia. *Marine and Freshwater Research* 62, 255–265. doi.org/10.1071/MF09315

Kingsford, R. T., Bino, G., and Porter, J. L. (2017). Continental impacts of water development on waterbirds, contrasting two Australian river basins: Global implications for sustainable water use. *Global Change Biology* 23(11), 4958-4969.

Koehn, J. D. (2022). Key steps to improve the assessment, evaluation and management of fish kills. Learnings from the Murray-Darling Darling River system, Australia. *Marine and Freshwater Research* 73, 269-281.

Koehn, J. D., and Lintermans, M. (2012). A strategy to rehabilitate fishes of the Murray–Darling Basin, south-eastern Australia. *Endangered Species Research* 16, 165–181. doi:10.3354/esr00398

Koehn, J. D., Balcombe, S. R. Bice, C. M., Baumgartner, L., Burndred, K., Ellis, I., Koster, W., Lintermans, M., Pearce. L. Sharpe, C., Stuart, I., and Todd, C. R. (2020). What is needed to restore native fishes in Australia's Murray-Darling Basin? *Marine and Freshwater Research* 71, 1464-1468

Layton C,, Coleman MA, Marzinelli EM, Steinberg PD, Swearer SE, Verges A, Wernberg T, Johnson CR. (2020) Kelp Forest Restoration in Australia. *Frontiers in Marine Science*. 7 https://doi.org/10.3389/fmars.2020.00074

Legge, S., Woinarski, J., Garnett, S., Nimmo, D., Scheele, B., Lintermans, M., Mitchell, N., Whiterod, N., and Ferris, J. (2020). *Rapid analysis of impacts of the 2019–20 fires on animal species, and prioritisation of species for management response*. Report prepared for the Wildlife and Threatened Species Bushfire Recovery Expert Panel 14 March 2020. Available at https://www.environment.gov.au/biodiversity/bushfire-recovery/priority-animals [accessed 1 April 2023].

Lester, R. E., Webster, I. T., Fairweather, P. G., and Young, W. J. (2011) Linking water-resource models to ecosystem-response models to guide water-resource planning – an example from the Murray–Darling Basin, Australia. *Marine and Freshwater Research* 62, 279–89.

Liermann, C. R., Nilsson, C., Robertson, J., and Ng, R. Y. (2012). Implications of dam obstruction for global freshwater fish diversity. *BioScience* 62, 539–548. doi:10.1525/bio.2012.62.6.5e

Lintermans, M. (2023). *Fishes of the Murray–Darling Basin: An Introductory Guide*. Australian River Restoration Centre, Canberra.

Lintermans, M., Geyle, H. M, Beatty, S., Brown, C., Ebner, B., Freeman, R., Hammer, M. P., Humphreys, W. F., Kennard, M. J., Kern, P., Martin, K., Morgan, D., Raadik, T. M., Unmack, P. J., Wager, R., Woinarski, J. C. Z., and Garnett, S. T. (2020). Big trouble for little fish: identifying Australian freshwater fishes in imminent risk of extinction. *Pacific Conservation Biology* 26(4), 365-377.

Lugg, A., and Copeland, C. (2014). Review of cold water pollution in the Murray–Darling Basin and the impacts on fish communities. *Ecological Management Restoration* 15, 71–79. doi:10.1111/emr.12074

Lyon, J. P., and O'Connor, J. P. (2008). Smoke on the water: can riverine fish populations recover following a catastrophic fire-related sediment slug? *Austral Ecology* 33, 794–806. doi:10.1111/j.1442-9993.2008.01851.x

Macreadie P. I., Ollivier Q.R., Kelleway J.J., Serrano O., Carnell P.E., Ewers Lewis C. J., Atwood T. B., Sanderman J., Baldock J., Connolly R. M., Duarte1 C. M., Lavery P. S., Steven A., and Lovelock C. E. (2017) Carbon sequestration by Australian tidal marshes. *Sci Rep* 7, 44071 (2017). https://doi.org/10.1038/srep44071

Maheshwari, B. L., Walker, K. F., and McMahon, T. A. (1995). Effects of regulation on the flow regime of the River Murray, Australia. *Regulated Rivers: Research and Management* 10, 15–38. doi:10.1002/rrr.3450100103

Mallen-Cooper, M., *and Zampatti, B. P. (2020). Restoring the ecological* integrity of a dryland river: why low flows in the Barwon–Darling River must flow. Ecological Management & Restoration 21(3), 218-228.

MDBC (2004). *Native Fish Strategy for the Murray–Darling Basin 2003–2013*. (Murray–Darling Basin Commission: Canberra.) Available at https://www.mdba.gov.au/sites/default/files/pubs/NFS-for-MDB-2003-2013.pdf [accessed 23 May 2023].

Murphy, B. F., and Timbal, B. (2008). A review of recent climate variability and climate change in southeastern Australia. *International Journal of Climatology* 28, 859–879. doi:10.1002/joc

Nelder, V. J., Wilson, B. A., Thompson, E. J. & Dillewaard, H. A. (2012) *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities* in Queensland. Queensland Herbarium, Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Nelder, V. J., Niehus, R. E., Wilson, B. R., McDonald, W. J. F. & Ford, A. J. (2014) *The Vegetation of Queensland.* Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Paling, E. I., Kobryn, H. T. & Humphreys, G. (2008) Assessing the extent of mangrove change caused by Cyclone Vance in the eastern Exmouth Gulf, northwestern Australia. *Estuar Coast Shelf Sci* 77, 603–613, doi: 10.1016/j.ecss.2007.10.019.

Peter I. Macreadie, Q. R. Ollivier, J. J. Kelleway, O. Serrano, P. E. Carnell, C. J. Ewers Lewis, T. B. Atwood, J. Sanderman, J. Baldock, R. M. Connolly, C. M. Duarte, P. S. Lavery, A. Steven & C. E. Lovelock (2017) Carbon sequestration by Australian tidal marshes. *Scientific Reports* volume 7, Article number: 44071

Pittock, J., and Finlayson, C. M. (2011). Australia's Murray-Darling Basin: freshwater ecosystem conservation options in an era of climate change. *Marine and Freshwater Research* 62, 232–243.

Pittock, J., Finlayson, C., Gardner, A. and MacKay, C. (2010). Changing character: The Ramsar Convention on Wetlands and climate change in the Murray-Darling Basin, Australia. *Environmental and Planning Law Journal* 27(6), 401-425.

Pittock, J., Williams, J., and Grafton, R. (2015). The Murray-Darling Basin plan fails to deal adequately with climate change. *Water: Journal of the Australian Water Association*, 42(6), 28-32.

Prahalad, V. N. (2014) Human impacts and saltmarsh loss in the Circular Head coast, north-west Tasmania, 1952-2006: implications for management. Pac Conserv Biol 20, 272–285.

Prosser, I. P., Chiew F. H. S., and Stafford Smith M. (2021). Adapting Water Management to Climate Change in the Murray–Darling Basin, *Australia. Water* 13(18), 2504.

Reid, D. D., Harris, J. H., and Chapman, D. J. (1997). *NSW inland commercial fishery data analysis*. Fisheries Research and Development Corporation, Canberra.

Rogers, K., Knoll, E. J., Copeland, C. & Walsh, S. (2016). Quantifying changes to historic fish habitat extent on north coast NSW floodplains, Australia. *Regional Environmental Change*, 16 (5), 1469-1479.

Rowland, S. J. (1989). Aspects of the history and fishery of the Murray Cod, *Maccullochella peelii* (Michell) (Percichthyidae). *Proceedings of the Linnean Society of New South Wales* 111, 202–213.

Rowland, S. J. (2005). Overview of the history, fishery, biology and aquaculture of Murray cod (*Maccullochella peelii peelii*). In Lintermans M. and Phillips B. (Eds) Management of Murray cod in the Murray–Darling Basin: Statement, Recommendations and Supporting Papers. *Proceedings of a workshop held in Canberra*, 3–4 June 2004, pp. 38–61. Murray–Darling Basin Commission and Cooperative Research Centre for Freshwater Ecology, University of Canberra: Canberra.

Saintilan, N. & Williamns, R. J. (2000) The decline of saltmarshes in SE Australia: results of recent surveys. *Wetlands Australia* 18, 49–54.

Saunders MI, Cannard T, Fischer M, Sheppard M, Twomey A, Morris R, Bishop MJ, Mayer-Pinto M, Malcolm F, Vozzo M, Steven A,. Swearer SE, Lovelock CE, Pomeroy AWM, McLeod I, Waltham NJ (2024) A roadmap to coastal and marine ecological restoration in Australia. *Environmental Science & Policy,* Vol 159. https://doi.org/10.1016/j.envsci.2024.103808

Serrano O, Lovelock C, Atwood T, Macreadie P, Canto R, Phinn S et al. (2019). Australian vegetated coastal ecosystems as global hotspots for climate change mitigation. *Nature Communications* 10(1):1–10.

Sharpe, C. P. (2011). *Spawning and recruitment ecology of golden perch (*Macquaria ambigua *Richardson 1845) in the Murray and Darling Rivers.* PhD Thesis, Griffith University, Queensland.

Sinclair, S. & Boon, P. (2011) Changes in the area of coastal marsh in Victoria since the mid-19th century. *Cunninghamia* 12, 153–176.

Stuart I.G., Fanson B., Lyon J.P., Stocks J., Brooks S., Norris A., Thwaites L., Beitzel M., Hutchison M., Ye Q., Koehn J.D., and Bennett A.F. (2021). Continental threat: how many common carp *(Cyprinus carpio*) are there in Australia? *Biological Conservation* 108942

Stuart, I., Koehn, J., Boyle, K., and Baumgartner, L. (2023). *Exploding carp numbers are 'like a house of horrors' for our rivers. Is it time to unleash carp herpes? The Conversation* 23 January 2023

The Nature Conservancy Australia (2024a). Reef Builder Monitoring and Evaluation Report. A report prepared for the Department of Climate Change, Energy, the Environment and Water by Bayraktarov, E., Rullens, V., Valesini, F., Branigan, S., Martinez-Baena, F., and Reeves, S. The Nature Conservancy Australia, Melbourne, 73p. 10.5281/zenodo.11516296.

The Nature Conservancy Australia (2024b). Reef Builder Final Summary Report. A report prepared for the Department of Climate Change, Energy, the Environment and Water by Branigan, S., Bohm, C., Bossie, A., Breschkin, S., Connell, M., Dahle, K., Dal Pozzo, B., Nedosyko, A., V., Valesini, F. The Nature Conservancy Australia, Melbourne, 40p. 10.5281/zenodo.11516466

Thurstan, R. H., Diggles, B. K., Gillies, C. L., Strong, M. K., Kerkhove, R., Buckley, S. M., King, R. A., Smythe, V., Heller-Wagner, G., Weeks, R., Palin, F., & McLeod, I. (2020). Charting two centuries of transformation in a coastal social-ecological system: A mixed methods approach. Global Environmental Change, 61, 1020581.

van Dijk, A. I. J. M., Beck, H. E., Crosbie, R. S., de Jeu, R. A. M., Liu, Y. Y., Podger, G. M., Timbal B., and Viney, N. R. (2013). The Millennium Drought in southeast Australia (2001–2009): natural and human causes and implications for water resources, ecosystems, economy, and society. *Water Resources and Research* 49, 1040–1057.

Vertessy, R., Barma, D., Baumgartner, L., Mitrovic, S., Sheldon, F., and Bond, N. (2019). *Independent assessment of the 2018–19 fish deaths in the lower Darling. Final Report.* Available at https://www.mdba.gov.au/sites/default/files/pubs/Final-Report-Independent-Panel-fish-deaths-lower%20Darling_4.pdf [accessed 11 May 2023].

Walker K. F. (2006). Serial weirs, cumulative effects: the lower River Murray, Australia. In Ecology of Desert Rivers. (Ed. R. Kingsford.) pp. 248–79. Cambridge University Press, Cambridge, UK.

Walker, B. (2019). *Murray-Darling Basin Royal Commission Report.* SA Government, Adelaide.

Wegscheidl C, Sheaves M, McLeod I and Fries J (2015) *Queensland's saltmarsh habitats: values, threats and opportunities to restore ecosystem services, Centre for Tropical Water & Aquatic Ecosystem Research*. (TropWATER) Publication, James Cook University, Townsville, 25 pp.

Whetton, P., and Chiew, F. (2021). Chapter 12 - Climate change in the Murray–Darling Basin, Eds. B. T. Hart, N. R. Bond, N. Byron, C. A. Pollino, M. J. Stewardson, Pp. 253-274, In, *Ecohydrology from Catchment to Coast, Murray-Darling Basin, Australia*, Volume 1, Elsevier, https://doi.org/10.1016/B978-0-12-818152-2.00012-7.

Williams, R., Watford, F. Identification of structures restricting tidal flow in New South Wales, Australia. *Wetlands Ecology and Management* 5, 87–97 (1997). https://doi.org/10.1023/A:1008283522167

Wilton, K. Coastal Wetland Habitat Dynamics in Selected New South Wales Estuaries. (2002) *Unpublished PhD thesis, Australian Catholic University*, http://researchbank.acu.edu.au/theses/60/

Appendix 4 Interpreting 'effective restoration' for KM GBF Target 2

The following notes propose definitions and interpretations of 'effective restoration' drawing on information provided in (i) the Kunming-Montreal Global Biodiversity Framework (KM GBF) Target 2 guidance and (ii) the (draft) Resource Guide to Target 2 (FAO 2024).

Two types of restoration are encouraged in KM GBF Target 2 guidance

The stated purpose of **ecosystem restoration**, embedded in the wording of Target 2, is *"to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity."*

Both the official CBD guidance to Target 2 (CBD 2024) and the Draft Resource Manual for T2 (2024) make it clear that Ecosystem restoration comprises two types of restoration: **Rehabilitation** and **Ecological restoration** - and that that the two restoration types (combined) are intended to contribute to the qualitative outcomes of Target 2 as cited above.

The Draft Resource Manual states that *" ... in order for an activity to be considered ecosystem restoration, it must result in a net gain for biodiversity, ecosystem health and integrity, and human well-being, including sustainable production of goods and services (Gann et al. 2019, FAO et al. 2022).* (FAO 2024)." We understand that the final draft will clarify that benefits to native biodiversity and ecosystem integrity are expected in rehabilitation, although not to the extent they are expected in ecological restoration.

Separate definitions of the two types of restoration that include benefits to biodiversity will be provided in the revised Resource Manual and the interim definitions provided in this document are likely to be very close to the final formal definitions. This is important to ensure that (i) Target 2 is focused on only projects that contribute a net benefit to biodiversity and not just benefits to people and (ii) appropriately high ecological restoration standards are adopted in cases where higher standards are appropriate. This careful definition process both honours the valid differences between the two restoration types as well as reinforces the thread that unites them.

2 Effective ecosystem restoration in the context of KM GBF Target 2

Ecosystem restoration in the context of KM GBF Target 2 can be attained through two types of restoration: (i) rehabilitation and (ii) ecological restoration. (See also Appendix 1 and Glossary.)

For the purposes of KM GBF Target 2, activities that fit the definition of **rehabilitation** restore functions of a degraded ecosystem in order to provide ecosystem services while also providing net benefits to biodiversity. **Ecological restoration** activities assist the partial or full recovery of a degraded native ecosystem (including biodiversity, integrity, resilience, functionality, services and ideally connectivity) relative to an appropriate native reference ecosystem (Figure 1).

Both these two restoration types provide net benefits to nature and people but differ in their intended outcomes and so will vary in their capacity to meet the key elements of Target 2. Optimal outcomes, however, are often attained by the integration of these restoration types in a landscape or waterscape to (i) reduce impacts upon the systems that support biodiversity i.e. in areas that are permanently transformed, such as for production or urban purposes, and (ii) directly restore biodiversity in locations where that is possible and desirable.

Rehabilitation should not be used as an alternative to ecological restoration if the latter is affordable and desirable. When choosing the type or types of restoration to implement, a useful rule of thumb is to consider what is the highest-level outcome that can be effectively achieved at that site, given societal goals (FAO 2024). (See also the 'restorative continuum' diagram Fig. 2.)

Table 2. Rapid assessment of potential targets for aquatic ecosystem restoration in Australia by 2030

Ecosystem	Project Indicators	Functional Indicators	Losses	Targets
Saltmarsh and mangroves	Number of locations Hectares of projects Number of projects registered under the CER Hectares of projects registered under the CER tCO2e/yr sequestered Number of people employed Number of jobs created Number of SME's engaged Number of land managers and traditional owners benefitting through carbon income	Red-listed migratory wader presence	Mangrove/Saltmarsh 25,300 km^2	By 2030 restore 14000 ha Planning controls in place upland of all Ramsar and Directory Wetlands containing saltmarsh to protect upland migration
Seagrass	As above		32000 km^2	By 2030 restore 3000 ha
Kelp (*Macrocystis*/ Giant Kelp and *Ecklonia*/Golden Kelp)	As above		380 ha	By 2030 restore 100 ha
Shellfish reefs (oysters and mussels)	As above with the blue carbon		> 300,000 ha	By 2030 restore 300 ha across 60 locations
Coastal rivers			>5000 barriers to fish movement	By 2030 500 barriers removed or ameliorated
Coral Reefs				
Inland rivers	As above without the blue carbon	30% increase in area of distribution of threatened fish	90% reduction in fish populations overall in MDB Over 50% of species with conservation listings in the MDB Over 3500 km of MDB rivers unsuitable for warm water native species due to coldwater releases. Over 100 million fish are lost annually to irrigation diversions	Recovery plans funded and enacted for 30% or threatened species 500 major barriers and 100 minor barriers to fish passage removed or ameliorated 1000 lateral connectivity pathway blockages removed or ameliorated. overbank flows, flow pulses, increased by 30%; all base flows restored to adequate levels for population survival 1200 km of river temperature restored in a minimum of 5 rivers 30% of pumps and irrigation diversions have screens installed 30% of lowland rivers resnagged

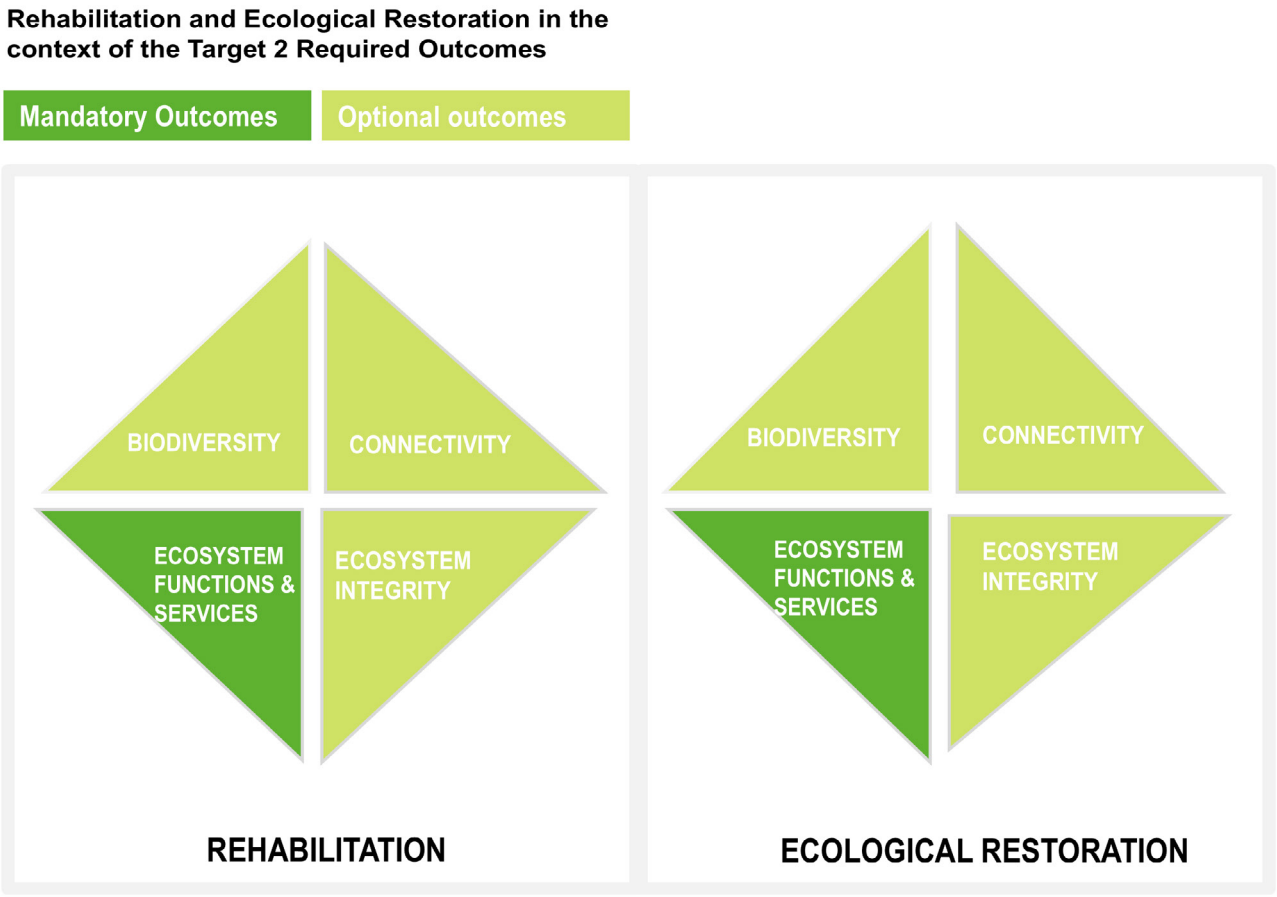

Fig 1. Primary restoration types and their relationship to Target 2 outcomes. (From FAO 2024). *Note that the final revision of FAO 2024 may change 'Optional Outcomes' in the legend to 'Encouraged Outcomes'.)*

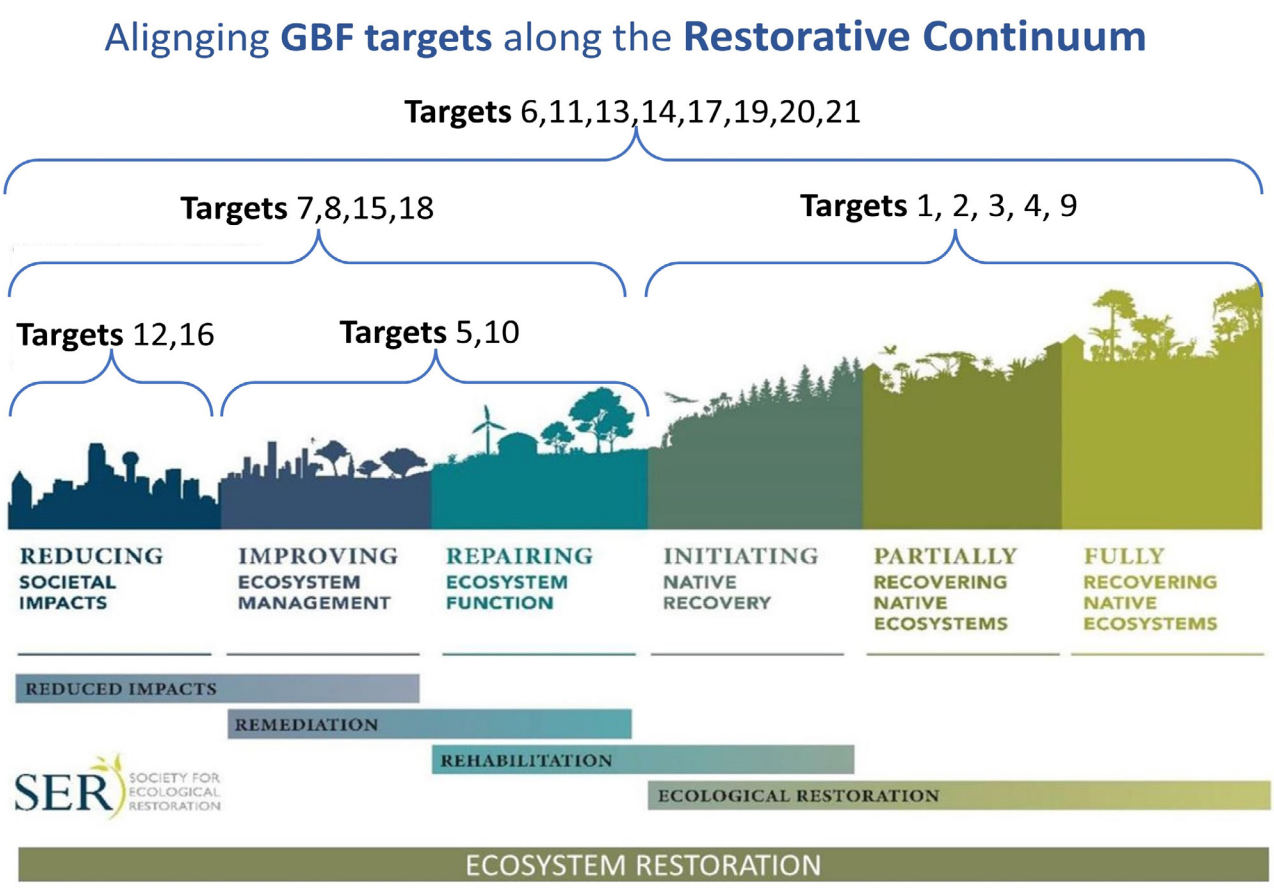

Figure 2. Restorative Continuum diagram and the 23 KM GBF targets (Adapted from Gann et al. 2019 by the Restoration Decade Alliance.)

Caption: This diagram shows how meeting the 23 KM GBF targets can be assisted by the six 'restorative practices' along the stylised urban-production-natural area continuum. Viewed as a landscape continuum, the overlapping 'bars' below the six categories show that there is a relationship between each category and its neighbouring category. The diagram should not be misread, however, as implying that (a) the practices are not mutually distinct or (b) ecological restoration cannot be located anywhere along the urban-production-natural area continuum. (Source : SER Restoration Standards with KM GBF Target annotations by the Restoration Decade Alliance.)

EFFECTIVE REHABILITATION

Rehabilitation *Management actions that reinstate some physical properties (e.g. soils, water) and a level of ecosystem functioning on degraded or transformed sites, along with a renewed and ongoing provision of a level of ecosystem services. Biodiversity and ecosystem integrity are supported but actions do not achieve substantive recovery of a natural ecosystem.*

Effective rehabilitation projects:

- Focus on repairing ecosystem functions (to within the naturally occurring range)
- Renew ecosystem services
- Provide a net gain to biodiversity
- Avoid damage to native ecosystems or other assets
- Address the causes of degradation to the extent possible
- Follow a plan or strategy informed by restoration science and practice
- Have measurable goals and objectives using ecological indicators.
- Are adaptable (and adapted) to changing environmental conditions and new information
- Address the values of both nature and people and engage with all stakeholders

Activities that would **not** be considered rehabilitation (or ***effective*** rehabilitation) include (but are not confined to) those that:

- Only improve ecosystem services without providing any net gain for biodiversity
- Modify or create levels of ecosystem function that are so ***dissimilar*** to natural local conditions that the project would be considered further conversion to agriculture rather than a type of restoration (e.g., enriching the chemical or physical properties of native soils for agriculture or redirecting natural water flows for the purposes of agriculture)
- Introduce or foster invasive species.

EXAMPLES OF REHABILITATION ACTIVITIES

- Controlling invasive plants and animals in modified or transformed landscapes
- Minimising excess deviation of water from natural flow systems
- Minimising nutrient discharged from production or urban areas through:
    - Reducing nutrient input levels to only those needed
    - Filtering runoff between production areas and streams
    - Reinstating natural hydrological flows by Improving vegetation cover of soils to encourage water infiltration through:
        - Reducing overgrazing by ensuring pasture recovery periods
        - Retaining organic matter in cropping or horticulture
        - Applying Water Sensitive Urban Design/On-Site Detention
- Revegetating stream banks for bank stability, lowering water temperature, reducing flood damage and to attain aesthetic and cultural values
- Retaining or reinstating habitats for pollinators and natural pest control
- New and retrofitted fish passage at stream crossings/bridges

Note *that if revegetation uses appropriate local native species and their genes and the site's physical conditions and management regimes allow recruitment and perpetuation of those species, benefits for biodiversity and ecosystem services can be multiplied because this can lead to increased resistance and resilience of the vegetation to periodic floods, fires and drought. (Where substantive native ecosystem recovery may result this can move the activity into the ecological restoration category.) Consideration should therefore be given to potential for reinstating native ecosystems to reinstate ecosystem services – e.g., by restoring native woodland patches for shade and shelter or restoring marsh or swamp ecosystems to filter agricultural runoff prior to its release to streams.*

Identifying goals and monitoring progress of rehabilitation is best done using SMART goals, objectives and indicators against natural ecosystem benchmarks. (See National Restoration Standards (Standards Reference Group SERA 2021). Natural ecosystem benchmarks for clean air and water (fresh or saline) or such functions as soil stability tend to be universal. However desired states for functional and productive soils or appropriate hydrology will vary according to the local natural benchmarks.

EFFECTIVE ECOLOGICAL RESTORATION

Ecological Restoration *activities that result in recovery (to the highest extent practicable) of a degraded native ecosystem (including biodiversity, integrity, resilience, functionality, services and ideally connectivity) relative to an appropriate native reference ecosystem. The conservation and restoration of biodiversity is a primary outcome.*

Effective ecological restoration projects would:

- Restore a native ecosystem to the highest practicable recovery level
- Be informed by the attributes of an appropriate native reference ecosystem, taking irreversible environmental change into account
- Address the causes of degradation to the extent possible
- Avoid damage to native ecosystems or other assets
- Follow a restoration plan or strategy informed by restoration science and practice
- Be implemented over sufficiently long timeframes to secure the planned ecological outcomes
- Utilise approaches and treatments well matched to the degradation:resilience status of the site to optimise natural recovery processes of species; and to complement this where necessary with reintroduction of plants, animals or other organism to the extent natural recovery is not possible.
- Aim to establish conditions for ongoing natural recruitment in the long term
- Have measurable goals and objectives using ecological indicators
- Be adaptable (and adapted) to changing environmental conditions and new information
- Optimise ecological connectivity to the extent practicable
- Address the values of both nature and people and engage with all stakeholders
- Seek cost-effective solutions to make the most of limited resources

Activities that would **not** be considered **effective** ecological restoration include those that:

- introduce or foster invasive species
- use species (including 'natives' from other parts of the country) that are not components of the reference ecosystem (unless there is a particular ecological justification)
- use appropriate species but without sufficient genetic diversity or site conditions to allow them to breed and recruit effectively
- undertake treatments without adequate follow up and ongoing management
- do not address or mitigate causal factors
- cause harm to native ecosystems

Important note: *While the Target 2 is expressed in terms of 'areas' this includes all the biota that inhabits these areas – including flora, fauna, fungi, algae and microorganisms.*

Identifying goals and monitoring progress of ecological restoration. Progress toward recovery of ecosystem functions and services can be measured against SMART goals, objectives and indicators relative to the appropriate reference ecosystem model identified at the planning stage. Useful monitoring models are referred to in Resource Guide to Target 2 KM-KM GBF and guidelines for monitoring are available in the National Restoration Standards (Standards Reference Group SERA 2021) and the SER Restoration Standards (Gann et al. 2019)

Benefit would be gained from the use of standardised monitoring and reporting system for restoration projects to confidently understand restoration trajectories and the need for intervention. The National Restoration Standards 5-star system (see the more recently updated tool used with SER Standards) can standardise the reporting of condition classes (both at the baseline stage and at intervals during recovery) and can be fitted to any monitoring system that uses a scale of 1-5.

Examples of ecological restoration activities that can also improve ecosystem services

Benefiting terrestrial ecosystems

- Restoring and expanding remnants for farm amenity (e.g. including natural pest control and pollination and occasional grazing and shelter where appropriate)
- Revegetation with native species for shade and shelter for livestock where this improves connectivity and leads to self-perpetuating habitats
- Increasing populations of native pasture species to improve drought resistance and resilience, improve soil stability and water holding and infiltration capacity of soils
- Reintroducing or introducing artificial habitat (nest/habitat boxes, ground habitat) that also assist with pest management

Benefiting inland water ecosystems

- Restoring freshwater wetlands as nutrient filters to improve water quality
- Restoring resilient riparian vegetation to stabilise banks, reduce siltation and increase habitat and shade for fish and fisheries
- Reinstating natural hydrological flows and connectivity between components of aquatic systems (e.g. channels and floodplains)
- Reinstating and revegetating levee banks to allow reformation of backwaters for flood mitigation

Benefiting marine and coastal ecosystems

- Restoring shellfish reefs to act as nutrient filters in coastal waters for water quality and fisheries
- Restoring mangroves, seagrass and kelp forests for shoreline protection and fish nurseries
- Restoring coral reefs for fish nurseries and tourism

Implementing effective restoration

Who are the likely implementers of restoration?

All land and water managers in Australia can play a role in restoration, from improving management practices to mitigate degradation through to undertaking low- to high-skill restoration activities.

Effective **rehabilitation** activities to reduce impacts arising from production or wild harvest are likely to require the specialised knowledge and skills of a farmer or fisher, as appropriate to the context. Specialist knowledge and experience is also required for repairing production soils, hydrology, managing invasive species, improving silvicultural practices or conducting successful carbon farming. This knowledge is then complemented by additional knowledge and skills pertinent to environmental repair. The latter are increasingly becoming part of mainstream practice and are being disseminated to landholders and fishers through industry groups, NGOs (particularly Landcare networks), and agency extension staff.

Effective **Ecological restoration** depends on specialist capacity to ecologically assess degradation level at a site and appropriately prescribe, carry out and monitor ecological repair interventions over time until a site shifts from a restoration to a maintenance phase. Specialist knowledge is also usually required for the restoration of (i) vegetation communities and (ii) faunal populations, although integration of knowledge of both of these is desirable and encouraged. Specialist knowledge and experience is also usually required for the restoration of terrestrial as distinct from aquatic ecosystems. Furthermore, specialisation is usually required for *particular* terrestrial ecosystems (e.g., whether rainforests, dry forests or grasslands) or *particular* aquatic ecosystems (e.g., seagrass areas, kelp forests or shellfish reefs).

Key agents or players in the restoration space

Key agents for effective **rehabilitation** particularly include industry groups developing rehabilitation innovations, e.g. regenerative farmers, natural resource management agencies and NGOs supporting landholders or fishing groups. These agents may have extensive landholder networks, a factor important to the ongoing dissemination of knowledge and skills.

Key agents for high-skill **ecological restoration** activities are specialist agencies (such as national park or land and water management agencies) as well as NGOs with specialist capacity in land or water restoration and significant experience in cross tenure, cross discipline restoration and management. In addition, numerous conservation trusts have extensive private conservation landholder networks. Important to all these groupings is the growing, but still insufficient, number of experienced contractors with expertise in one or other form of restoration or who specialise in a specific restoration approach or in the restoration of a specific ecosystem.

Need for increasing the capacity of those agents or players

All decision makers and responsible parties need to have an understanding of restoration practice, whether in the rehabilitation or ecological restoration area. Too many examples exist of restoration outcomes being hampered by poorly designed, poorly funded, poorly timed and poorly scaled projects, resulting in wasted expenditure.

The shortage of skilled restoration practitioners across Australia is a serious impediment to reaching restoration targets and significant effort needs to be put into both training appropriate implementer and valuing their work appropriately to keep skilled people in the industry. Vocational and tertiary education and training needs to be fit for purpose to allow all responsible parties to work together and understand the needs and constraints of each other. Opportunities exist to develop bridging courses to increase understanding between professions and to allow for better career mobility and between on ground restoration outcomes.

Effective restoration in the context of the Nature Repair Market

- 1. All Nature Repair Market (NRM) projects need to follow an NRM Method to be eligible for registration and awarding of a biodiversity certificate that can attract payment. However it is unclear whether all Methods will conform to the criteria of ecological restoration or whether some Methods may be prepared that represent rehabilitation.
- A major current concern (in the absence of examples of NRM Methods) is that *best practice restoration is still not widely known or implemented* around Australia and many projects that strictly follow Methods may fail if there is insufficient specification in the Methods or lack of other available guidelines. This suggests that NRM Methods require all relevant detail or other guidelines to be prepared and referred to in Methods
- **Of particular concern is the paucity of expertise in a range of areas essential for restoration success**. This not only affects the design of Methods, restoration planning and implementation but also project auditing – which suggests there is a need for training in many areas if the NRM is to be successful. Examples of areas of insufficient expertise across Australia include capacity for the following.
    - **Identification of appropriate reference ecosystems** in the absence of at least above-ground native flora. (Yet appropriately identifying reference ecosystems is essential for selecting appropriate species to reintroduce or reinforce.)
    - **Analysis of the potential and limits of natural regeneration** at a site. (Yet such analysis is essential for identification of the appropriate restoration approach and series of treatments)
    - **Assessment, planning and procurement of propagules with appropriate genetic diversity / provenancing.** (Yet knowledge in this area is essential for all projects involving reintroduction that hope for future breeding and recruitment, particularly under climate change).

  - **Correct conceptualisation of restoration among not only practitioners but also planners and policy makers**. (Yet globally agreed terms exist and can greatly improve two-way dissemination of knowledge and thereby the efficiency and effectiveness of restoration) One serious example is the tendency of many to continue to refer to restoration associated with remnant ecosystems as merely 'management' rather than 'restoration' which can lead to errors in Method writing and sell Australia short when it comes to reporting Australia' attainments against the KM GBF Target. (Restoration is what is practised wherever there is any degree of degradation and is a subset of management.)

- **Differences between the cost of higher and lower quality projects can drive lower standard projects to be favoured over higher standard projects if there is insufficient transparency about quality or the conservation value of the project.** Hence conservation importance and 'goal' condition class (or 'Improvement' score) of a project should be clear on the certificate (and enabled in the Methods) – using something like a 5-star condition 'recovery wheel' to simplify communication of complex scenarios.
- **Potential for utilisation (e.g. managed grazing) may make some projects more attractive to investors or sellers and may be accommodatable in some projects but not others.** So opportunities could be lost – or outcomes lowered – if this is not taken into account in Methods. Hence evidence-based information on potential for periodic utilization within the permanency period would need to be clear in all NRM Methods to add affordability for higher quality restoration but limit further degradation.
- **Easily conflated concepts can driver lower quality outcomes. For example low permanency periods (e.g. 25–50 years) may drive low level approaches where 'permanency' level is conflated with perpetuation capacity.** Species used in ecological restoration should be capable of persisting in perpetuity given appropriate management. This is not to be confused with an agreement with respect to the period of time (permanency) a landholder commits to maintaining the project.

REFERENCES

CBD (2024) Consolidated guidance notes for the targets of the Kunming-Montreal Biodiversity Framework

FAO (2024) "Delivering restoration outcomes for biodiversity and human wellbeing" (Resource Guide to Target 2 of the Kunming-Montreal Global Biodiversity Framework) DRAFT 26 May 2024

Gann GD, McDonald T, Walder B, Aronson J, Nelson CR, Jonson J, Hallett JG, Eisenberg C, Guariguata MR, Liu J, Hua F, Echeverría C, Gonzales E, Shaw N, Decleer K, Dixon KW (2019) International principles and standards for the practice of ecological restoration. Second edition. *Restoration Ecology* 27(S1): S1–S46.

Standards Reference Group SERA (2021) Standards for the practice of ecological restoration in Australia. https://www.seraustralasia.com/standards/principle2.html

Appendix 5 Considerations for Australia's identification of priority degraded areas for GBF restoration Target 2

The global KM GBF Target 2 is to ***"Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity."*** Australia's revised Strategy for Nature expresses our target as having "Priority degraded areas (across terrestrial, inland water, coastal and marine ecosystems) are under effective restoration by 2030 to recover biodiversity and improve ecosystem functions and services, ecological integrity and connectivity.

Two problems with the current wording of the target

This wording conveys an intent to have some areas under restoration by 2030 but cannot function as a target with potential to galvanise action across Australia. This runs a very high risk that Australia will miss out on the impetus of the GBF to add value to existing efforts and support for future global efforts may be dimmed. Another problem is that the wording ties the target to priority areas alone. This runs a high risk of either excluding from the reporting of Australia's attainments many important (often community-led) initiatives that may not fall into priority areas or forcing the description of priority areas to become so inclusive that they fail to focus investments in highly important areas.

Potential solutions

1. The problem of a non-quantified target sub-optimising support for restoration could be partly compensated for by using more ambitious an inspiring language in Australia's restoration implementation plan (and its public promotion) to convey encouragement for governments, industries and communities across Australia to strive for the highest practicable levels of halting degradation and effecting sustainable recovery within the remaining timeframe to 2030.

2. The problem of Australia's target not including restoration conducted outside priority areas can be overcome by the combination of (i) recognising that identifying priorities for investment is a separate exercise to reporting Australia's area under effective restoration by 2030; and (ii) careful wording of the description of priority areas to include a statement to the effect that priority areas can also include existing priorities of agencies, restoration groups and communities.

Potential for rapid assessment of priority areas to identify a quantitative target

Some contribution to the topic of identifying priority degraded areas (see Annexure 1 at the end of this Appendix) was made by a September ACIUCN workshop in Canberra although this was non-systematic. It is likely that a group such as CSIRO could be commissioned to more reliably rapidly assess priority areas drawing knowledge from both conservation and restoration subject matter experts as well as incorporating currently available conservation priority data.

Risks associated with spatial mapping of priority areas for investment include leaving out some important areas and including less important areas - largely because restoration is a complex and relatively new discipline and information on existing and potential projects is not held at any central location. This could be overcome by a rapid assessment process with the following scope.

- Identification of **candidate** priority areas for investment - represented both by (i) spatial mapping (where practicable) and (ii) listing of types of priority ecosystems and degradation drivers. (Leaving **actual** priority locations unmapped, to allow flexibility by restoration actors and investors.)

- Inclusion of at least **two analyses** to represent both types of restoration priorities that are encouraged under KM GBF Target 2: (i) an analysis representing priority 'core native ecosystems' and (ii) an analysis representing 'production areas influencing core native ecosystems'. (See Appendix 4 – 'Effective restoration'.) Target 2 priorities should also consider information available on Targets 1 and 3 of the KM GBF.
- Consideration of agreed ecological and social planning principles. (See Annexure 2 at the end of this document – Principles that can help to guide prioritisation.)
- **Accessing the advice of subject matter experts in restoration** (including managers from land and water agencies, NGOs and restoration and production industries) to ensure the rapid assessment process considers on-ground feasibility.

Key considerations for identifying priority areas

What constitutes 'degraded areas'?

The KM GBF guidance notes define *"Degraded land" as "natural ecosystems which have included a loss of ecosystem functions and services and transformed ecosystems (such as agricultural areas)."*

The above definition is likely to be only part of the KM GBF's conceptualisation of degraded **natural ecosystems** – as on the same page of the document 'habitat degradation' is described as also including 'a decline in biodiversity, ... and resilience" arising from human-induced processes. Furthermore, the wording of the target itself implies that degraded ecosystems can also include declines in integrity and connectivity. Hence we propose the following definition of 'degraded areas'.

Degraded areas may include native ecosystems and areas of land and water that, as a result of deleterious human impact, exhibit loss of biodiversity, integrity, connectivity or ecological function, that generally leads to a reduction in the flow of ecosystem services and increases vulnerability to stressors associated with climate change.

This definition accommodates potential for interpretation in the context of both areas of native ecosystems (where ecological restoration is the appropriate restoration type) and areas transformed for production (where rehabilitation is often the more appropriate restoration type in order to reduce impacts upon the systems that support biodiversity and improve ecosystem services). For further information on the tworestoration types - Rehabilitation and Ecological restoration – see Fig 1 and Appendix 4 'Effective Restoration' . We note however that transformed ecosystems may be restored back to native ecosystems (fully or partially) in cases where that is necessary or desirable.

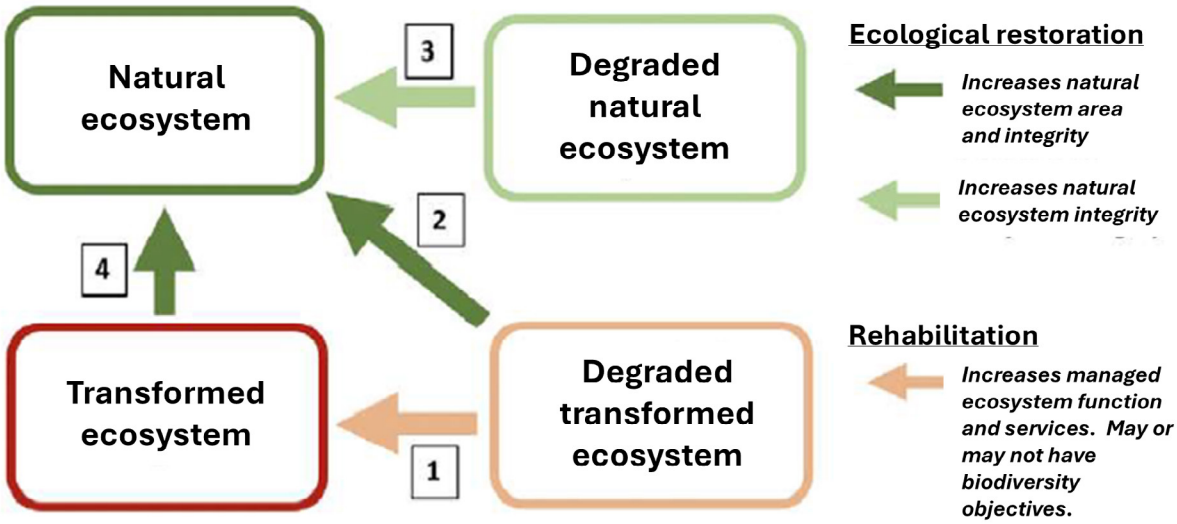

Figure 1. Conceptualisation of the context of rehabilitation and ecological restoration. [Reproduced from FAO (2024) *"Delivering restoration outcomes for biodiversity and human wellbeing" Resource Guide to Target 2 of the Kunming-Montreal Global Biodiversity Framework]*

What type of areas should be prioritised?

1. Conservation priority should be a primary consideration. The 23 targets of the KM GBF clearly point to the primacy of the need to protect and restore native ecosystems. Linked to this is the climate priority of improving the ecological integrity of ecosystems to both increase carbon sequestration and secure storage in ecosystems as well as enhance migration and adaptation potential of species under pressure from climate change now and in the future. Guidance on how to deliver synergistic outcomes for both climate and biodiversity was provided at the 2021 joint IPBES/IPCC workshop which concluded that the protection and restoration of carbon and species rich ecosystems offered the greatest potential for achieving synergistic outcomes and that doing so was critically important for tackling the entwined climate and biodiversity crises. Important considerations that flow from this to the identification of priority areas include consideration of connectivity across the climate gradient, Impact of sea level rise and susceptibility to alteration of ecosystem states through disastrous change, such as through repeated mega fires or erosive floods.

Conservation priorities need to be planned (KM GBF Target 1) and be proactively directed towards the necessity of a climate resilient future - reversing the extinction of ecological communities, species, contributing to climate mitigation, and maximising the adaptive capacity of ecosystems. The identification of areas for KM GBF Target 3 – to protect 30% of native ecosystems by 2030 - is particularly important and already goes some way to identify priorities for Target 2. That is, the selection of priorities for Target 3 will logically focus on biodiverse areas that have sufficient ecological integrity, extent, function and connectivity to persist and where threats can be managed accordingly. However in many cases, Target 3 areas may require ecological restoration to halt the causes of degradation and bring degraded ecosystems up to a threshold of sufficient extent and condition where the risk of further decline is reduced. In other cases, protected areas may require extension or connection through reconstructed linkages to improve their viability. Spatial planning that considers Target 2 and 3 together is particularly important in this context.

2. Conservation priorities are relevant to both types of restoration – i.e. rehabilitation and ecological restoration. This is because the intent of rehabilitation in the context of the KM GBF is not soley to focus on restoring functions to improve ecosystem services to people but also to provide at least some net benefit for the systems that support biodiversity. (See Appendix 4 on 'effective restoration' and Glossary for definitions of each restoration type).

As a result, it would be useful to map priority areas that point to core native habitats and critical ecosystems for threatened species, communities and populations (particularly those with carbon dense ecosystems with potentially high relative integrity) and assess opportunities to (i) conduct ecological restoration in those areas as well as (ii) rehabilitation in adjacent transformed production areas to provide indirect benefits to biodiversity and reduce degradation drivers.

There are numerous production areas that influence the health of terrestrial, in-stream, wetland and coastal ecosystems where rehabilitation can make a substantial contribution to achieving recovery of ecosystem integrity and biodiversity in core habitat areas - one obvious one being the Great Barrier Reef (GBR) where reducing agricultural run-off affecting the waters of the reef is already a government priority and where there is substantial potential for scaling up this work. In addition, however, it can be noted that any restoration work capable of sequestering serious amounts of carbon - irrespective of proximity to the core site - is likely to be relevant to the global heating threat posed to not only the GBR but all ecosystems.

A process could therefore start with identifying priority areas for restoration based on biodiversity priorities and informed by climate mitigation and adaptation benefits - and then expanding these to incorporate their proximal or distal priority areas for rehabilitation that can attain other benefits.

For the same reasons habitat configuration and conservation spatial planning principles should feature strongly in the identification of priority areas. That is, consideration should be given to prioritising projects that optimise the size and integration of fragmented areas to support adaptation by species to large scale environmental change.

3. Conservation priorities should not be the sole factor however. Other factors such as the following, need to be taken into account.

- **Particular needs of Indigenous communities.** Support is urgently required for Indigenous community efforts to restore their ancient, nature-based cultures which are under intense extinction pressure. These cultures are of high significance to humanity's ultimate capacity to rebuild our positive relationship with the rest of nature.
- **Representativeness.** There is a strong argument that priority areas should be representative of all ecosystems across Australia - particularly representing all three major KM GBF areas (terrestrial, inland waters and coastal and marine).
- **Existing initiatives and investments** in restoration by governments and NGOs that can be built on (whether or not they reflect the highest conservation priorities).
- **Potential synergies with other KM GBF targets.** Added weight may be particularly given to degraded areas or projects where substantial contribution can be made to KM GBF Target 8 (minimising the impacts of climate change),Target 6 (Invasive Alien Species), Target 3 (Protected Areas), Target 10 (Enhance Biodiversity and Sustainability in Agriculture, Aquaculture, Fisheries, and Forestry) and Target 11 (Restore nature's contributions to people).
- **The location of degradation drivers,** particularly for rehabilitation projects and programs.
- **Feasible and reliable methodologies** for the particular ecosystems.
- **The interests, capacity and opportunities of restoration actors**, particularly local communities to ensure long-term and enduring management.
- **Opportunities to incentivise and model restoration** actions taken by industry and community (e.g. taking advantage of innovations or momentum that is already building in some industry or restoration sectors).
- **Opportunities to promote restoration** to the general public.

Who should be involved in identifying degraded priority areas?

Key informants include Indigenous custodians, conservation specialists, restoration specialists, those involved in active restoration programs and representatives of agencies and landholder and industry groups - for the following reasons.

- Indigenous custodians have cultural obligations to care for land and sea Countries and many thousands of years of accumulated Traditional Ecological Knowledge with respect to land and water management and promote the integration of connections between land and water and linkages between regions.
- Conservation specialists are essential to identify the need for restoration – i.e. to interpret which threatened ecosystems and species present the greatest restoration imperative.
- On-ground restoration specialists - often NGOs -involved in or advising on active restoration programs are essential to identify what restoration is potentially successful and feasible to commence within the 2030 timeframe, ensuring sufficient ongoing input is available over the longer time frames required for restoration projects.
- Agency representatives are essential to advise on existing and proposed programs – including 'improved management' programs that meet the definition of 'effective 'restoration'
- Landholder and industry groups are essential to identify potential for restoration, particularly rehabilitation, to be integrated into production areas.

Information from each of these groupings needs to be integrated to allow Australia to aim for the highest possible 'priority degraded' areas within the bounds of feasibility - bearing in mind that areal extent of restoration is the key KM GBF reporting requirement and the spirit of the KM GBF is to achieve rapid, ambitious and large-scale restoration of ecosystems globally. However areal extent should not be sought at the expense of the quality of recovery at a site where quality is a more important ecological criterion.

At what scale should 'priority areas' be identified?

There is a difference between the exercise of identifying priority areas and that of calculating and reporting attainments of Australia's contribution to Target 2 by 2030; the latter can count works in both priority and non-priority areas.

Spatial mapping

- Mapping of many priority areas in a wide range of bioregions / regions is possible; but to avoid errors it would be important to accompany any such mapping by also preparing:
- lists of priority ecosystem types (irrespective of location) to ensure that high priority ecosystems can still be picked up even if their region is not mapped accurately, which is the case in many regions around Australia;
- lists of priority degraded area types where rehabilitation activities can have an important influence on priority degraded ecosystems; and,
- statements of appreciation and encouragement of all restoration work carried out in Australia irrespective of whether the location of that work is mapped as a national priority.

It will be difficult to identify a scale that offers a reasonable correspondence between the location of priority areas and size of an area where work can feasibly be carried out. It may be possible to identify priorities for investment at a bioregional scale, based on identified needs within those regions- with operational areas remaining flexible so that adjustments can be made depending on what is feasible to attain. This may then allow a quantitative (percentage of priority areas) target to be identified without risking over-reach.

Reporting of areas undergoing effective restoration

It is essential to include in Australia's Target 2 reporting, the many small restoration projects undertaken by many thousands of community and NGO groups. There would therefore be huge benefits in setting up a system of registration of restoration projects as early as possible to capture all work done irrespective of whether the sites occur in 'priority degraded areas'.

The UN Decade on Ecosystem Restoration (and KM GBF implementation advice) promotes the use of FERM monitoring and registration software for registering and reporting projects and programs. However it may be beneficial to have an Australian system that is independent from FERM but compatible with it. For example the Atlas of Living Australia (ALA) is successfully hosting an open access (unlimited and secure) BioCollect database called the Habitat Restoration Hub for mapping and tracking results of individual restoration projects across all tenures. This is just one of 4000 BioCollect projects (funded via CSIRO) but shows great promise for rolling out this or a similar project nationally. Over 3500 projects are already mapped at property scale (mainly from NSW), georeferenced to an accuracy level of 10 m or less, with boundaries superimposed over satellite imagery. Data categories have been designed in collaboration with practitioners. Repeated measures are possible to show progress. Data is entered through carefully designed survey forms, with only 13 of 100 fields compulsory. The records are largely self-reported by 63 agencies, NGOs and landholders so far. Endorsement and investment would be needed for a mapping system to be rolled out across the country.

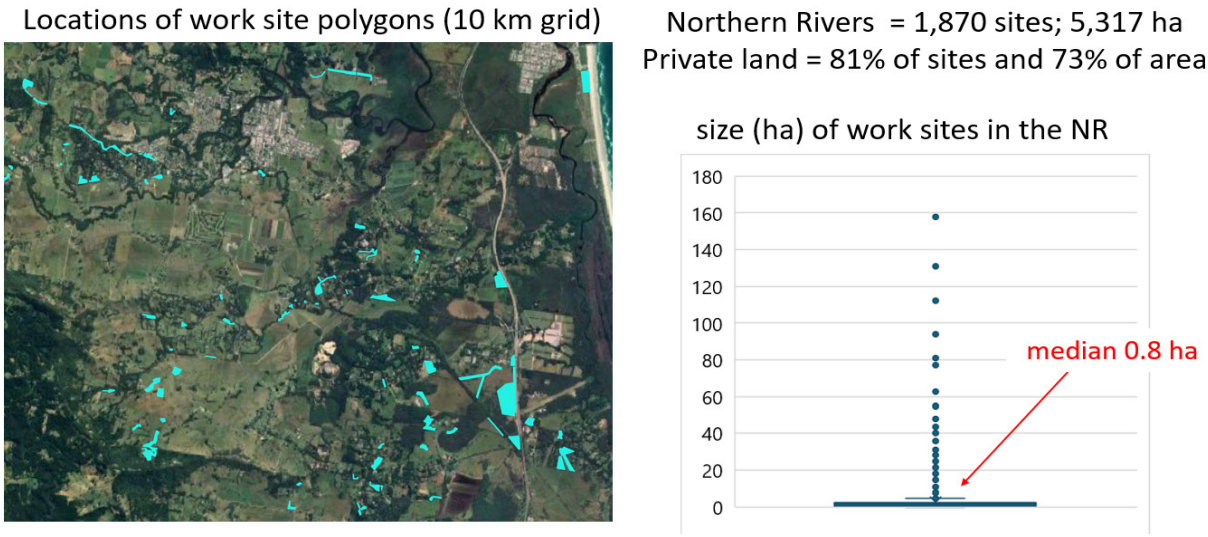

Figure 2. Aggregation of polygons entered into Habitat Restoration Hub for the NSW northern rivers region alone - showing that restoration area is primarily comprised of small sites on private land. This shows that without counting these small projects recorded Australia's reported Target 2 attainments would be substantially less than is occurring in reality. (Most of these sites will be ongoing in 2030.)

Such a system should be linked to, if not designed by, Environment Information Australia, with a dedicated restoration data analyst role to drive analysis across all spatial scales. Mechanisms/incentives need to be developed to encourage the private sector to adopt minimum reporting standards and eligibility criteria would be needed for reporting against Target 2 – e.g. meeting the definition for one of the two types of 'effective restoration'.

Data would need to be sufficiently detailed to ensure (i) the area of restoration reported includes only the locations directly involved in the works and (ii) sites fully restored prior to 2022 or by 2030 are distinguished by their dates. Ideally the fields of a registration system should be compatible with SOE reporting and emphasis should be on local data first, aggregating to state, then to national datasets. At the very least, fields need to include site name and contact details, ecosystem type, ecological community, polygon of treatment area, restoration type, restoration approach, – starting condition (and repeat measures) and evidence of recovery (e.g. recruitment).

Public relations regarding prioritisation and broad encouragement of restoration. The Draft resource manual (FAO 2024 p. 11) states that signatories should apply restoration in the spirit of the KM-KM GBF, to achieve rapid, ambitious and large-scale restoration of ecosystems globally.

Engaging all Australians in restoration is essential. To avoid prioritisation damping enthusiasm by a wide range of restoration actors (particularly landholders and those working in restoration on-ground or in-water), positive promotion will be needed to encourage all possible restoration where there is potential and willingness. This is because such work – scattered though it may be – will not only contribute important hectares of restoration to meet Australia's final KM GBF 2030 reporting but it also has the capacity to reinforce existing social transformation from a nature negative Australia to a nature positive Australia.

Periodic reporting of how Australia is doing in terms of meeting KM GBF Target 2 – e.g. through a registration and reporting system such as described above - would be a highly important tool to engender enthusiasm for the national and global challenge amongst the public and drive higher attainments for the sake of biodiversity.

Importantly, the resulting spatial mapping may also assist with the future planning and development of corridors for ecological connectivity and hence the setting of targets for restoration beyond 2030, overcoming one of the major shortfalls in information that hampered quantitative target-setting for KM GBF Target 2.

Annexure 1 Defining degraded areas and priority degraded areas

[Also see Glossary]

Degraded areas may include: (i) native ecosystems and areas of land and water that, as a result of deleterious human impact, exhibit loss of biodiversity and simplification or disruption in their composition, structure, and functioning, and generally leads to a reduction in the flow of ecosystem services; and, (ii) utilised ecosystems that have been unsustainably modified or transformed and require repair of at least ecosystem functions to return ecosystem services and reduce impacts upon native ecosystems.

Typical examples of degraded areas at the lower end of the degradation spectrum:

- Presence of invasive species to the point where they are competing with natives or causing dysfunction in other ecosystem processes
- Over- or under-abundance of particular native species due to human-induced impacts including altered natural disturbance regimes
- Reduction in species richness due to human over-harvesting or other over-use
- Loss of functional groups of native species due to anthropogenic damage to habitats, over-harvesting or other over-use

Typical examples at the higher end of the degradation spectrum:

- Removal or modification of terrestrial or aquatic habitats (beyond the range of natural variation) due to:
    - over-harvesting
    - excessive scale, magnitude or frequency of disturbances of biota and substrates
    - physical and chemical contamination of soil, water and air
    - excessive changes to hydrology drying or flooding due to human impacts

Note that ecosystem state changes similar to the range of natural variation (including long term traditional Indigenous management) would not be considered degradation.

Priority Degraded areas – degraded areas that are deserving of primary focus for ecosystem restoration due to their potential to: (i) secure the urgent conservation of threatened species and ecosystems (or those which have dramatically diminished but not yet on federal and state lists); (ii) 0substantially reintegrate larger but fragmented habitats to support ongoing evolution; (iii) substantially reduce anthropogenic impacts upon the systems that support biodiversity; (iii) innovate or model broadscale ecosystem restoration action across society; and / or (iv) deliver robust climate mitigation and adaptation outcomes. Priority areas are by definition smaller than all the degraded areas warranting attention due to the inevitable limits of restoration resources.

Annexure 2 Principles that can help to guide priorities for investment

EXAMPLES OF ECOLOGICAL PRINCIPLES

For native ecosystems – *Higher priority can be given to those ecosystems that have been historically lost and/ or degraded where restoration can attain the highest benefit for land or water maximising ecosystem integrity and potential for species (particularly threatened species) to adapt to climate change.*

Other factors should be considered in prioritising areas including areas that have the highest capacity to integrate with existing intact remnants. This could allow priorities to end up focusing on large areas of intermediate and low degradation - except where restoration of small areas of high degradation may be essential for reintegration of the large areas.

For production areas – *Higher priority can be given to those production areas where reduction in drivers of degradation allows highest recovery potential for priority native ecosystems.*

EXAMPLES OF SYNERGISTIC PRINCIPLES

- The following factors could function as additional criteria to (i) allow a project that is not listed or mapped to move up in priority and /or (i) add weight to its priority level where there are competing projects.
- The project is already underway and is capable of rapid scaling up if further investment is provided.
- The project is highly innovative in terms of developing technical solutions.
- The project offers an outstanding ecological restoration or rehabilitation model for application by others in the future.

GLOSSARY

(Note: Most of these definitions are drawn from or adapted from those in the SER Standards)

Biodiversity the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within genes, species, between species and of ecosystems. Biodiversity reflects, and is closely coupled with, unique characteristics of local environments interacting with biota over very long evolutionary timeframes.

Degradation a level of deleterious human impact to ecosystems that results in the loss of biodiversity and simplification or disruption in their composition, structure, and functioning, and generally leads to a reduction in the flow of ecosystem services.

Degraded areas include native ecosystems and areas of land and water that, as a result of deleterious human impact, exhibit loss of biodiversity and simplification or disruption in their composition, structure, and functioning, and generally leads to a reduction in the flow of ecosystem services.

Ecological connectivit the degree of connection between the various natural environments present within a landscape, in terms of their components, spatial distribution and ecological functions.

Ecosystem functions the workings of an ecosystem arising from interactions and relationships between biota and abiotic elements. This includes ecosystem processes such as primary production, decomposition, nutrient and water cycling and energy flows, habitat provision and properties such as competition and resilience.

Ecosystem integrity the ability of an ecosystem to support and sustain characteristic ecological functioning and biodiversity (i.e., species composition and community structure). Ecological integrity can be measured as the extent that a community of native organisms is maintained.

Ecological restoration (for the purposes of KM GBF Target 2) management actions that result in recovery (to the highest extent practicable) of a degraded native ecosystem (including biodiversity, integrity, resilience, functionality, services and ideally connectivity) relative to an appropriate native reference ecosystem. The conservation and restoration of biological diversity is a primary outcome.

Ecosystem services the direct and indirect contributions of ecosystems to human wellbeing. They include the production of clean soil, water and air, the moderation of climate and disease, nutrient cycling and pollination, the provisioning of a range of goods useful to humans and potential for the satisfaction of aesthetic, recreation and other human values. These are commonly referred to as supporting, regulation, provisioning, and cultural services. Restoration goals may specifically refer to the reinstatement of particular ecosystem services or amelioration of the quality and flow of one or more services.

Effective restoration (for the purposes of KM GBF Target 2) can include both rehabilitation and ecological restoration

Key ecosystem attributes broad categories developed for restoration standards to assist practitioners with evaluating the degree to which biotic and abiotic properties and functions of an ecosystem are recovering. Here we identify six key attributes: absence of threats, physical conditions, species composition, structural diversity, ecosystem function, and external exchanges.

Priority Degraded areas degraded areas that are deserving of primary focus for ecosystem restoration due to their potential to: (i) secure the urgent conservation of threatened species and ecosystems (or those which have dramatically diminished but not yet on federal and state lists); (ii) substantially reintegrate larger but fragmented habitats to support ongoing evolution; (iii) substantially reduce anthropogenic impacts upon the systems that support biodiversity; (iii) innovate or model broadscale ecosystem restoration action across society; and / or (iv) deliver robust climate mitigation and adaptation outcomes. Priority areas are by definition smaller than all the degraded areas warranting attention due to the inevitable limits of restoration resources

Rehabilitation (for the purposes of KM GBF Target 2) Management actions that reinstate some physical properties (e.g. soils, water) and a level of ecosystem functioning on degraded or transformed sites, along with a renewed and ongoing provision of a level of ecosystem services. Biodiversity and ecosystem integrity are supported but actions do not achieve substantive recovery of a natural ecosystem.

RESTORATION DECADE ALLIANCE

Australian Restoration organisations supporting the
United Nations Decade on Ecosystem Restoration 2021–2030

Decline and recovery, Marra Creek catchment, NSW

This painting depicts the process of topsoil loss across 1000s of ha of native rangelands in semi-arid New South Wales after overgrazing during the late19th centuary. No vegetation could grow on the hard claypans.

It wasn't until 100 years later (and 20 yrs of experimentation by NSW Soil Conservation Service) that 'waterponding' was devised. It uses laser-levelling and road graders to create ponds that hold 10 cm of rainfall long enough to cause deep cracking.

These cracks provide moist niches for wind-blown native seed germination. Within 18 months ~15 native species typically recover.

Virtually all landholders in the Marra Creek area have applied the treatments and have collectively 'ponded' >40,000 ha of scalds, which are now sustainably grazed.

Artist:

Water ponds. Image: Soil Conservation Service NSW.